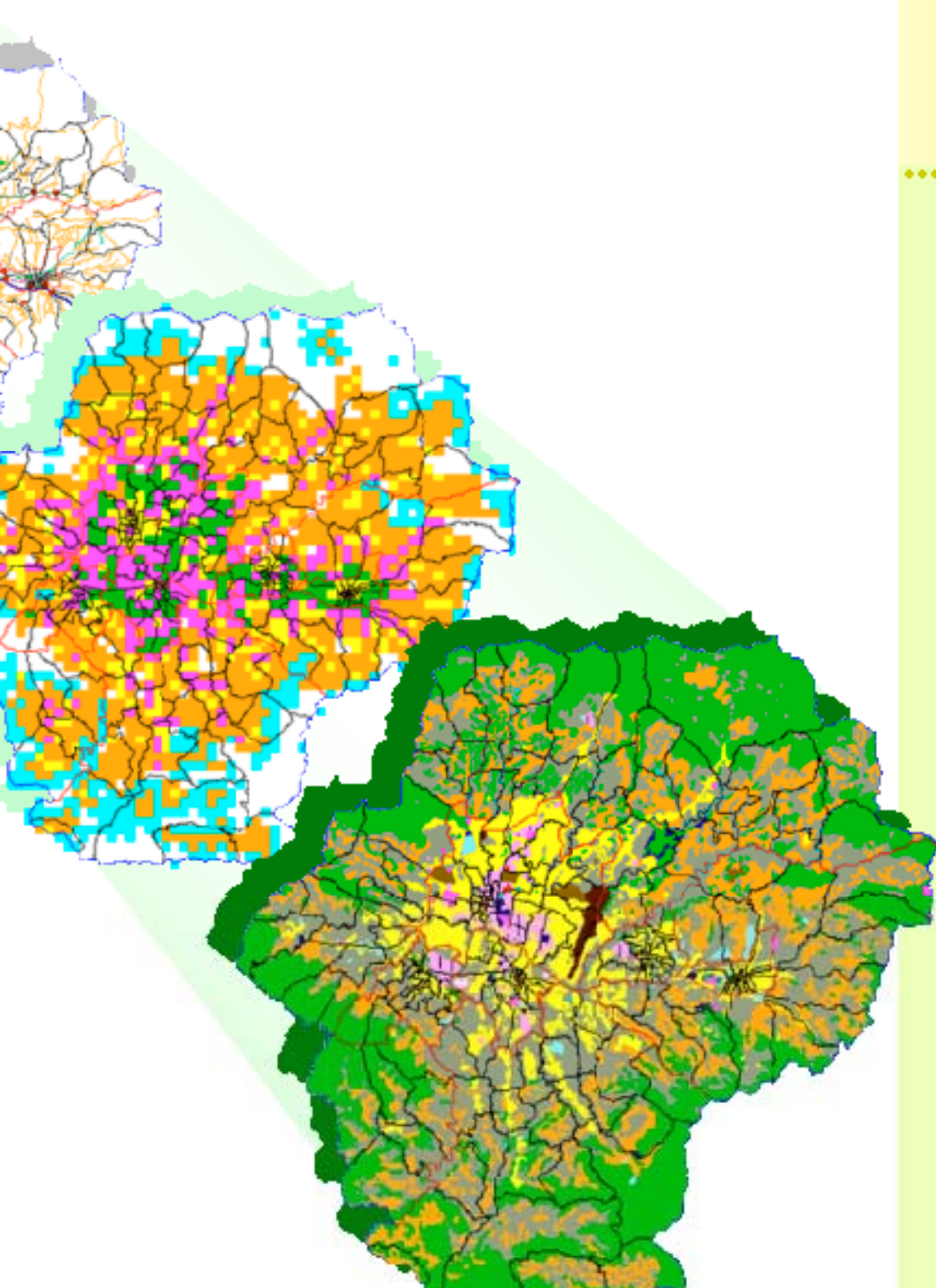


JICA Japan International Cooperation Agency (JICA)



Ministry of Home Affairs, HMG of Nepal



No.



The Study on Earthquake Disaster Mitigation

In the Kathmandu Valley
Kingdom of Nepal

Final Report

Vol. I II III IV V

SUMMARY

March, 2002

Nippon Koei Co., LTD.
Oyo Corporation

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF HOME AFFAIRS, HIS MAJESTY'S GOVERNMENT OF NEPAL

**THE STUDY
ON
EARTHQUAKE DISASTER MITIGATION
IN
THE KATHMANDU VALLEY, KINGDOM OF NEPAL**

FINAL REPORT

VOLUME I

SUMMARY

MARCH 2002

NIPPON KOEI CO., LTD.
OYO CORPORATION

Composition of the Final Report

Volume I : SUMMARY

Volume II : MAIN REPORT (1/2)

BLUEPRINT FOR KATHMANDU VALLEY EARTHQUAKE DISASTER MITIGATION

Volume III : MAIN REPORT (2/2)

EARTHQUAKE DISASTER ASSESSMENT AND DATABASEMENT SYSTEM

Volume IV : APPENDIX

Volume V : SUMMARY in Japanese

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October, 2001

PREFACE

In response to a request from His Majesty's Government of Nepal, the Government of Japan decided to conduct the Study on Earthquake Disaster Mitigation in the Kathmandu Valley, Kingdom of Nepal and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Dr. Yoshitake EGAWA of Nippon Koei Co., Ltd. (consist of Nippon Koei Co., Ltd. And OYO Corporation) to Nepal, three times between February 2001 and January 2002.

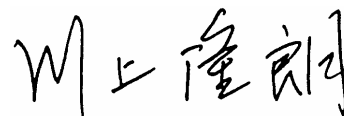
In addition, JICA set up an advisory committee headed by Professor Haruo HAYASHI, Kyoto University between January 2001 and January 2002, which examined the study from technical points of view.

The team held discussions with the officials concerned of His Majesty's Government of Nepal and relevant personnel, and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Nepal for their close cooperation extended to the Team.

March 2002



Takao Kawakami

President

Japan International Cooperation Agency

March, 2002

Mr. Takao Kawakami

President

Japan International Cooperation Agency (JICA)

Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir,

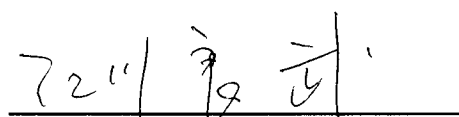
It is with great pleasure that we submit to you the Final Report of the “The Study on Earthquake Disaster Mitigation in the Kathmandu Valley, Kingdom of Nepal”.

A great earthquake may hit the Valley at any time. The Study has prepared the holistic and multi sectoral plans for earthquake disaster reduction, emergency management and disaster rehabilitation/restoration based on scientific damage evaluation, in order to maintain sustainable development in Nepal.

We hope this report will be helpful for realization of the tasks and programs proposed in this study to mitigate earthquake disaster in the Kathmandu Valley.

We wish to express our deep appreciation and gratitude to personal concerned of your Agency, JICA Nepal Office, the Embassy of Japan in Nepal, Ministry of Home Affairs and the authorities concerned of His Majesty’s Government of Nepal, Municipalities and Communities and NGOs for courtesies and cooperation extended to us during our Study.

Very truly yours,

A handwritten signature in black ink, appearing to read 'Yoshitake Egawa', is written over a horizontal line.

Yoshitake Egawa

Team Leader

The Study on Earthquake Disaster Mitigation
in the Kathmandu Valley, Kingdom of Nepal

Executive Summary

The Great Gujarat Earthquake in India in January 2001 revealed the vulnerability of “non-earthquake-proof” cities and villages. In 1934, an earthquake of magnitude 8.4 caused serious damages to 60% of the buildings in the Kathmandu Valley. It is a cause for great concern that the next great earthquake may strike Nepal at any time, after almost 70 years of silence.

The Kathmandu Valley is the exclusive centre of Nepal for politics, the economy, and society, with a large population of more or less 1.5 million. Once a great earthquake occurs, Kathmandu will suffer immense losses of life and property and will be unlikely to be able to function as the capital of Nepal.

Current natural disaster management and the present legal framework focus mainly on rural water-induced disasters and give inadequate attention to earthquake disasters in the highly urbanised Kathmandu Valley. A major earthquake in the Valley’s urban areas will result in tragic disaster.

His Majesty’s Government of Nepal (HMG) has been concerned about earthquake disaster management and requested the Government of Japan to implement a study on earthquake disaster mitigation in the Kathmandu Valley. The Government of Japan, through the Japan International Cooperation Agency (JICA), the official implementing agency for Official Technical Cooperation, dispatched a preliminary survey team to Kathmandu in August 2000 and exchanged a Scope of Work and Minutes of Meeting with HMG. Nippon Koei Co. Ltd. and OYO Corporation were contracted by JICA to conduct this study from January 2001 to March 2002. The resulting report, "Study on Earthquake Disaster Mitigation in the Kathmandu Valley" is presented herein.

The goals set in this study are focused on;

- 1) Protecting life and property in the Kathmandu Valley,
- 2) Strengthening socio-economic systems, and
- 3) Protecting the stability of governance even in the event of major earthquakes.

Approaching the goals as closely as possible, this study forms one milestone in a long process.

The objectives of the Study set by the Team, following the goals, are;

- 1) to formulate a plan for earthquake disaster mitigation in the Kathmandu Valley,
- 2) to carry out technology transfer to Nepalese counterpart personnel, and
- 3) to create a database on earthquakes and for earthquake disaster estimation.

Earthquake Disaster Assessment

In this study, three new fault models were selected, and the destructive force of each was calculated as follows, based on the natural and social conditions:

- 1) Mid Nepal Earthquake (Richter magnitude = 8.0); MMI VIII (Modified Mercalli Intensity)
- 2) North Bagmati Earthquake (magnitude = 6.0); MMI VI or VII.
- 3) KV Local Earthquake (magnitude = 5.7); Most parts MMI VII or VIII, as high as IX along the fault line.

In addition, a fourth model, the reoccurrence of the 1934 Bihar-Nepal Earthquake (Magnitude = 8.4) was modelled for comparison. For the most part it had an MMI of VIII, in the eastern part, MMI IX.

The liquefaction potential for all models was evaluated as relatively low compared with previous estimate.

The anticipated disaster in the Kathmandu Valley that would be caused by the “Mid Nepal Earthquake” is as follows:

- 1) The number of heavily damaged buildings, 53,000, i.e., 21% of all buildings.
- 2) The death toll, 18,000, i.e., 1.3% of the total population in the Valley.
- 3) The seriously injured people: 53,000, i.e., 3.8% of the total population in the Valley.

Mechanisms for Sustainable Development of Disaster Management

Currently Nepal lacks the necessary mechanisms for sustainable disaster management. It is clear that the following steps must be taken to improve the capacity for disaster management in Nepal:

- 1) Establish a strong legal base for a comprehensive risk management system.
- 2) Create sustainable mechanisms for inter-governmental and inter-institutional coordination.
- 3) Ensure that the Tenth Five-Year Plan, currently in preparation, includes plans and funding for firm disaster mitigation measures.
- 4) Promote and strengthen self-governance of local bodies for risk management.
- 5) Promote public awareness on self-protection against earthquake disasters and outreach to targeted groups.

Need to Maintain Governance

The government, at all levels, is responsible for providing continuity of effective leadership, direction of emergency operations, and management of recovery operations. For this reason, it is essential that governmental entities continue to function during and following a disaster. This requires that they take actions on preparedness such as: preparing plans/manuals to guide initial response; establishing systems for communications/coordination, including an Emergency Operations Centre; and advising employees of their responsibilities in case of disaster.

Key elements of emergency plans and manuals include the assignment of responsibilities/authority, the establishment of systems for command/control/communications/coordination, and the collection/dissemination of information. Emergency response/recovery planning should be prepared for prompt/proper decision-making and smooth execution of the decided measures before, during, and after a disaster.

The importance of communication for the initial response should be recognised, as well as the importance of the role of the media in communication.

Protection of Life and Property

Many difficulties are anticipated in the initial stages of the disaster, including search and rescue operations, medical services, cremation, drinking water and food, public health care, security, fire-fighting, management of volunteers, safety inspections of structures and infrastructure, debris removal and disposal, shelter and temporary housing, etc. Due to inadequate response planning and systems for inter-institutional coordination, public onsite services in an emergency are likely to be deficient for the time being. Community involvement and the sense of self-protection by the people are accordingly indispensable.

The logistics to support on-site activities after the occurrence of a disaster is a critical issue. The transportation system must continue to function during and after the occurrence of the earthquake disaster so that the on-site activities of search and rescue and other socio-economic activities can continue to function. Similarly, prompt restoration of electrical service and water supplies to affected areas would play an important role during the initial stages of a disaster. The existing conditions of these and other critical elements of the infrastructure are discussed, identifying the underlying problems. Priority projects to improve the current situation are also presented.

The Need to Strengthen the Socio-Economic System

Working towards sustainable development is a natural and necessary companion to working towards effective earthquake disaster management itself, because the ability to deal with earthquake disasters is highly dependent upon the fundamentals of society, economic growth and social stability, all of which are the fruits of sustainable development. Urban society is highly dependent on the socio-economic infrastructure, and any weakness makes it vulnerable to disaster. The vast direct and indirect economic and societal losses caused by disasters can be reduced by reinforcing the infrastructure through sustainable development practices. The fundamental elements of the infrastructure are discussed.

(1) Transportation Facilities

The existing master plan studies were reviewed. Proposals for roads, bridges and the airport to improve the access to and mobility inside the Valley are presented.

(2) Building Structures

Most of the existing buildings have severe deficiencies regarding earthquake resistance. The report presents, discusses and makes recommendations on the current building construction system, the Draft National Building Code of Nepal, and the defects of individual types of buildings: hospitals, schools and public buildings, and historical buildings.

(3) Electric Power Supply Facilities

An evaluation of the master plan studies on the transmission and distribution network in the Valley was performed. Provision of a stable transmission system is proposed in the city core areas of Kathmandu Metropolis. Other recommendations, including preparation and implementation of design manuals for earthquake resistance and training of personnel for an effective technical support system, are presented.

(4) Water Supply and Sewerage Facilities

The ongoing Melamchi Project is expected to significantly improve the extremely poor water supply and sewerage conditions. Urgent tasks include preparing design manuals for earthquake resistance (including for the Melamchi project), securing a water supply distribution system by water tankers, and preservation of existing wells and spouts at the local level.

(5) Telecommunications Facilities

The current vulnerability of telecommunications facilities is carefully examined. To create a reliable network against disaster, it is recommended to complete the multiple diversity routing composition as well as to establish emergency communication and broadcasting systems.

(6) Urban Structure

Several separate areas within the city centre of Kathmandu should be designated as intensive development areas for disaster prevention by maximising the disaster mitigation characteristics of the urban structure. Securing emergency evacuation routes and preserving evacuation areas in some areas of the city are effective measures that can be applied to Kathmandu. Each of these measures should be implemented to reinforce the city against disasters. Disaster mitigation measures in central Kathmandu will be proposed on a geographic area basis by classifying the central city areas into eight strategic zones based on the characteristics of the urban structure.

Recommendations and Proposals

As a result of the study, about one hundred potential programmes were identified for the improvement of earthquake disaster management in Kathmandu Valley. The study team evaluated the programmes from the viewpoints of term, priority and reality.

Fulfilment of all the programmes would require a tremendous amount of time and money. The team consequently selected four projects, which each include several programmes, for urgent implementation. The implementation of the projects will hopefully bring visible results and thus further promote endeavours to achieve the three goals for earthquake disaster reduction.

The four projects are:

- a) Establishment of an Early Earthquake Information System,
- b) Establishment of a Municipality Disaster Management Institution and Exercise,
- c) Building Improvement, and
- d) Establishment of a Comprehensive Database for Earthquake Disaster Mitigation.

Besides the selected projects, it should be noted that there are important and long-term projects with high priority/reality, i.e., the Sinduri road project aiming at

improving access to the Valley, road widening projects for smoother mobility in the Valley, and the Melamchi water supply projects.

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Abbreviation

ACCL	Apla Consultant Co., Ltd.
AD	Adobe Structure
ADB	Asian Development Bank
AIGP	Additional Inspector General of Police
ATC	Applied Technology Council
BC	Brick with cement mortar
BDS	Bulk Distribution System
BJPY	Billion Japanese Yen
BM	Brick with mud mortar
BNRs	Billion Nepal Rupees
BOT	Build Operate and Transfer
BPC	Butwal Power Company
CBD	Central Business District
CBO	Community Based Organisation
CDOs	Chief District Officers
CDR	City Diagnostic Report
C(N)DRC	Central (Natural) Disaster Relief Committee
CNPS	Central Nepal Power System
D(N)DRC	District (Natural) Disaster Relief Committee
DHM	Department of Hydrology and Meteorology
DIG	Disaster Imagination Games
DMC	Disaster Management Committee
DMG	Department of Mines and Geology
DMO	Directorate of Military Operations
DNCMD	Department of Narcotics Control and Disaster Management
DOAD	Department of Agricultural Development
DOI	Department of Irrigation
DOL	Department of Labour
DOR	Department of Roads
DOSCE	Department of Soil Conservation
DPTC	Water Induced Disaster Prevention Technical Centre
DR	District Roads
DRCS	Digital Radio Concentrating System
DWIDP	Department of Water Induced Disaster Prevention
EC	European Community
ECB	Emergency Control Board
EMT	Emergency Medical Technician
EOC	Emergency Operation Center
FINNIDA	Finnish International Development Agency
FM	Frequency Modulation
FNCCI	Federation of Nepal Chamber of Commerce and Industry
FR	Feeder Roads
gal	(Earth Gravity: cm/sec/sec)
GDP	Gross Domestic Products
GIS	Geographic Information System
HF	High Frequency
HMG	His Majesty's Government
ICIMOD	International Centre for Integrated Mountain Development
IDA	International Development Association
IDNDR	International Decade for Natural Disaster Reduction
INGO	International Non-Government Organisation
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KERMIT	Kathmandu Valley Earthquake Risk Mitigation Tool
KMC	Katmandu Metropolitan City
KUDP	Kathmandu Valley Urban Development Project
KV	Katmandu Valley
KVDMC	Katmandu Valley Disaster Management Council
KVMP	Katmandu Valley Mapping Plan
KVTDC	Katmandu Valley Town Development Council
LDC	Load Dispatching Centre
LDC	Least Developed Countries
L(N)DRC	Local (Natural) Disaster Relief Committee
LPS	Land Pooling Scheme

LSI	Large Scale Integrated Circuit
MARTS	Multiple Access Radio Transmission System
MCA	Multi-Channel Access
MHPP	Ministry of Agriculture
MHz	Mega Hertz
MJPY	Million Japanese Yen
MLD	Million Litre per Day
MMI	Modified Mercalli Intensity
MNRs	Million Nepal Rupees
MOA	Ministry of Agriculture
MOEC	Ministry of Education and Culture
MOF	Ministry of Finance
MOFA	Ministry of Foreign Affairs
MOFSC	Ministry of Forest and Soil Conservation
MOHA	Ministry of Home Affairs
MOHe	Ministry of Health
MOI	Ministry of Industry
MOIC	Ministry of Information and Communication
MOLD	Ministry of Local Development
MOLJ	Ministry of Law and Justice
MOPE	Ministry of Population & Environment
MOWR	Ministry of Water Resources
MPPW	Ministry of Physical Planning and Works
MWSDB	Melamchi Water Supply Development Board
NARL	Nepal Amateur Radio League
NASC	Nepal Administrative Staff College
NBC	National Building Code of Nepal
NCC	National Cadet Corps
NDF	Nonproliferation and Disarmament Fund
NDMC	National Disaster Management Council
NEA	Nepal Electricity Authority
NEA	Nepal Engineering Association
NEPECON	Nepal Engineering Consultancy Services Center Ltd.
NFC	Nepal Food Corporation
NGO	Non-Government Organisation
NGS	Nepal Geological Society
NH	National Highway
NORAD	North American Air Defence Command
NPC	National Planning Commission
NRCS	Nepal Red Cross Society
NSC	National Seismological Centre
NSET	National Society for Earthquake Technology
NTC	Nepal Telecommunication Cooperation
NWSC	Nepal Water Supply Corporation
ODA	Official Development Assistance
OPEC	Organization of Petroleum Exporting Countries
PGA	Peak Ground Acceleration
PIP	Priority Investment Plan
PSTN	Public Subscriber Telephone Network
RC	Reinforced Concrete
R(N)DRC	Regional (Natural) Disaster Relief Committee
RNA	Royal Nepal Army
RTSC	Relief and Treatment Sub-Committee
SDH	Synchronous Digital Hierarchy
SOP	Standard Operation Procedure
SSRSC	Supply, Shelter and Rehabilitation Sub-Committee
ST	Stone Structure
SWC	Social Welfare Council
TESU	Traffic Engineering and Safety Unit
TIA	Trivuban International Airport
TU	Tribhuvan University
UHF	Ultra High Frequency
UN	United Nations
UNDP	United Nations Development Program
UR	Urban Roads
USA	United States of America

USAID/OFDA	U.S. Assistance for International Development/Office of Foreign Disaster Assistance
UTM	Universal Transverse Mercator
VDC	Village Development Committees
VHF	Very High Frequency
V-SAT	Very Small Aperture Terminal
WECS	Water and Energy Commission Secretariat
WHO	World Health Organization
WIL	Wireless Loop

Conversion Factors

Length (1)

m	cm	yard	ft	inch
1	100	1.09361	3.28084	39.370
0.01	1	0.010936	0.032803	0.39370
0.91440	91.4400	1	3	36
0.30480	30.480	0.33333	1	12
0.02540	2.54000	0.02778	0.08333	1

Length (2)

km	nautical mile (nm)	yard	mile
1	0.5400	1093.61	0.62137
1.852	1	2026.67	1.1515
0.000914	-	1	-
1.60934	0.869	1760	1

Area (1)

m ²	cm ²	ft ²	in ²
1	10000	10.764	1550
0.09290	929.0	1	144.0
0.0001	1	0.001076	0.1550
0.0006452	6.4516	0.006944	1

Area (2)

ha	km ²	acre	mile ²
1	0.0100	2.471	0.00386
100	1	247.10	0.3861
0.4047	0.004047	1	0.001563
259	2.590	640	1

Volume

in ³	U.S. gallon	Imperial gallon	ft ³	m ³	acre-ft
1	0.00433	0.00361	5.79×10^{-4}	1.64×10^{-5}	1.33×10^{-8}
231	1	0.833	0.134	0.00379	3.07×10^{-6}
277	1.20	1	0.161	0.00455	3.68×10^{-6}
1728	7.48	6.23	1	0.0283	2.30×10^{-5}
61,000	264	220	35.3	1	8.11×10^{-4}
7.53×10^7	3.26×10^5	2.71×10^5	43,560	1230	1

Discharge

U.S. gallon/day (gpd)	ft ³ /day	U.S. gal/min	Imperial gpm	acre-ft/day	ft ³ /sec (cfs)	m ³ /sec
1	0.134	6.94×10^{-4}	5.78×10^{-4}	3.07×10^{-6}	1.55×10^{-6}	4.38×10^{-8}
7.48	1	5.19×10^{-3}	4.33×10^{-3}	2.30×10^{-5}	1.16×10^{-5}	3.28×10^{-7}
1440	193	1	0.833	4.42×10^{-3}	2.23×10^{-3}	6.31×10^{-5}
1728	231	1.20	1	5.31×10^{-3}	2.67×10^{-3}	7.57×10^{-5}
3.26×10^5	43,560	226	188	1	0.504	0.0143
6.46×10^5	86,400	449	374	1.98	1	0.0283
2.28×10^7	3.05×10^6	15,800	13,200	70.0	35.3	1

Weight

kg	t	oz	lb	short ton	long ton
1	0.001	35.27	2.2046	0.00110	9.8420×10^{-4}
1000	1	3.527×10^4	2204.6	1.1023	0.984
0.02835	2.835×10^{-5}	1	0.06250	3.125×10^{-5}	2.790×10^{-5}
0.4536	4.536×10^{-3}	16	1	0.0005	4.464×10^{-4}
907.2	0.9072	32.000×10^3	2.000×10^3	1	0.8529
1016	1.016	3.584×10^4	2.240×10^3	1.12	1

Velocity

m/sec	km/hr	ft/sec	mile/hr	kn
1	3.600	3.2808	2.237	1.9438
0.2778	1	0.9113	0.6214	0.5400
0.3048	1.0973	1	0.6818	0.5925
0.4470	1.6093	1.4667	1	0.8690
0.5144	1.8520	1.6878	1.1508	1

Density (c.g.s. Unit)

gr/cc	kg/m ³ =(gr/l)	gr/m ³	lb/ft ³	oz/ft ³
1	1×10^3	1×10^6	62.43	998.8
0.001	1	1×10^3	0.06243	0.9988
1×10^{-6}	1×10^{-3}	1	6.243×10^{-5}	9.988×10^{-4}
0.016018	16.018	1.6018×10^4	1	16
0.0010012	1.0012	1.0012×10^3	0.0625	1

Pressure

MPa =(N/mm ²)	Pa =(N/m ²)	bar	kgf/cm ²	atm	mmH ₂ O	mmHg
1	1×10^6	10	10.197	9.8692	1.0197×10^5	7500.617
1×10^{-6}	1	1×10^{-5}	1.0197×10^{-5}	9.8692×10^{-6}	0.1019716	7.5006×10^{-3}
0.1	1×10^5	1	1.019716	0.9869233	1.0197×10^4	750.0617
0.0980665	98066.5	0.980665	1	0.9678411	1×10^4	735.5593
0.101325	101325	1.01325	1.03323	1	1.0332×10^4	760
9.8067×10^{-6}	9.80665	9.806×10^{-5}	1×10^{-4}	9.6784×10^{-5}	1	7.3555×10^{-2}
1.3332×10^{-4}	133.3224	1.3332×10^{-3}	1.3595×10^{-3}	1.3158×10^{-3}	13.59510	1

PART I

**BLUEPRINT
FOR
KATHMANDU VALLEY EARTHQUAKE DISASTER MITIGATION**

CHAPTER 1 INTRODUCTION

1.1 Background

The Great Gujarat Earthquake in India in January 2001 revealed the vulnerability of “non-earthquake-proof” cities and villages. The earthquake killed approximately 20,000 people and destroyed over 300,000 houses. Nepal lies closer than Gujarat to the subduction zone where the Indian plate passes under the Himalayas, and may actually be susceptible to even larger-scale earthquakes. In 1934, an earthquake of Magnitude 8.4 caused serious damages to 60% of the buildings in the Kathmandu Valley and killed about 4,300 people. It is a cause for great concern that the next great earthquake may occur at any time after around 70 years of silence. Earthquakes are an inevitability for the Kathmandu Valley, and the people have to find ways of coping with earthquake disasters.

The Kathmandu Valley is the exclusive centre of Nepal for politics, the economy, and society, with a large population of more or less 1.5 million in an area of 668 km². Once a great earthquake occurs, Kathmandu will suffer immense losses of life and property, and will be unlikely to be able to function as the capital of Nepal.

It is foreseeable that the adverse influence of the earthquake will be felt throughout Nepal and cause long-term stagnation of its development. Earthquakes are one of the biggest obstacles for sustainable development in the Kathmandu Valley and Nepal as a whole. Without proper planning, today’s development will be tomorrow’s mounds of debris.

An earthquake disaster will increase poverty in Nepal by not only having the greatest impact on the poor but also by creating additional numbers of poor people, contrary to the national goal of alleviating poverty. The key and most pressing theme of the next (Tenth) Five-Year Plan, currently being developed, is poverty alleviation. Thus, this study has strong significance for the Tenth Five-Year Plan and the poverty issue.

The government of Nepal, international societies and NGOs have developed many systems for disaster management and the cooperation of relevant organisations. Through these efforts, great improvements in disaster mitigation have been achieved in Nepal. Nevertheless, this does not mean that the capability for managing an earthquake disaster, especially in the Kathmandu Valley, has been improved. Statistics show that the most frequent disasters in Nepal are water-induced disasters rather than great earthquakes. Therefore, current natural disaster management and the present legal framework focus mainly on rural

water-induced disasters and give inadequate attention to earthquake disasters in the highly urbanised Kathmandu Valley. The Kathmandu Valley has been considered to be free from natural disasters other than from earthquakes with a rather long recurrence interval. Nonetheless, a major earthquake in the Valley's urban areas, where most houses are multi-storied, the population density is very high, and everyday life depends heavily on various lifelines, will result in tragic disaster. This disaster will threaten the fabric of society and the mental condition of people in both the affected and the surrounding areas. Above all, such an earthquake would be catastrophic to the entire society in Nepal.

Therefore, planning and management to achieve earthquake disaster mitigation in the Kathmandu Valley are indispensable.

Based on this understanding, the Government of Nepal requested the Government of Japan to conduct "The Study on Earthquake Disaster Mitigation in the Kathmandu Valley, Kingdom of Nepal". In accordance with the Scope of Work and Minutes of Meetings signed in August 2000, the Japan International Cooperation Agency (JICA) formed a Study Team, which is a joint venture of Nippon Koei Co. Ltd., and Oyo Corporation, and conducted this Study from January 2001 to March 2002.

1.2 Goals, Concept and Objectives

1.2.1 Goals

This study is an urgent attempt to establish a holistic plan for earthquake disaster management in the Kathmandu Valley. The goals shall be focused on:

- a) Protecting the life and property of the people in the Kathmandu Valley,
- b) Strengthening socio-economic systems, and
- c) Protecting the stability of governance even in case of earthquakes.

The goals mentioned above, however, represent tasks too great to be accomplished in a limited period. Approaching the goals as closely as possible, this Study forms one milestone in a long process.

1.2.2 Concepts

In order that the goals are more clearly focused, the root causes of earthquake disasters, the relation between earthquake disaster management and other policies and priorities, and the need for balance between risk reduction and preparedness will be discussed.

(1) Identifying the Root Causes of Earthquake Disasters

Earthquake disasters are a society-based phenomenon. Loss of life or property in earthquake disasters generally occurs in relation to poorly built structures in vulnerable locations or improper social reactions to the quakes. The poor and disadvantaged will suffer most from earthquake disasters, because they live in poorer houses on more vulnerable sites, and they have less capacity to adapt to the tragic circumstances by themselves. In contrast, more affluent people can usually afford the costs of recovery, even in a tragic disaster. A disaster may disproportionately hit and thus disclose the most poor and disadvantaged elements of society.

(2) Realisation of Sustainable Development

Any country, especially a developing country, has to maintain steady, sustainable development in order to eliminate poverty. Disasters will be great obstacles for sustainable development unless mitigation and preparedness succeed in stopping the vicious cycle.

Working toward sustainable development is a natural and necessary companion to working toward effective earthquake disaster management itself, because the ability to deal with earthquake disasters is highly dependent upon the fundamentals of society, economic growth and social stability, all of which are the fruits of sustainable development.

(3) Emphasising Strategic Management

Sustainable development, then, is both a condition and a consequence of earthquake resistant society. Hence, earthquake disaster management has to focus not only on investment for emergency management in the narrow sense but also in a broader and more strategic sense, focusing on development policy as the foundation for a wealthy sustainable society and the accumulation of economic surplus.

Any projects to improve the everyday life of people, assure fundamental human rights, and alleviate poverty, being planned and implemented in and around the Kathmandu Valley, need to be recognised as relating closely to earthquake disaster management. Therefore, this study analyses and evaluates planned and existing projects from a mitigation point of view.

(4) Realisation by Multi-sectoral Decentralisation and Cooperation

The great risk posed by the current concentration of development in the Kathmandu Valley leads this study to adopt and develop a policy of decentralisation.

Decentralised management is very important in an earthquake disaster. A great

number of people, not only in the public sector but also citizens, have to be involved in disaster management because the project is more successful if there is mutual cooperation among all the related personnel and agencies, including central/local governments, public agencies, NGOs, and inhabitants. For effective disaster management, a flexible and cooperative society will be required. It is a society with greater emphasis on municipalities, communities and NGOs, etc., rather than the national government.

(5) Balancing Mitigation and Preparedness

The destructive power of earthquakes is sometimes so large that no countermeasures can provide total resistance. Earthquake disaster management must set an earthquake intensity limit within which we can expect to prevent disaster but beyond which we must accept the real risk of damages. This limit can be called the mitigation limit.

Although wealthy countries can set the mitigation limit at a high level, many developing countries need to set it lower due to the deficiency of economic surplus, and Nepal is unfortunately not the exception. Hence, this study places more emphasis on preparedness although all stages of management including risk reduction will be covered.

The word mitigation in this report covers both risk reduction and preparedness, unless any other definition is described, although the term often means risk reduction only.

(6) Presupposing International Cooperation

Great earthquakes hit suddenly without warning and are so catastrophic that any country has a hard time to manage the crisis by itself. The project team's planning recommendations keep in mind that the management of an earthquake disaster is a matter of international cooperation.

1.2.3 Objectives

The objectives of the Study set by the Team, following its goals and concepts, are;

- a) to formulate a plan for earthquake disaster mitigation in the Kathmandu Valley,
- b) to carry out technology transfer to Nepalese counterpart personnel and formulation of a plan encouraging them to undertake emergency actions in the course of the Study, and
- c) to create a database on earthquakes and an earthquake disaster estimation and scenario for sharing understanding of earthquake disaster management among all stakeholders.

As a consequence of restricted time and lack of related plans, the plan covers the general issues to be included in a holistic management plan covering the three stages of earthquake disaster and on which the succeeding solid plan will be based. We also introduce the mechanisms for developing sustainable inter- and intra-organisational cooperation. Meanwhile, an earthquake may hit the Kathmandu Valley at any time. Urgent and practicable emergency management must be implemented as soon as possible. Therefore, the plan also identifies and proposes urgent projects based on evaluations of the vulnerability of present systems and structures.

What this report suggests or recommends may not necessarily be consistent with the position of HMG; however, the team believes that even if this is the case, it is worthwhile to present these ideas as the basis for productive discussion.

1.2.4 Study Area

The study area covers the Kathmandu Valley, consisting of three Districts of Kathmandu, Lalitpur and Baktapur, including five Municipalities, namely, Kathmandu, Lalitpur, Baktapur, Madhyapur-Thimi and Kirtipur.

1.2.5 Schedule

The study is carried out for about 14 months, from January 2001 to March 2002, dividing into three phases as shown in Table 1.2.1.

Phase 1 Data Collection

Phase 2 Data Analysis

Phase 3 Mitigation Planning

Table 1.2.1 Overall Schedule

Item	2001												2002		
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Phase	Data Collection The 1st Phase			Data Analysis The 2nd Phase			Formulation of Plan The 3rd Phase								
Field Study (Nepal)	The 1st Field Study			The 2nd Field Study			The 3rd Field Study			The 4th Field Study					
Home Work (Japan)	Preparatory Work			The 1st Home Work			The 2nd Home Work			The 3rd Home Work					
Report	Inception Report			Interim Report			Draft Final Report			Final Report					
Work shop Seminar	Work Shop			The 1st Seminar			The 2nd Seminar								

1.2.6 Study Team Members

The study team consists of 14 members as shown in Table 1.2.2.

Table 1.2.2 List of Study Team Members

Expertise	Name
Team Leader	Egawa Yoshitake
Deputy Team Leader/Disaster Management Planning	Kaneko Fumio
Earthquake and Seismic Analysis	Segawa Syukyo
Ground	Yano Kenji
Building Structure	Ohsumi Tsuneo
Infrastructure (Road, Bridge, Lifeline)	Sthapit Naresh
Information, Communication	Kurono Muneo
GIS Database	Toyama Nobuhiko
City and Regional Planning	Watanabe Jiro
Public Awareness and Education	Shaw Tomoko
Public Health and Sanitation	Komura Takashi
Structure, Institution and System	Mattingly Shirley
Building Structure	Kagawa Hideo
Assistant	Taguchi Hiroyuki

The Nepalese counterpart organisation is the Department of Narcotics Control and Disaster Management, Ministry of Home Affairs (MOHA). Counterparts were designated from MOHA and other concerned Ministries as shown in Table 1.2.3.

Table 1.2.3 List of Counterparts

Name	Designation	Office
Dr. Min Bahadur Paudyal Chhetri	Director	Ministry of Home Affairs, Dept. of NDC & Disaster Management
Mr. Pravakar Adhikari	1st Class Officer	Ministry of Information & Communication
Mr. Laba Prasad Tripathi	Director	Ministry of Education & Sports, Department of Education
Mr. Durgendra Man Kayastha	Chief Survey Officer	Ministry of Land Reform & Management, Survey Department
Mr. Sudhir Rajoure	Seismologist	Ministry of Industry, Department of Mines & Geology
Mr. Gyani Raja Chitrakar	Geologist	Ministry of Industry, Department of Mines & Geology
Mr. Amrit Man Tuladhar	Engineer	Ministry of Physical Planning & Works, Department of Urban Planning & Building Construction

Based on the Scope of Work, a Steering Committee was formulated by Nepalese government to carry out the Study smoothly. A list of the members is shown in Table 1.2.4.

Table 1.2.4 List of Steering Committee Members

Name	Designation	Office
Mr. Tulsi Prasad Bhattarai	Chief District Officer	Kathmandu District
Mr. M. K. Adhikari	Deputy Chief District Officer	Lalitpur District
Mr. Ram Prasad Khatriwada	Chief District Officer	Bhaktpur District
Mr. Keshab Sthapit	Mayor	Kathmandu Metropolitan City
Mr. Buddhiraj Bajracharya	Mayor	Lalitpur Municipality
Mr. Prem Suwal	Mayor	Bhaktpur Municipality
Mr. Madankrishna Shrestha	Mayor	Madhyapur Municipality
Mr. Hirakaji Maharjan	Mayor	Kirtipur Municipality
Mr. Balananda Paudel	Under Secretary	Ministry of Finance
Mr. Mohan Bahadur Karki	Under Secretary	Ministry of Science and Technology
Mr. Padam Lal Shrestha	1st Class Officer (Technical Officer)	Ministry of Physical Planning & Works
Dr. Shyam Prasad Bhattarai		Ministry of Health
Mr. Narebdra B. Amatya	Under Secretary	National Planning Commission, Administration Section
Mr. Nanda R. Sthapit	Director General	Department of Mines and Geology
(Chair) Mr. Shree K. Regmi	Secretary	Ministry of Home Affairs

1.2.7 Structure of Report

The reports of the Study consist of the following 5 volumes.

Volume I : English Summary

Volume II : Main Report Volume 1 Earthquake Disaster Mitigation Plan

Volume III: Main Report Volume 2 Damage Estimation

Volume IV: Appendix

Volume V : Japanese Summary

This volume is Volume 1 English Summary and its contents are as follows.

Part I : Blueprint for Kathmandu Valley Earthquake Disaster Mitigation

Part II : Earthquake Disaster Assessment and Database System

Part III: Conclusions

Part I comprises holistic and conceptual disaster mitigation plans, which is the main output of Phase 3 of this Study.

Chapter 1 is the introduction and Chapter 2 introduces the “Earthquake Scenario”, which is based on the damage estimation. This Scenario is the basis for mitigation planning.

Chapters 3 to 6 are conceptual suggestions for earthquake mitigation planning. Following are the features of the contents.

- a) Concrete suggestions for sustainable mechanisms for earthquake disaster management are described in Chapter 3. Earthquake mitigation plans would not be effective unless they are developed by entities at different levels, such as National government, Local government, private companies, citizens etc., and linkage and mutual cooperation should be included in the framework.

- b) Chapters 4 to 6 describe suggestions according to three targets: 1) protecting the life and property of the people in the Kathmandu Valley, 2) strengthening socio-economic systems and 3) protecting the stability of governance even in case of earthquakes. In these chapters, only holistic and conceptual plans are shown, since concrete plans should follow during and after the establishment of the framework.

Part II compiles the results of the earthquake damage estimation, the main product of the first and second phases. This section would provide the basis for the disaster mitigation planning.

Chapter 7 contains the scientific results of the estimation; scenario earthquakes, seismic intensity, building damages, human losses (casualties), and infrastructure damages. No seismic data for damage estimation has been accumulated in Nepal, thus there is a limitation of accuracy.

Chapter 8 contains the database of basic data and results of the damage estimation. A new simulation software was developed and added. The database is expected to be utilised for accumulation of data and increasing accuracy in the future.

Chapter 9 explains about the web-site which was built to disseminate the purpose of the survey, methodologies, process, results and so on.

Part III, Chapter 10, consists of conclusions and future project proposals based on the suggestions made in Parts I and II, in the conclusions.

CHAPTER 2 EARTHQUAKE SCENARIOS

2.1 Scenario Earthquakes

Although the detailed results are shown in Part II, Chapter 7, this Chapter summarizes and presents them as an event scenario to serve as the basis for earthquake disaster management planning. Four scenario earthquakes were set in this study, and a disaster assessment was done for each scenario earthquake as summarised below.

(1) 1934 Earthquake (Magnitude 8.4)

The re-occurrence of the 1934 Bihar-Nepal Earthquake was modelled. In this earthquake the Valley would experience the largest intensity in four scenario earthquakes. The seismic intensity in Modified Mercalli Intensity (MMI) would be MMI VIII in most parts of the Valley and MMI IX in some eastern areas. The liquefaction potential is very low in most of the Valley. Moderate potential was identified in some areas along the Bagmati River.

(2) Mid Nepal Earthquake (Magnitude 8.0)

This earthquake has been set based on the seismic gap in the middle of Nepal. Except in mountainous areas, MMI VIII would be experienced in the Valley. If an aftershock of magnitude 7 occurred at a position nearest to the main rupture zone, the Kathmandu Valley would experience MMI VII. Moderate liquefaction potential was identified in some areas along the Bagmati River.

(3) North Bagmati Earthquake (Magnitude 6.0)

This scenario earthquake model has been set based on the earthquake cluster, which is located just north of the Valley. Except in mountainous areas, the Valley would experience MMI VI or VII. No part of the Valley would be liquefied because there is only very low liquefaction potential.

(4) Local Earthquake (Magnitude 5.7)

This earthquake model has been set based on a distinct lineament in the Valley. The area along the fault would experience MMI IX. Other parts of the Valley, except the mountainous areas, would experience MMI VII or VIII. A few grid cells close to the fault were judged to have a high liquefaction potential. Along the Bagmati River, there are some grid cells with moderate liquefaction potential.

2.2 Earthquake Disaster Scenario

This Earthquake Event Scenario outlines the direct effects that would occur if the Mid Nepal Earthquake were to hit the Kathmandu Valley. The scenario intends to identify the weak points of the current Kathmandu Valley in order that the entire Valley can be strengthened. Further, note that different earthquakes will provide a different pattern of damage and influences.

(1) Earthquake

We can imagine ourselves a few years in the future recounting the events that occurred on a winter afternoon in the year 200X. It was a normal day with people going about their normal business when suddenly a terrible ground shaking began and continued for a couple of minutes. Most of the people could not stand still or walk at all. Older people and experts had warned about the vulnerability and lack of preparedness for such an earthquake. Aftershocks collapsed the partially damaged buildings and in some cases killed the people inside.

(2) Social Turmoil

The Central Government failed to function right after the earthquake, due to the lack of preparedness and mitigation planning and practice and drills. Therefore the King ordered the immediate establishment of a National Disaster Control Board comprised of Ministers, Mayors in the Kathmandu Valley and the Commander-in-Chief to implement the same tasks as the National Defence Council of Nepal and to request aid from overseas. The King made a direct appeal to the people on radio not to be panicked and bewildered by rumours. Although continuous aftershocks made people unsettled, and the lack of coordination for International Relief activities created further turmoil, self help activities among ward offices and municipalities became successful. Volunteers and NGO activities have been appreciated. At the same time, the importance of the dynamic power of the Central Government and its coordination capacity has become recognised.

(3) Building Damages

Around 20% of the total buildings were heavily damaged. Higher rates of damage were seen in weak building types such as earthen-mud, stone and adobe. Lower percentages were experienced in BC or RC buildings, but even many of these were damaged due to low engineering standards, and weathering by moisture and inadequate foundations. Many houses collapsed with bricks, iron, timber, furniture and dust. The number of damaged buildings was much greater in urban areas than rural areas, with almost half of the buildings in the whole Valley experiencing some kind of damage.

(4) Casualties

Most of the death toll of 18,000 resulted from the collapse of houses. Specifically half of the deaths and injuries were concentrated in the urban areas of Kathmandu Municipality. Most corpses remained in the debris of buildings for a number of days and the capacity for proper cremations was overtaxed. Most of the 147,000 injuries were caused by building collapse and objects falling from buildings or within buildings (such as furniture). Over half of the deaths and injuries consisted of older people, children and women. A significant number of visitors to Kathmandu, including tourists, were killed and injured.

(5) Fire, Blockage and Debris

Although fires broke out in tens of places, most did not spread due to the primarily inflammable building materials. One of the serious problems was that buildings along roads and highways collapsed onto the roadway and blocked access at many places, especially in the recently developed core and commercial areas. The debris of buildings was mostly reused for reconstruction, and the materials caused weakness of the reconstructed buildings. Already retrofitted schools were safe and generally suffered only slight damage.

(6) Medical Care and Hospitals

Serious injuries requiring hospital care reached 53,000 and other injuries were another 94,000. Limited resources of doctors, nurses, medicines and other resources or facilities were critical. Assistance from abroad helped significantly, but it arrived several days after the earthquake.

(7) Homeless, Refugees, Shelters

Around 500,000 people were left homeless and they gathered in shelters or open spaces, searching for their families and relatives. Many affected people were forced to use river water for drinking and washing. Space in shelters and materials were limited and insufficient for serving all the homeless people. Almost 10,000 people stayed at shelters for a long time. Not only the people in the shelters but also many others complained about the government's inadequate preparation and management of the crisis.

(8) Education and schools

Sixty percent of the public schools were damaged, because their buildings were very poor and vulnerable. Over 40,000 children were affected. Many remaining schools were used as shelters for a long time for the people who lost their houses or they could not be used at all.

(9) Infrastructure (Roads, Bridges and Airport)

Fortunately, there were not too many incidents of damage or cracks in highways and roads, except blockage by collapsed buildings in dense areas. In the western mountainsides, slope failures occurred, causing blockage and suspension of access to and from India. In lower land, several bridge failures occurred due to liquefaction. Difficult access between big settlements was the most significant problem for at least a few days, the most important days for emergency response. The airport also suffered slight damages. Except for recovering from the suspension of power, the airport's functionality recovered in a few days and it was activated for transportation of necessary materials and resources from outside of the Valley.

(10) Water Supply and Sewage

Damages to water pipelines affected a total of 80% of the users in municipal areas. All available water supply trucks tried to move among the dwellings to compensate for the loss of supplies from broken pipelines. But the lack of access in the narrow streets hindered truck access. Insufficient supplies to municipal people lasted a very long time.

(11) Power Supply

Damage to power lines was concentrated in Kathmandu Municipality. Many power cables, mainly lower voltage lines, were cut by the shaking of the ground and supporting poles. Since electricity is the most important lifeline facility, emergency efforts were focused on their recovery by the management of NEA (Nepal Electricity Authority). The recovery of electric power provided the suffering people with enhanced ability to promote rehabilitation, rescue/relief and recovery activities.

(12) Communication and Information

a) Telecommunications

Telecommunications stopped completely, and the earliest information of the tragedy was transmitted by satellite phone to the world. After several days, most of the telecommunications had been recovered and mobile phones played an important role.

b) Media (TV, FM-radio and newspaper)

Power failure caused a suspension to broadcasting. Half of the FM radio stations had their own home power generator, and after recovering power the next day, they continued to broadcast safety information, information about relief supplies for

victims, and requests for volunteers in the Valley. As for newspapers, damage to the buildings was moderate, but facilities and equipment for printing suffered seriously.

SUSTAINABLE MECHANISMS FOR DEVELOPMENT OF DISASTER MANAGEMENT

3.1 Current Institutional System

No single ministry or two ministries can begin to handle effectively all aspects of managing earthquake risk or managing an earthquake disaster. All ministries, local governments, and other sectors of society must participate individually and collectively. The framework for an updated institutional system for disaster management in Nepal comprises three major elements:

- a) Clear assignment of responsibilities to ministries, local governments, and other institutions.
- b) Creation and strengthening of sustainable mechanisms for cooperation.
- c) Development and implementation of policies and plans.

It is clear that the following steps must be taken to improve the capacity for disaster management in Nepal:

- a) Establish a strong legal base for a comprehensive risk management system, involving each level of government and the community. Ascribe responsibility for leadership to all levels of government, and charge agencies at each level with responsibilities for preparedness and mitigation work in accordance with their assigned functions.
- b) Create sustainable mechanisms for inter-governmental and inter-institutional coordination of mitigation, preparedness, response, relief, and recovery activities. The proposed National Disaster Management Council (NDMC) would be responsible for formulating national disaster management policies and overseeing their implementation through disaster management plans and programs throughout Nepal. The Kathmandu Valley Disaster Management Council (KVDMC) would be responsible for disaster management policies, plans, and programs to meet the specific needs of the Kathmandu Valley.
- c) Ensure that the Tenth Five-Year Plan includes plans and funding for firm disaster mitigation measures

Among the public service sectors in any country, local bodies provide a major role in rescue and relief for victims, because they know the extent and characteristics of the disaster situation and needs of the people. Of course, local bodies should be supported by the central government. Nevertheless, in Nepal, the central government's Ministry of Home Affairs (MOHA) is mandated as not only a guiding and supportive organisation for local bodies but also the key entity for disaster

operations. Insofar as the area affected by a disaster would be a rural area governed by a Chief District Officer (CDO), it may be rational for MOHA to be in charge of disaster operations, because the CDO is the local agent of the ministry. In the Kathmandu Valley, however, local bodies including the five municipalities represent more than the CDOs as far as public services are concerned. To deal effectively with earthquakes, a new institutional system that involves the capabilities of all levels and sectors of government and society is needed.

3.1.1 Problems of the Current Framework

The existing legal framework for the roles and responsibilities of the government related to disaster management is provided by the following:

- a) Constitution of the Kingdom of Nepal, 1990.
- b) Natural Calamity Relief Act, 1982.
- c) Local Administration Act, 1971.
- d) HMG (Allocation of Functions) (Second Amendment) Rules, 1996.
- e) Local Self-Governance Act, 1999.
- f) Kathmandu Valley Town Development Act, 2000
- g) Buildings Act, 1998 (also see Draft Building Council Act, 1994).

Four problems must be addressed in order to enhance disaster management capabilities in Nepal.

(1) Legal basis

The system is based on an antiquated law that was enacted before democratisation and the Local Self-Governance Act. There is no formal assignment of roles and responsibilities to ministries, other than to MOHA, or to local governments. The current law and system focus entirely on short-term relief to victims only after the event occurs and have inadequate provisions for public education and information, coordination of response activities, mitigation in pre- or post-earthquake environments, and management of recovery and reconstruction. It is not clear who is in charge of overall disaster response (command and control) or who should oversee and coordinate disaster mitigation activities and programs. (See Figure 3.1.1)

On the other hand, in the Local Government Act and the Ninth National Five-Year Plan (1997-2002), a focus on decentralization to local bodies not only in the existing development administration but also direct disaster management activities is suggested.

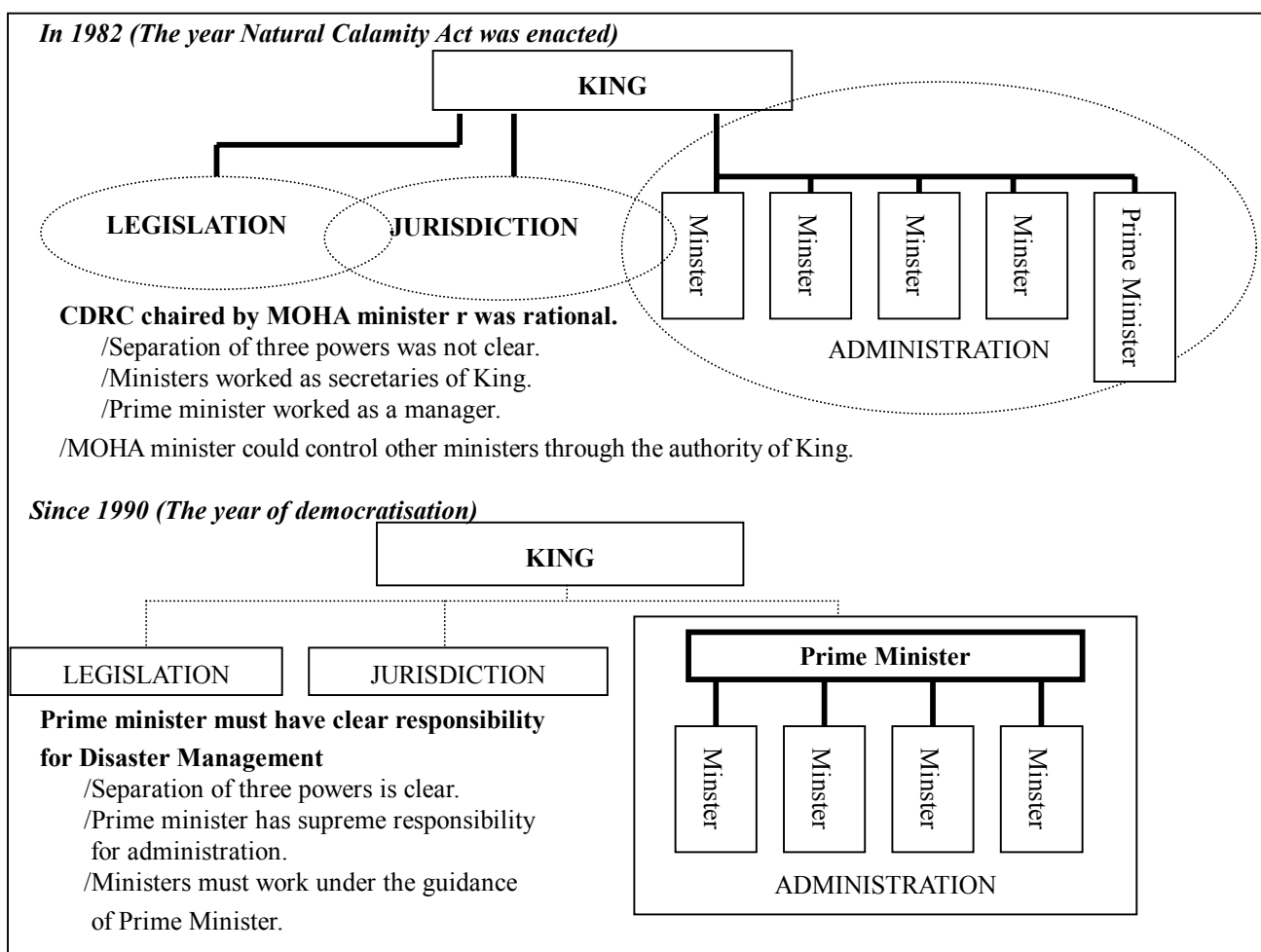


Figure 3.1.1 Environment of the Natural Calamity Act

(2) Institutional Framework

The Natural Calamity Act designates disaster relief committees at the national, regional, district, and local levels. (See Figure 3.1.2) However, the committees are only for relief actions after the disaster event occurs. Moreover, the regional, district, and local committees are only constituted by the central government “according to need,” and their membership and leadership are not specified. For municipalities, only Kathmandu Metropolitan City has a disaster management section. (See Figure 3.1.5)

- The system relies almost completely on central government institutions and officials. (See Figure 3.1.3)
- There is no involvement of ward, VDC, and municipal-level governments.
- There is a recognised central focal point for relief (MOHA), but there is no such clear focal point in regard to mitigation and other aspects of disaster risk management. (See Figure 3.1.4)

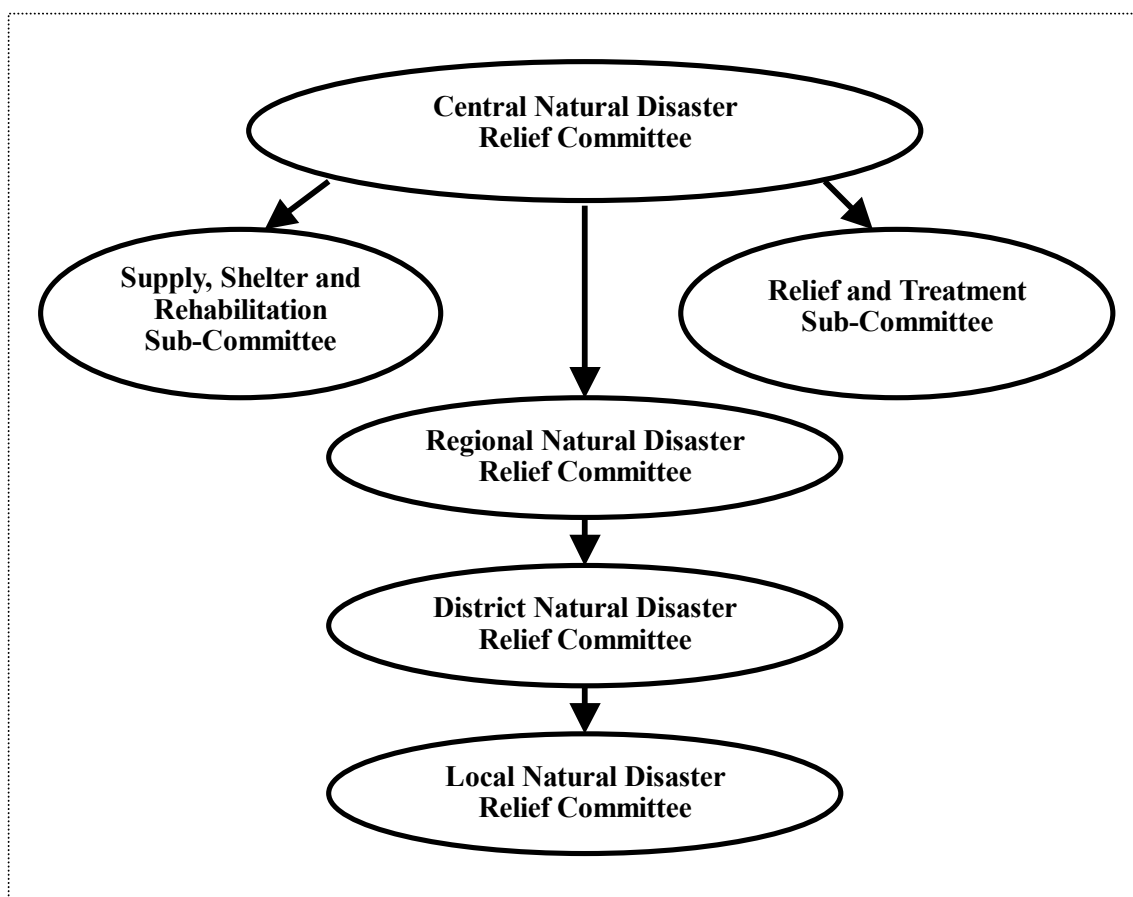


Figure 3.1.2 Nepal Institutions for Natural Disaster Management

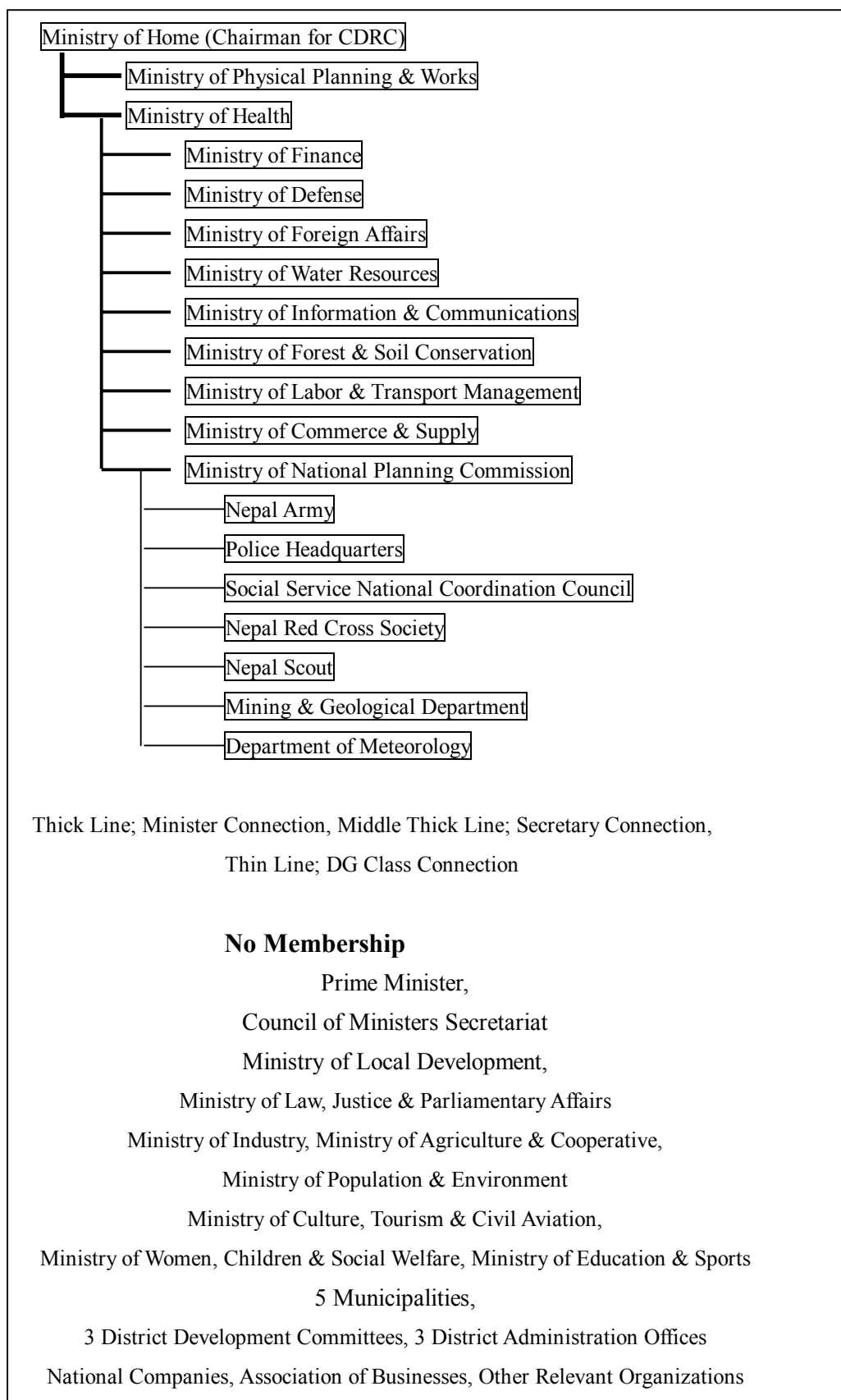


Figure 3.1.3 Membership Central Disaster Relief Committee in Natural Calamity Act

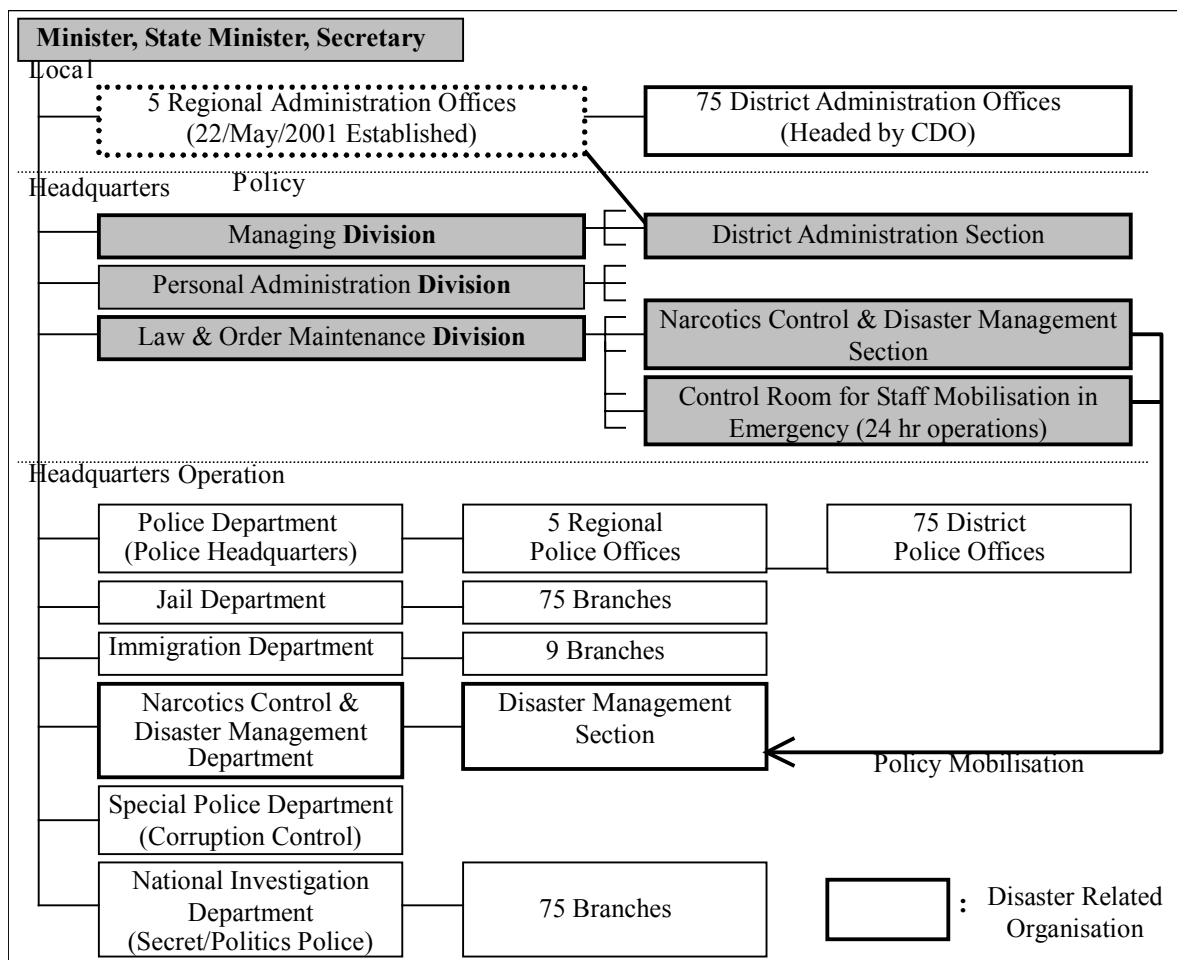


Figure 3.1.4 Organisation Chart of Kathmandu Municipality

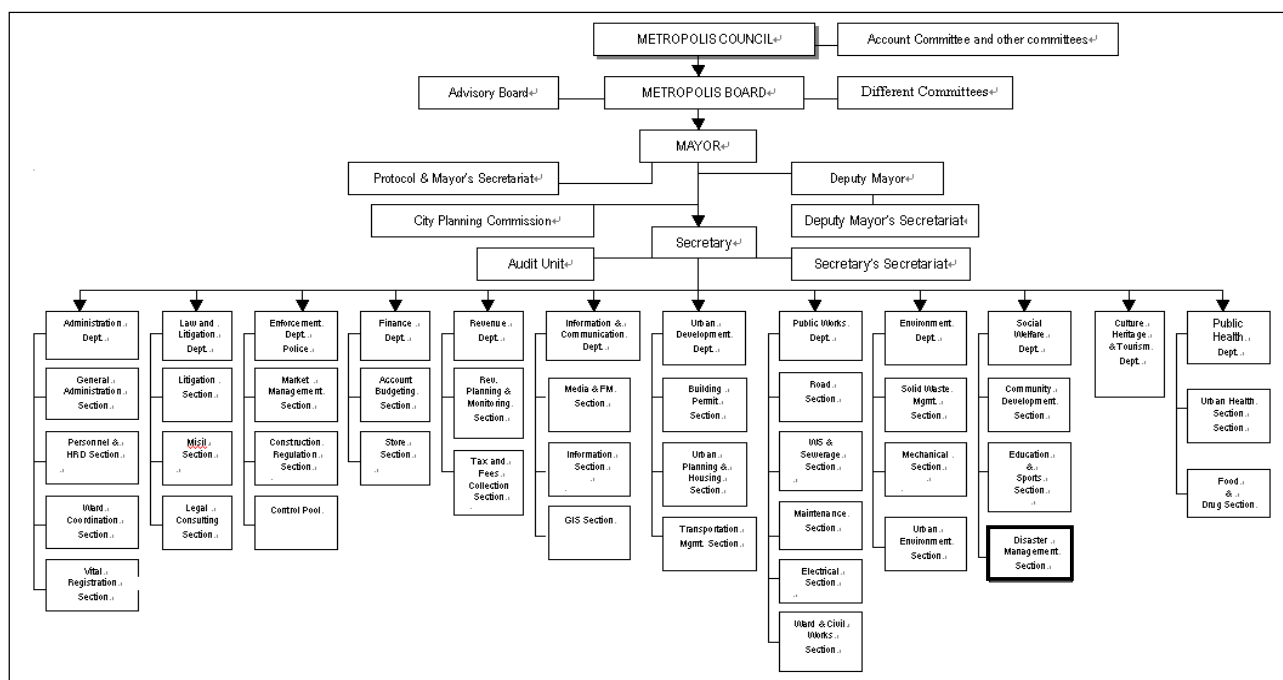


Figure 3.1.5 Organisation Chart of Ministry of Home Affairs

(3) Inter-institutional Cooperation

There is inadequate linkage between disaster management and physical and economic development programs. There is no mechanism for coordination of disaster mitigation activities and implementation of mitigation in development plans and programs. There is no adequate mechanism for coordination of immediate response actions among central government agencies, which in the past has led to duplication of work and delays in rescue and relief works. There is no adequate mechanism for communication of immediate disaster information among central government agencies, with local officials, or with the public.

(4) Policies and National Plans

There is no adequate policy in regard to disaster management and mitigation. The National Actions Plans (1996, 1998) for disaster mitigation have not been implemented.

There is no effective mechanism for oversight and implementation of existing mitigation plans. There are very few institutional or inter-institutional emergency plans and no national emergency plan. Seismic design and construction standards are not nationally accepted, and adequate construction supervision and control mechanisms do not exist.

3.1.2 Framework to be Established

A future framework must be built, based on the current problems.

(1) Establishing a new and powerful legal and institutional framework

The followings are focal points of a new institutional framework.

- The new legal and institutional framework should involve municipalities and communities as well as the central government.
- Overall responsibilities for earthquake disasters in the Kathmandu Valley should be defined.
- Responsibilities at each organisation should be clarified for emergency response as well as preparedness and mitigation.

(2) Establishing a management organisation for close linkage between central and local government

At the earliest, the National Disaster Management Council should be established in order to create a close linkage between central and local governments and other concerned organisations. The Council would prepare the Disaster Management Plan, coordinate mitigation policies and plans for infrastructure and economic

development projects, and oversee their implementation. The Council would be comprised of chief executives of key institutions including ministries, municipalities and non-governmental organisations. The Council should be presided over by the Prime Minister.

(3) Establishing Disaster Management Councils or Committees (Figure 3.1.6) at Each Level

Each level of government should establish its Disaster Management Council or Committee, which would prepare disaster management policies, plans, and programs. The central government, municipalities and private entities in the Valley should define each of its roles and responsibilities, and create inter-linkages for inter-organisational coordination.

(4) Emphasis on Disaster Management Policy and Plans in the Tenth National Five Year Plan

Budget allocations for disaster mitigation would be ensured by defining disaster management policies and plans in the National Five Year Plan. Each organisation at different levels of government would prepare, implement and coordinate their Earthquake Disaster Management Plans according to the allocated budget.

(5) Ensuring Budget Allocation and Fair Implementation Mechanism

Legal mechanisms for ensuring budget allocations and expenditures, accountability of the central government's budget allocations to local governments, the appropriate operation of disaster aid funds, and establishment and operation of appropriate auditing mechanisms are recommended to be established.

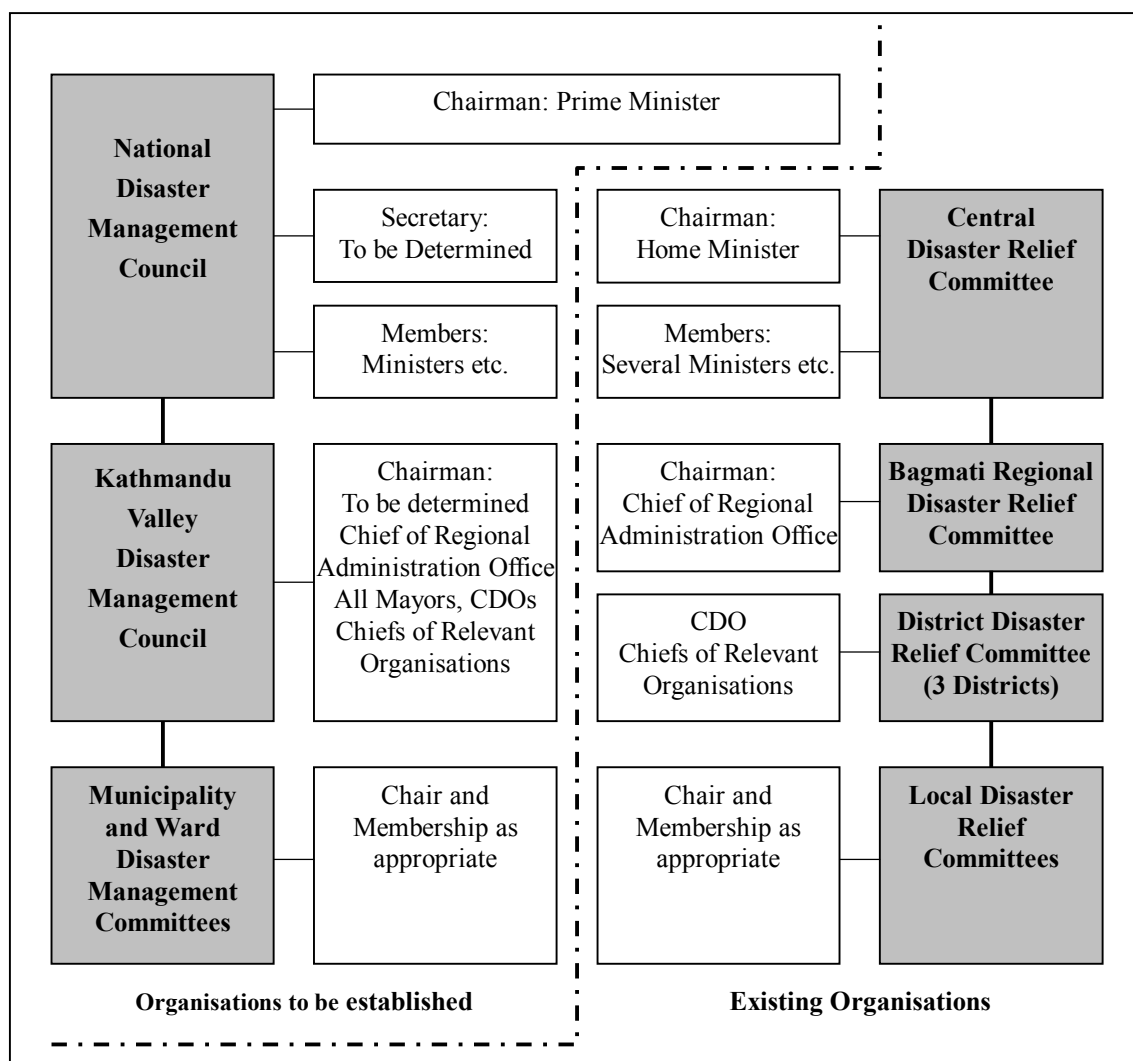


Figure 3.1.6 Disaster Management Organisations in the Kathmandu Valley

3.1.3 Disaster Management Organisation before, during and after Earthquakes

Different elements of the disaster management organisation must be active during different stages before during, and after the disaster. This applies to different levels of organisations, from central to municipality, ward and the private sector.

(1) Before the Earthquake: Disaster Management Council or Committee

Before the earthquake, the disaster management organisation focuses primarily on policy making, planning, setting long-term priorities and implementing mitigation and preparedness programs. Therefore, the membership of the Council is broad and diverse in order to cover different areas and include many stakeholders.

(2) During the Earthquake: Emergency Control Board (ECB) with Emergency Operations Centre (EOC)

The focus is on quick decision-making, gathering and assessing information, and coordinating response operations during this stage, so a limited and mobile group is

required. Therefore, a core group of Disaster Management Council or Committee members, including Army, police, and public officials, is activated as an Emergency Control Board. The Board manages response and coordinates with other institutions and levels of government. The Board is supported by an operative facility known as an Emergency Operations Centre (EOC) where information and decisions are coordinated.

(3) After the Earthquake: Rehabilitation Council / Agency

Difficult and special demands face a government or private entity in recovering from a major disaster. Intensive investments are required in the reconstruction stage, and many social sectors need to be involved. A special organisation for reconstruction and rehabilitation would often be established in order to manage recovery and rehabilitation processes that could not easily be handled ordinary administrative structures or the Disaster Management Council. In other cases, ordinary public authorities or the Disaster Management Council would be in charge of reconstruction.

3.2 Plans for Earthquake Disaster Management

Earthquake disaster management should be conducted under an integrating concept and set of principles that provide unity and continuity among the plans of governmental and societal entities. These principles include recognition of the need for leadership, risk reduction, dissemination of public information, and rapid response and recovery actions by all levels of government and society. Thus, the earthquake disaster management plans at each level of government all fit together as one elements of a single overall system, operating in a coordinated fashion.

The individual disaster management plans prepared by each level of government and each institution should be the fruit of participatory planning by all stakeholders. The procedure of cooperative planning is the prerequisite for later cooperation in the implementation stage. An important component of each plan should be a matrix of functions and responsibilities that will list by function the lead and supporting organisations designated to perform each function.

The planning process should follow certain steps, including: get the support and involvement of the chief executive, establish a team representing all branches of the organisation to draft the plan, set goals and objectives, assign tasks and responsibilities, achieve consensus and sign-off by responsible parties, train staff, and exercise the plan.

3.2.1 Plans at Each Level

The system would be composed of six related but separate plan elements, differentiated by administrative and societal unit, as follows:

- a) National plan.
- b) National Government plans
- c) Municipalities plans.
- d) District plans.
- e) National companies plans.
- f) Private plans.

Each of these plans should incorporate the relevant means of coordination and communication with the other elements. (See Figure 3.2.1)

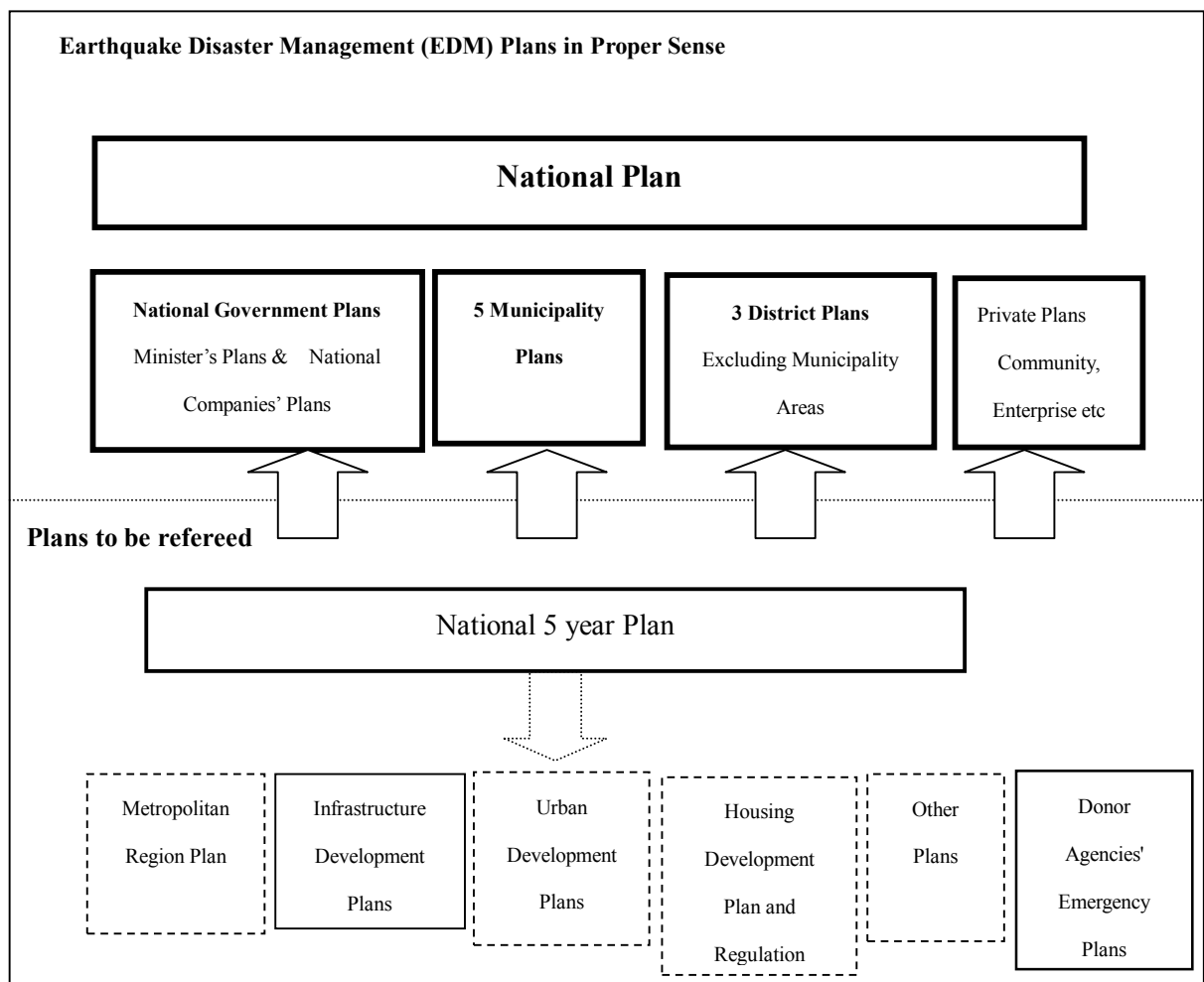


Figure 3.2.1 Structure of Disaster Management Plans and other National Plans to be referred

(1) National Plan

The National Plan deals with basic risk management policy and formulation of a

national framework of cooperation among central government, army and national police, local bodies, national companies, private enterprises, non-governmental organisations, communities and international agencies active in Nepal etc. The plan also assures the mechanisms for accessing national assets including government funds.

(2) National Government Plans

The National Government Plans are for Ministries, Royal Nepal Army and National Police, which need to formulate solid plans for disaster mitigation and initial response for individual governmental institutions. Individual Ministries' plans also provide guidelines for disaster management for the national companies they oversee.

(3) Municipality Plans

Municipality Plans are for Kathmandu Metropolitan City, Lalitpur Sub-Metropolitan City, Bhaktapur Municipality, Madhyapur Municipality and Kirtipur Municipality. Some national plans treat municipalities, districts and the private sector as subordinate, while others treat them as parallel to the national plan, dividing tasks and responsibilities horizontally with it. In Nepal, the latter case, i.e. independent municipalities' plans with a parallel but not hierarchical structure to the national plan, would be preferable, because:

- a) The target area, the Kathmandu Valley is special in terms of urbanisation and the general guidelines of the National Plan for managing earthquake disaster risk throughout the country are not entirely applicable
- b) The central government does not have enough resources to lead and oversee all aspects and elements of disaster management planning.

The municipalities' plans should integrate ward-level plans defining the tasks and responsibilities to be carried out at the ward level.

(4) District Plans

District Plans are for the Kathmandu, Lalitpur, and Baktapur Districts excluding the municipality areas. The Kathmandu Valley belongs to the Region/Central Administrative Unit, though the Unit's administrative office is located in Hetauda, a half-day drive outside of the Valley. Moreover, the office's task has been no more than maintenance of security. Therefore, the Region/Central is not feasible to conduct management of an earthquake disaster that impacts the Valley.

The five Municipalities and 97 VDCs are the administrative components of the Kathmandu Valley. Each Municipality is expected to be the key administrative body under the newly enacted Local Self-Governance Act, so this administrative level has to play the biggest role in earthquake disaster management; not just because the urban area is prone to disaster, but also because it is closest to the citizens. The VDCs are also closest to the people and have to play a big role in disaster time, but their planning resources are very limited. Therefore, the district administration offices should cover these VDCs in the district plans and provide planning guidelines to the VDCs. Based on the guidelines, the individual VDCs will understand their disaster management responsibilities and can easily prepare their own basic VDC plans to integrate them into the district plans.

(5) National Companies' Plans

National Companies' Plans are for lifeline companies such as Nepal Electric Authority, Nepal Telecommunication Company, Nepal Water Supply Company and the national bank, Nepal Rastra Bank. These companies have to make plans for earthquake disaster management in order to maintain normal function as much as possible even in earthquake disaster time. In addition, dysfunction of their operations and facilities would be inevitable in earthquake disaster time, so they need plans for fast recovery and restoration of services. These companies should be provided guidelines by the national government plans and elements of the National Plan. They should develop detailed plans for seismic strengthening, maintaining operational status, and post-earthquake rehabilitation.

(6) Private Plans

Private Plans are for individual companies, associations, institutions such as schools, hospitals, the private sector and non-governmental organisations (NGOs). Private companies and these other organisations will conduct a large portion of the relief and reconstruction works. For example, emergency transportation of food, water, fuel and utensils, etc. will be provided by private companies, and emergency removal of blockages on roads and emergency bridge restoration will be performed by private construction companies. Private companies should be requested to prepare plans for fast response. Community-based organisations, associations, other groups and NGOs will be very powerful stakeholders in disaster time. It is preferable for each of them to develop individual disaster management plans through participatory processes.

3.2.2 Earthquake Disaster Management Plan and other Referred Plans

(1) National Five-Year Plans

The supreme development plan in Nepal is the National Five-Year Plan by the National Planning Commission (NPC). It is sometimes said that plans are worth little because most often projects have been conducted independently from the plans. In fact, ministries seem to show little regard for the planning. Whatever the reasons for ignorance or disregard of the plan may be, the plan must be more respected in order to implement systematic and cooperative management for earthquake disasters.

The NPC has been preparing the next Five-Year Plan targeting 16/July/2002 -15/July/2007. It has submitted conceptual papers for further discussion, and detailed planning will proceed until June 2002. According to an authoritative source, the NPC will put more emphasis on measures to cope with earthquake disasters, devoting a specific section of the Plan to this subject. In these circumstances, concerned ministries have to prepare huge supporting documents with a matrix of prioritisation for detailed planning on projects for management of earthquake disasters. This report may meet the requirements for the supporting documents.

(2) Specific plans to be Referred

A management plan for earthquake disaster should be prepared based on the existing specific plans that have already been prepared for improving everyday life and social development. The reason for this is that minimum standards for either quality of life or function of urban facilities in normal times form the basis for determining the actions to be taken for disaster management. Consistent functioning in normal times must be assured. The earthquake disaster management plan aims to minimise the deterioration in function of systems and facilities even in disaster time. However, in any country the tasks of improving everyday life and assuring consistent functioning of urban systems and facilities on-going. Therefore, the usual earthquake disaster management plan would refer to the National Five-Year Plan, the Kathmandu Metropolitan Region Plan, various Infrastructure Development Plans, Urban Development Plans and Housing Development Plan and Regulation, etc. However, in the current instance these cannot be referenced because most of them are either inadequate or not authorised. Our plan has limitations for this reason. Meanwhile, the study team is providing suggestions to make and authorise such development plans from the viewpoint of earthquake disaster management.

3.3 Community Resilience and Self-reliance

3.3.1 Characteristics of the Social Structure

The findings of the personal interviews are summarised in this section.

(1) Key Factors for Formulation of Disaster Mitigation Planning

- a) Households keep stocks of food and water to survive in the emergency situation for the first few days, which may be of use to others during disaster time.
- b) Households value education more than health services.
- c) Households are mostly religious and have an attitude of helping each other.
- d) Households feel they are not well prepared for mitigation measures, however they are prepared to volunteer for rescue operations if needed and expressed a need for relevant training.
- e) The community is not highly stratified by caste as most were prepared to share shelter and food together in case of disaster. However, certain considerations of the society need to be taken in regard to those who are unwilling to do so.
- f) Social organisations such as *Guthi*, clubs, trusts and associations are very useful community based organisations that may well be mobilised during a disaster.
- g) For new settlers and younger households, various clubs, association and similar other informal organisations were more important.

(2) Notable Social Cohesion and Mutuality – Newari Characteristics

About 42 % of the Valley population are *Newari*. The *Newari* have notable features in terms of social cohesion and settlement patterns. The old city core areas are *Newari* settlements. The *Newar* society is notable for its numerous *Guthi* institutions, which grant membership to the individual household groups. Each *Newar*, in one way or another, is associated with his *Guthi* in his society. The *Guthi* is created by offering private property, cash or kind, including landed property for the sake of sustaining worship in temples, maintenance of public rest houses for pilgrims and several other socio-religious functions. The *Guthis* appear to be religious in nature but they perform innumerable social functions. The temples and rest houses run by the *Guthis* are venues for socio-religious functions. In times of calamities these venues provide excellent rescue and relief sites. Thus, the *Guthis* are useful both during peace and disaster.

(3) Notable Settlement Patterns and Society - Newari Settlements

Newari settlements are highly urban and densely inhabited, with more than 1000 persons/ha, the highest in the city core area. The streets are mostly narrow and

brick or stone paved and the houses, of rather uniform height, traditionally three and one-half stories, built on either side have at least the brick walls of the compounds adjoining. Those enclosing a courtyard are sometimes secular growths of earlier monastic units and are termed '*Bahals*' - this is particularly true in the three cities of the Valley. Wells and waterspouts are found either in partially or totally enclosed courtyards. The city structure is characterised by bigger open spaces in the centre, where palaces and important monuments and temples are located.

3.3.2 Target Groups and Tasks

Citizens and communities can become more self-reliant and resistant to earthquake impacts through sustainable outreach and education programs which provide them the knowledge and skills to prepare for and respond to a disaster. For effective disaster education activities, four target groups are recognised: citizens, public administrators, school children, and local masons as shown in Figure 3.3.1. It has been observed in Kathmandu that the school buildings are not properly built and children are regarded as one of the more vulnerable populations in the Kathmandu Valley. Moreover, most of the casualties in a Kathmandu Valley earthquake will be attributed to the unsafe buildings, which are built by local masons, often without any proper engineering intervention. With the growing demands for new construction in the Valley, increasing the capacity of the local masons is an important element to reduce vulnerability.

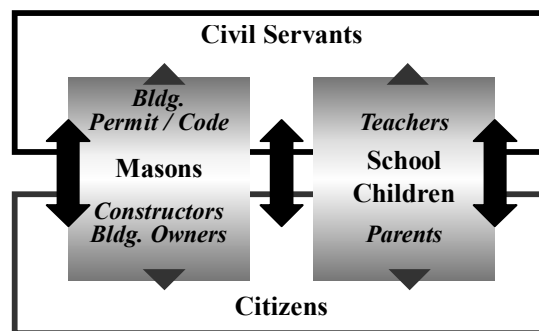


Figure 3.3.1 Masons and Schools Children as a Binding Actors between Civil Servants and Citizens

Valuable lessons have been learned during the Social Structure Survey and Community Activities in the study's Pilot Project. Six tasks have been chosen in summarising these lessons as shown in Figure 3.3.2.

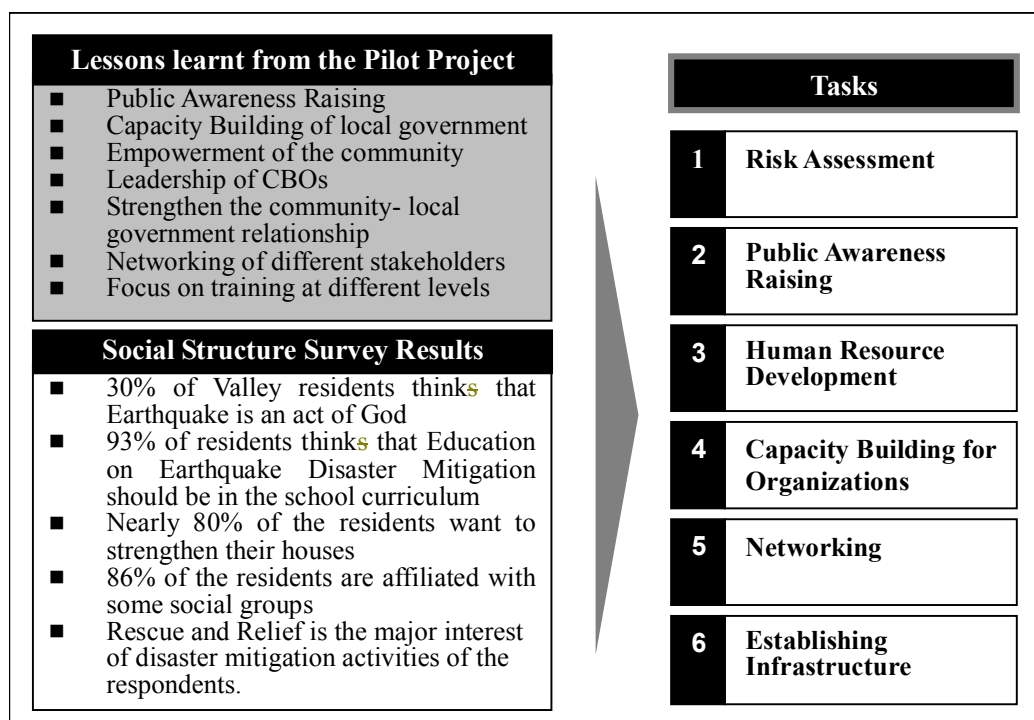


Figure 3.3.2 Evolution of Tasks

3.3.3 Task-Target Matrix for Effective Exercise and Education

The recommended task target Matrix of effective exercise and education is shown in attached Tables 3.3.1 and 3.3.2. Establishment and operation of a disaster management centre and mason training centre have been proposed as the first visible signs of progress.

To achieve the 6 task targets, 3 steps, namely, Learn, Think & Plan, and Action (See Figure 3.3.3) were set for basic disaster mitigation activities.

The outlines of the activities for each target group are as follows.

Citizens: Citizens are to acquire first hand scientific and technological knowledge of earthquake disaster management, know risks of their neighbourhoods through Community Watching and hazard maps, experience earthquake drills, participate in exhibitions and workshops. These activities will be initiated by Disaster Management Committee, which will be formulated at each ward level. Community leaders will be trained and by their initiative, community networks are to be developed and strengthened. A Disaster Management Centre will be newly established and function as centres for awareness raising activities, disaster related information, and networking for citizens.

School: School teachers are trained and develop school curricula on disaster management (lectures, training etc.). School children, who are considered to be future citizens, will receive disaster related education at school and they are expected to diffuse their gained knowledge to their family.

Civil Servant: Each civil servant is trained to manage community activities and understand the risks of the neighbourhood to take initiatives and promote community activities to increase resilience among local communities.

Mason: To support practical activities at the municipal level, a Disaster Management Centre and a Mason Training Centre will be constructed. Local masons are to participate in the construction process of the Mason Training Centre and be trained in technical skills for earthquake resistant building construction. This centre will contribute towards the sustainable efforts for effective disaster mitigation. At the same time, the social economic system to ensure higher wages for masons will be introduced along with upgrading technical skills

CHAPTER 4 MAINTAIN GOVERNANCE

Disasters occur whether we have adequately prepared or not. Some are slow to develop, while others, including earthquakes, occur without warning. When disasters strike, individuals and organisations react; their reactions are guided by whether they know what to do, their degree of preparedness to take appropriate action, and other factors including their confidence in the safety of loved ones.

In a major earthquake disaster, it is quite possible that some key officials of the government may be injured, incapacitated, or killed, that some government offices and equipment would be destroyed, and that documents essential to the continuity of governmental and business operations would be ruined or lost. But government, at all levels, is responsible for providing continuous, effective leadership and authority, direction of the emergency operations, and management of recovery operations. For this reason, it is essential that governmental entities continue to function during and following the occurrence of a disaster. This requires that they take precautions and preparedness actions including developing plans and manuals to guide response, establishing systems for communications and coordination including Emergency Control Board / Emergency Operations Centres, and advising employees of their responsibilities and obligations in case of disaster.

The primary aims of emergency planning are to save lives, protect property, and avoid disruption of governmental, social and economic activities. Key elements of emergency plans and manuals include the assignment of responsibilities and authorities and the establishment of systems for command and control, communications, coordination, and collection and dissemination of information. Emergency response and recovery planning provides for enhanced decision-making and implementation of the decisions before disaster strikes, in the immediate emergency period when decision-making is life-and-death, and after the event, when the welfare of victims, society, and the economy are at risk.

4.1 Lessons from the Gorkha Earthquake

The Gorkha earthquake which occurred at about 9:57 pm on 16 July 2001 revealed a weak initial response in Nepal. The Department of Mines and Geology (DMG) calculated the epicentre and magnitude of the earthquake within 30 minutes, using data automatically transmitted through their own lines from various seismographic observation centres; however, they did not actively report the information to anyone. At MOHA's Department of Narcotics Control and Disaster Management there was no knowledge of the epicentre and magnitude, and it was thought that the initial

response should be taken by the CDO, not by the department. Consequently, no action was taken officially by the department until the next morning. But because each CDO has limited resources and controls a limited geographic area, it is essential that the department and MOHA become comfortable in playing a leadership role in managing inter-institutional response to all but the smallest disasters.

In order to manage a great earthquake disaster in the Kathmandu Valley, MOHA and the department will need to gain repeated experience in managing smaller disasters and simulated large disaster events. They need to become accustomed to handling such operations in advance of large earthquake disasters, as the anticipated Kathmandu Valley event will cause much more extensive disruption and damage than any disasters that have occurred in the past in rural areas.

One of the most important lessons learned from the Gorkha Earthquake was that Nepal currently has no rapid means to communicate an overview of the earthquake information when an earthquake hits the nation. The Control Room in MOHA would be able to receive some initial subjective reports regarding disaster information from the 75 CDOs. However, identifying seismic intensity requires much skill, and MOHA's communication system is not resistant to strong ground motion nor is it capable of dealing with congestion caused by many communications.

4.1.1 Acquisition of Earthquake Information

DMG is operating the one and only seismological network in Nepal. This organisation is responsible for determining the size and location of earthquakes, and DMG can decide this information soon after earthquake if the earthquake occurs during business hours. There is no responsible person in the National Seismic Center (NSC) at night time and on holidays because the organisation is regarded as a purely academic research institute. The NSC should be designated as one of the disaster prevention organisations and a system of 24-hour operation is necessary.

4.1.2 Prompt Radio/TV Broadcasting

Rapid radio/TV broadcasting of the occurrence of the quake, as a natural phenomenon rather than as a disaster, has sometimes received little attention. There is typically confusion among policy-makers and emergency responders in the absence of accurate information about the severity and scope of the disaster. Prompt broadcasting by radio and TV of the earthquake event, even if there is little or no information about the disaster, can assist in securing appropriate responses by

the public as the disaster unfolds.

The electronic media provide the best tool for rapid dissemination of earthquake information to the public. An excellent example of this is presented by the system in Japan. It has become customary in Japan that as soon as citizens and officials sense earthquakes, they automatically switch on their television or radio to find out the location of the epicentre, the magnitude, and the shaking intensity level in various districts. This behaviour is almost routine for many Japanese and has contributed to a high level of sensitivity to earthquake disasters and to training on how to respond when the disaster strikes their area. Announcers in broadcasting stations are trained to provide appropriate messages. The Japan Meteorological Agency analyses transmitted earthquake data, collects reports of shaking intensity from various districts, and reports the results automatically to concerned authorities and media companies on direct lines within minutes. This system provides the foundation for prompt response by the media to any earthquake.

4.1.3 Rapid Notification of Key Institutions

In the Gorkha Earthquake, the DMG succeeded in identifying the quake's epicentre and magnitude within 30 minutes. A similar response is expected in the case of the anticipated Mid Nepal Earthquake because DMG's observation system is supported and backed up by its own tough wireless systems and generator. It is strongly recommended that DMG develop an automated reporting system to key institutions, preferably by dedicated lines.

4.2 Communication of Damage Information

4.2.1 Assessment of Damage Information

Timely assessment of damages is essential for rescue and relief work. In any country, the initial response from government depends primarily on information from the media. Government has lines of communication from the police, army and ministries; nevertheless, their reports are generally not only either slow or old but also do not reach the persons in proper positions who need the information. The media is expected to provide information services to society in Nepal; however, the contribution would be within some limitations because the capability has not developed very well.

Most detailed information from the official sector would be provided by the Royal Army, police, fire service and civil servants who are close to the community. However, systematic institutional lines for the collection of information have not

been developed in the administrative sector. Even in normal times, the bottom up transmission of information is limited due to the prevailing centralised environment. First, the lines of communication should be established, and the business style in normal times should be improved from the current top-down approach to a combination of top-down and bottom-up.

An even more difficult task is to acquire early damage assessment information for areas at the regional/district level. Recognising the difficulty of damage assessment, HMG developed certain strategies during the response to the floods of 1993 (Disaster Relief Implementation Manual: Logistics Support, 1996, UNDP), which are also applicable for the current case:

- a) The fielding of personnel from the international community to act as monitors and neutral observers of relief operations in the field
- b) Inviting international personnel to join the Government team staffing the Disaster Relief Unit (note: no longer in existence) in the Ministry of Home
- c) Sending a special team to the field from the central government to verify damage statistics and take necessary actions to improve the disaster response efforts.

Aerial photography or High Resolution Satellite Images taken following an earthquake would be a realistic and powerful tool for preliminary assessment of earthquake damage in Nepal because it does not depend on institutional systems. It provides accurate maps not only for the initial response, e.g. to determine which areas are affected the worst and where roads are blocked due to landslide, but also for planning for reconstruction. Aerial photographs are preferable due to higher resolution, though Nepal has no aeroplanes for this purpose, so this is something that international donor institutions should implement promptly and provide to the appropriate Nepalese institutions.

4.2.2 The Role of the Media

The media would be an indispensable tool for initial response. The media provides the fastest information to the public, even though they are poorly equipped. Among the media, the electronic media is expected to play the largest role in an earthquake disaster because of their potential for providing fast and detailed reports, although newspapers have the advantage of being able to provide more analytical, objective and influential comments. Technical issues must be addressed in order to facilitate advances in the electronic media. Also, government officials must take into account that for the media to fulfil their potential, they require good cooperation from the official sectors.

The Government monopolised all media before the multiparty revolution and there are still no private TV stations. Meanwhile, the radio stations are developing steadily to contribute to disaster management through the principle of competition. Radio Sagarmata has regular earthquake disaster awareness programs under the sponsorship of the National Society for Earthquake Technology– Nepal (NSET). The radio stations also have improved their initial response after earthquakes, as in the case of Radio Sagarmata following the Ghorka Earthquake.

The private media are still facing a chronic lack of resources like qualified staff, reinforced offices, alternate communication systems, and mobile systems, etc. Preparedness of the media is strongly recommended in order to enhance the initial response in an earthquake disaster. In addition, local journalists have little experience in dealing with a tragic disaster, so they are not well prepared to meet the rigorous demands of the situation that would be caused by a major earthquake. Therefore, it is also recommended that periodic seminars be conducted, as NSET-Nepal has done, on the role of the media in disasters and how to react and provide useful and accurate coverage of the disaster situation. It should also be considered to offer the chance for journalists or media companies to receive international training or consultancy services as an ODA.

The National Broadcasting Act, 1993 formulates the priority programs agencies must present; however, it does not mention anything about disaster reporting. Prompt revision of the Act to outline the responsibilities and tasks of the various media in regard to disaster reporting is recommended.

4.2.3 Emergency Public Information

Public awareness about disasters can be easily enhanced through detailed news reports on earthquake disasters, their impacts, and how to avoid loss and injury due to disastrous events. Live reports of how people are coping with the disaster can educate better than textbooks if they are thoughtfully prepared. Besides acting as a lighthouse for initial response, the media plays at least five roles for earthquake disaster management as follows:

- a) Biggest tool for awareness
- b) Obstacle against irresponsible rumours
- c) Interface between rescue teams and victims
- d) Conveyer of encouragement for depressed people
- e) Watchdog for proper management by the public sector

Before the earthquake occurs, public awareness campaigns about the potential

threat and appropriate response to it should be conducted. When a disaster occurs, the Emergency Control Board is responsible for coordinating the release and dissemination of situation-specific information. It is essential that the government speaks with a single voice, and for that reason a Coordinator of Public Information should be designated to be responsible for information dissemination to the media and the public during disasters.

The first priority is to give information and instructions that are timely, coherent and useful to the at-risk public. The control of false rumours and problems with “black market” traffic and price speculation for emergency supplies need to be taken into account. Positive and verified information about the operations in response to the emergency should be offered. Public information should correspond to protocols or procedures that have been designed to generate an effective response by the population.

4.3 Emergency Communications

4.3.1 Communication System in Army and Police

The army and police hold the only nation-wide emergency communication networks in the country. The existence and functionality of these networks are essential. Every effort should be made that these systems be maintained to operate satisfactorily at all times to cope with a state of emergency. In other words, they should operate without any failures and bring their ability into full play during relief and restoration activities.

A heavy responsibility toward the people must not be neglected in order to get trust. The role of the army and police contains many different things in order to protect the nations’ life and property as well as social life, in which the stabilised emergency communication system is indispensable.

To strengthen the functioning of the communication network, it is first requisite to make close inspections periodically of the existing facilities for completeness of operation. Secondly, it is required to have a sufficient number of communication equipment, and finally, since the presently operating systems are of conventional type, it is recommended for the police communication system to be replaced with a modernised digital system such as multi-channel access (MCA).

4.3.2 Emergency Communication between Administrative Organisations

For gathering emergency information and fast contact with each administrative organisation right after the earthquake, several communication means are

contemplated, including utilising subscriber telephone, public mobile cellular phone, leased lines, facsimile and Internet etc. It is more effective for the Government to establish exclusive hot lines as an integrated communication network between each organisation using a digital mobile multi-channel-access system. The mobile telephone network operates as two-way communications like an ordinary telephone and can even be connected to the public subscriber telephone network (PSTN). The portable handset is small in size and light in weight, so that the person in charge always carries it without missing an important emergency call. The ideal situation would be to establish all at once an integrated communication system for disaster management, all in one project; however, it is not realistic. This goal should be pursued so that such systems would be realised to some practical extent, in the course of development of individual projects to construct or improve individual communications systems. In order to achieve the anticipated goal, however, it is desirable that a master plan be designed for an integrated communication system, so that the development of individual components of the system is compatible with other components. As part of this overall master plan, certain protocols should be prepared, e.g. planning of appropriate emergency frequencies.

4.3.3 Amateur Radio Network

In the event that the major communications network is interrupted or disabled, amateur radio operation is helpful in reporting the disaster status. Since the number of amateur radio stations in Nepal is extremely small or negligible, it is suggested that the governmental entities concerned should promote the widespread use of the amateur radio stations that can then cooperate and contribute in an emergency. By forming the Nepal Amateur Radio League (NARL), the activity by amateur radio operators will fulfil its function of assistance and contribution to the official relief work.

4.4 Direction, Control and Coordination of Response Operations

4.4.1 Direction and Control

In a crisis, in order for response operations to be undertaken with speed and efficiency, everyone must recognise who is in charge, who sets priorities, how decisions are made, and how they are communicated to field personnel and other implementing entities. If a grave crisis confronts Nepal, His Majesty the King may declare or order a State of Emergency and issue such orders as are necessary to meet the situation. Such orders are operative with the same force and effect as law during

the State of Emergency. Accordingly, it is clear that His Majesty retains the power to direct and control all operations in response to a disaster during a declared State of Emergency.

When a disaster appears imminent or has been detected, the Prime Minister or other responsible official should activate the governmental resources necessary to respond. Also, the responsible officials in each governmental entity should activate the necessary personnel. Each governmental organisation should be required to develop procedures for activation and mobilisation of its personnel.

4.4.2 Coordination by the Emergency Control Board

When several or many organisations respond to a disaster, decision-making must be coordinated and centralised. The organisational model for multi-agency response should emphasise coordination rather than a strictly militaristic command and control model. It is envisioned that the proposed Emergency Control Board of the central government should play the primary role in overseeing and coordinating all governmental activities in response to a disaster situation. The Board would be convened by the Prime Minister to share disaster information in support of decision-making for directing and coordinating response, rescue, and relief operations. The Board would supervise and control the actions of the government and coordinate them with district and local authorities as well as non-governmental organisations and international agencies.

In addition, every concerned organisation, either official or private, should establish its own Emergency Control Board (ECB), to be activated immediately after any medium to large scale earthquake occurs, to manage its own response and to coordinate with other responding agencies. Every ECB should have clear assignments of responsibilities among the organisations and clear lines of communication and command as a basic foundation.

To carry out these functions, each Board would be supported by an Emergency Operations Centre (EOC), as an operative facility.

4.4.3 Emergency Operations Centres (EOCs)

The central government EOC is the most important EOC, as it is the focal point for centralising all information about the disaster and response activities, for evaluating and prioritising needs for assistance and equipment, and to provide the basis for effective decision-making and dissemination of information. It serves as the natural focal point for the overall national emergency response as well as for the central

government's response. Also, involved ministries and government companies need to establish their own emergency procedures and EOC.

The central government EOC should be located in Singha Durbar, preferably in the Prime Minister's Office. As for communications systems, commercial lines, army lines, police lines, mobile communication systems and satellite communication systems should be included. A damage-resistant communication system is also needed to transfer the features of any earthquake, i.e. the location and depth of the epicentre, magnitude, and anticipated shaking intensity in each district.

Municipalities and wards should also designate an Emergency Control Board and maintain a facility that the Board can use as an EOC. Ward offices are the most fundamental EOCs, as they are closest to the people and to on-site information about the disaster. The ward level ECB would assess which sites are most affected, who needs what kinds of assistance/help, and mobilise representatives of individual communities to transfer relief work or materials to victims. The Ward EOC would be the focal point for coordination of information and activities at the ward level. However, at this time, most ward offices are very vulnerable to earthquake and do not have any emergency equipment or supplies.

The United Nations in Nepal has established an EOC building in PulChok where all UN organisations are congregated. The primary role of the UN's EOC is to confirm the safety and relief of their staff who are located all over Nepal, though, it would be available for rescue and relief to the citizenry after a while.

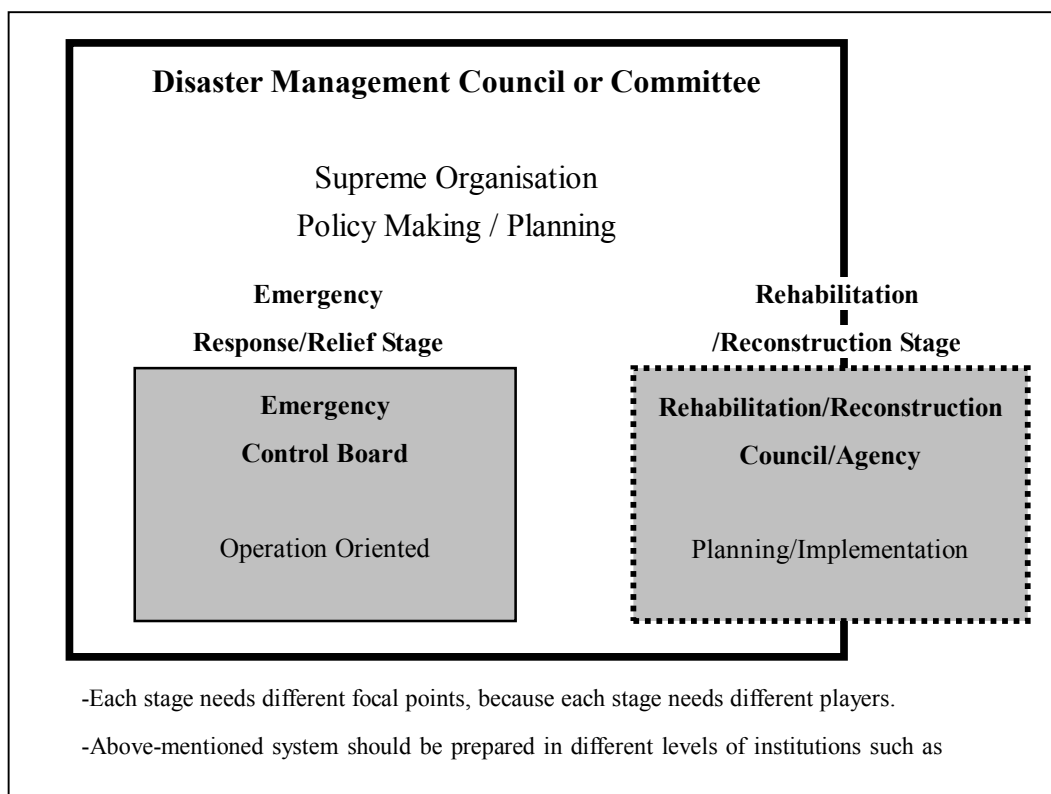


Figure 4.4.1 Special Organisations in Disaster Management Council during and after Earthquake

4.5 Maintain Ability of Governance

It is essential that governmental entities continue functioning during and following the occurrence of a disaster, because all levels of government are responsible for providing continuity of effective leadership and authority, direction of the emergency operations, and management of recovery operations. This requires that they take precautions to protect vital records, develop emergency procedures, and advise employees of their responsibilities and obligations in case of disaster.

4.5.1 Obligations of Officials and Employees of the Government

During a disaster, all officials and employees of the Ministries and other governmental entities should be advised that they are obligated to work and provide the services required by the situation or requested by the Prime Minister or other responsible official, as described 3.2 and 4.4.

4.5.2 Lines of Succession

It is necessary that every government official who has a role in managing disaster response and recovery nominate three alternate officials or staff who can, if necessary, carry out his responsibilities. The National Disaster Management Council and the central government ECB should maintain the succession lists including contact information for the persons who are named.

4.5.3 Preservation of Vital Records

Vital records can be defined as archives that are essential to the rights and interests of individuals, governmental entities, corporations and other entities, including vital statistics, land ownership and taxation files, registries of licenses and permits, articles of incorporation, and historical information. Vital records also include the records that are essential for response and recovery operations, the location of equipment and emergency supplies, personnel lists, etc. They also include the records that are essential to the functioning of the government, such as laws, decrees, court archives, financial records, etc. Each Ministry and governmental entity should be assigned responsibility for identifying, preserving and protecting its vital records, and creating and maintaining copies thereof in a location separate from the original documents.

4.6 Emergency Plans and Manuals

In the Kathmandu Valley, significant emergency planning efforts have been undertaken by three sectoral working groups organised jointly by the UNDP with other international institutions and the Government. This work has resulted in an inter-institutional planning process and draft implementation manuals for logistics, health disaster relief, and food disaster relief. To build on, complement, and integrate with these manuals, the central government and each concerned institution must develop its own emergency plan or manual to define the actions each will take and how they will interact and coordinate with other institutions. In more severe and tragic disasters, the central government has to play the most significant role, due to the overwhelming situation and need for many personnel and vast resources. Therefore, it is essential that a National Emergency Plan be developed to provide the framework for response and relief at each level of government and society. The Emergency Control Board should prepare the draft plan for the approval of the National Disaster Management Council.

Key areas on which to focus these emergency planning efforts include:

- a) Damage and needs assessment
- b) Logistics/acquisition and distribution of relief supplies
- c) Urban search and rescue
- d) Mass care and shelter
- e) Interagency coordination and command and control
- f) Communications and emergency public information
- g) Disaster Medicine

The design for the National Emergency Plan will reflect these criteria:

- a) Be simple and easily understood.
- b) Reflect reality in Nepal.
- c) State clear policies and operational priorities.
- d) Define responsibilities, authorities, and relationships.
- e) Provide systems for inter-institutional coordination.
- f) Provide timely and accurate information to decision-makers and the public.
- g) Involve non-governmental and community-based organisations.
- h) Aim to be widely accepted by involved organisations and the community.

The following key elements should be considered for inclusion in the draft National Emergency Plan. Only simple, critical information should be included, as detailed planning for each of the elements requires at least many months of effort.

EMERGENCYPLAN ELEMENTS

Basic Plan

Organization
Direction and control
Coordination of response operations
Roles and responsibilities
Inventory of resources
Preparedness and warning
Emergency public information

Response Operations

Damage and needs assessment
Emergency communications
Evacuation
Search and rescue
Medical and health care
Firefighting
Security

Restoring Basic Services

Debris removal and disposal
Energy and electricity

Telecommunication

Restoring Basic Services (continued)

Water and sewers
Transportation
Telecommunications

Relief and Recovery

Sheltering
Provisions for victims
Safety inspections of structures
Estimation of damages
Temporary housing
Psychological assistance
Managing donations and volunteers

Appendices

Authorities
Checklists of Roles and Responsibilities
Guidelines for Standard Operating Procedures (SOPs)

4.7 Establish Recovery Operations

4.7.1 Set Policies and Priorities

As in the pre-disaster period, after a disaster strikes, the government and affected community should set goals or guidelines to guide development and the reduction of risk from future disasters. One place to start would be to review the existing priorities and projects included in the National Five-Year Plan as well as District, Municipality, and Village Development Area plans, and evaluate them in light of their potential contribution to immediate recovery and long-term mitigation.

4.7.2 Develop Strategies for Relief and Recovery

In recovery, a community must deal with direct, indirect and less tangible effects of disasters, such as psychological recovery and restoring community services, employment, commerce, and industrial production. Recovery involves decision-making at every level, from individual and family to local and central government to international agencies. Strategies should be developed so that decisions made in the rush to restore normalcy do not have unintended, negative consequences on the welfare of the victims or the country.

4.7.3 Work with the Private Sector

Business and commercial activities rely on urban services including the workforce, transportation, and utilities. Small businesses and local artisans are particularly vulnerable to the effects of a disaster because they do not have adequate savings or access to credit or other resources to retain their customers until they can recover and resume operations. Following a major earthquake, many businesses will go out of business due to damaged facilities, destroyed inventory, lack of access to supplies, electrical power, or telecommunications services, or injury or death of key employees.

Addressing the needs of these affected businesses is essential to the economic well-being of the community. Some of their concerns may include;

- a) The need to relocate (temporarily or permanently) to a usable business location or building,
- b) Identification of government or international assistance,
- c) Use of new materials or types of construction for repairs and rebuilding,
- d) New sources of financial aid for existing or new businesses.

CHAPTER 5 PROTECT LIFE AND PROPERTY OF THE PEOPLE

One of the primary objectives of emergency planning is to protect life and property of the people. In order to protect life and property of the people through effective planning, it is first needed to understand the magnitude of the scenario earthquake and its potential for damage. Only after a better understanding of the factors relating to existing socio-economic problems in the urban structure planning for improvement can be effective.

The structure of this chapter is mainly divided into two sections. The first section deals with the Onsite Activities after the occurrence of the Scenario Earthquake. Each subsection covers the detailed scenario from the earthquake in the respective topic, based on the problems identified in the present status, followed by the proposals for improvement in order to protect life and property. The probable difficulties during the search and rescue operations are presented, including International Rescue. The underlying problems in the present status of important components of onsite disaster management activities such as medicine, drinking water and food, shelter and temporary housing, public health care etc. are then discussed. The sensitive social issue of cremation is discussed briefly, along with other key functions as security, fire-fighting, management of volunteers, safety inspections of structures and infrastructure, and debris removal and disposal.

The second section of this chapter covers the logistics required to support the Onsite Activities. The transportation system and power supply must continue to function in support of onsite activities of search and rescue and other socio-economic activities. The existing conditions of these factors are discussed, identifying any underlying problems, and the scenario of damage to these facilities is discussed. Proposals are then made such that these facilities for logistics during onsite activities can provide better support.

5.1 Search and Rescue

It will be extremely difficult to conduct search and rescue activities for the earthquake victims in the Kathmandu Valley. Rescue needs will be very high in the Old City Core of Kathmandu and Bhaktapur. In these areas, when people are entrapped under collapsed buildings, search and rescue within 72 hours (the period within which survival can be expected) will be almost hopeless because of the lack of heavy rescue tools and machines.

Generally speaking, the major suppliers of human and material resources for search

and rescue activities from the public sectors are the military, police and fire fighters. However, compared to the expected earthquake damages, such organisations are relatively powerless, even if they are fully activated.

In view of the inadequacy of public sector search and rescue capabilities, it will be necessary to rely heavily on search and rescue activities carried out by inhabitants and community-based sectors. At least concerning manpower (in terms of unskilled rescue workers), there is some potential within the Valley. However, because of the lack of search and rescue equipment, their contribution will be limited to light rescues which can be conducted without any heavy equipment. Concerning heavy rescue for the people entrapped within the structures, without some heavy industrial vehicles or equipment, unskilled manpower will not be able to conduct search and rescue activities.

It is not practical to stockpile light equipment in residences and similar structures due to the likelihood of collapse. For heavy rescue, industrial machines and vehicles are essential. However, because of the economic situation of Nepal as a developing country and the need for ongoing maintenance of the machines and vehicles, their introduction will not be well suited to the Nepalese situation.

5.2 Acceptance of International Rescue

From a realistic viewpoint, the most significant heavy rescue provider will be international disaster relief teams from various foreign countries. The biggest rescue team will be sent by India, and the Indian Army will be the major component of it. However, a large-scale earthquake in the Kathmandu Valley would also cause some damages to India, and the overland route to the Kathmandu Valley (from the Nepal/Indian border through the Tribhuvan highway) will be seriously damaged by landslides.

Although there must be some rescue teams arriving via air routes from industrialised countries such as the United States and Japan, whether Tribhuvan International Airport may function or not will be critical. Also, the number of rescue workers, heavy industrial machines and vehicles for search and rescue, and the amount of relief goods received will be heavily dependent on the extent and manner in which the international media treat the earthquake disaster and the damages caused.

Concerning international rescue operations, there are some channels for requests and acceptance, such as 1) within the United Nations system, 2) within the International Red Cross and Red Crescent movement, 3) on a bilateral basis, 4) by

NGOs, and 5) others. However, it can be expected that coordination among all rescue providers will be an issue. It is probably not realistic to expect HMG of Nepal to coordinate all such activities. In the case of the 1993 landslide, UNDP (leading agency within the UN system for disaster relief) conducted inter-agency coordination activities (even among HMG agencies).

5.3 Disaster Medicine

In the acute stage of the disaster (and also in post-acute stage), medical activities within the Kathmandu Valley will be very limited and insufficient. Moreover, this lack of medical resources will continue for years after the earthquake. The main reason for this situation will be the collapse and loss of function of hospitals.

Once building and functional damages occur in hospitals, because of the lack of budget for repairs, the low level of medical services will continue for several years after the earthquake and recovery will take many resources. In the meantime, continued assistance will be required. In addition, it should naturally be assumed that not only hospitals but also clinics, medical workers' residences, dormitories and so on will suffer serious damage. However, a suitable counter measure does not exist at present.

Concerning educational and training programs for disaster medicine and medical workers for disasters, these have been started but are only in a beginning phase. Much foreign aid in the field of medical care for the Nepalese people tends to focus on primary health care (safe drinking water, mother-and-child welfare, etc.) and not on disaster medicine, because primary health care is a more urgent concern than disaster medicine.

There are some positive efforts to establish disaster medicine training courses in Nepal. WHO and the Epidemiology and Disaster Control Division, DOHS, MOH conducted computer-based, desktop, and mock mass casualty management simulations. This is one example of the effort for disaster medicine. These training courses should properly reflect and correspond to the daily life of the Nepalese, especially the people in the Kathmandu Valley and other elements of the reality of Nepal.

Concerning medical transportation, there are also many problems. In case of a large-scale earthquake, emergency transportation of the patients will face various and serious difficulties, because there is almost no radio communication system, no Emergency Medical Technician (EMT) on board, no medical equipment, no overall ambulance control system like 911 in U.S. or 119 in Japan.

Shortage of materials and equipment for medical treatments are also critical. In case of an earthquake disaster, one of the most important resources for medical treatment will be water, especially purified water for irrigation of wounds. But, adequately detailed surveys of the emergency public water supply and plumbing of individual hospitals have not been conducted.

The basic concept of disaster medicine is how to maintain the balance of supply and demand of medical services within the disaster area with support from outside the disaster areas. In order to keep the balance, there are two fundamental ways; one is transportation of medical resources from outside toward the disaster area, and the other is evacuation of patients to outside the disaster area. However, the evacuation of patients is not a viable solution, nor is transportation of medical resources toward the Kathmandu Valley, other than on a limited basis and primarily from other countries.

As realistic counter measures, in the short term, stockpiling of equipment and making prior decisions on locations and plans for field hospitals will be suitable. In the longer term, replacement and reconstruction of hospitals around the Ring Road would be a better option.

5.4 Drinking Water and Food

After the earthquake, many people in the Valley would not be able to receive drinking water and food from outside for several days because of damage to water supply pipelines and roads blocked with debris. Although the condition of water and food supplies will be very serious after the earthquake, people in the Valley are relatively tough, compared with people in developed countries, because they generally keep reserves of water and food as mentioned below.

- a) Because of the poor piped water supply condition, many families keep reserves of water in private water tanks with a capacity of 200 litres to 500 litres or underground water storage with a capacity of more than 1,000 litres. Although some of the water tanks will be damaged due to the earthquake, drinking water of about 10 litres would be available for each person in the urban area. The minimum requirement for drinking water to survive in an emergency is said to be 3 litres per day per person, so the people would be able to manage to get drinking water from private water reserves for a couple of days.
- b) In rural areas, shallow groundwater in dug wells and shallow wells will be used after the earthquake almost as normal, since the facilities are simple and will not be seriously damaged.
- c) The staple food of people in the Valley is steamed rice and lentil soup. Most of

the families (except the lowest income group) keep at least polished rice and raw lentils in stock for several days to three weeks, depending on their income level. Enough for about two weeks supply of fuel for cooking stoves, such as kerosene and petroleum gas, is also kept in containers and available to use. It is thereby considered that a subsistence level of food is kept in stock in each house.

- d) In two to three days after the earthquake, debris blocked strategic roads will be cleared, and water tankers will be able to deliver water to major shelter sites and some neighbourhoods. Food supply will also be available, although an extreme rise in prices will occur. World-wide helping hands will also provide food after several days.

In the urban areas, tanked water will be a reliable water source to survive for a couple of days after the earthquake. In order to secure tanked water as much as possible after the earthquake, it is recommended:

- a) to fix the tanks onto the rooftops properly; and
- b) to close the valves nearby the tanks just after the earthquake.

The current habit of storing food and water is well-suited to survival in an emergency, and it is recommended to keep the habit.

In order to realise the above-mentioned recommended points, it is important to enhance the people's awareness of survival in an emergency through information dissemination and education as well as institutional improvement such as monetary support for private water reserve facilities.

5.5 Sheltering and Temporary Housing

To support earthquake victims in the Kathmandu Valley, planning before the earthquake for sheltering and housing the thousands of homeless is an important step for the protection of the population. Through the study of urban conditions in the Valley, sheltering and relocation plans could be formulated in terms of the following three functions in the urban area.

- Function a) Temporary meeting points in and around residential areas for each family such as a small park or safe "chowk(s)".
- Function b) Temporary safe place or facility for the people from many blocks in the community.
- Function c) Large scaled refuge with temporary housing space in the long term and on a regional basis after the earthquake disaster.

Based on the above-mentioned functions, the following should be considered as a development strategy:

- Function a) • The establishment of safe areas and evacuation routes, removal of obstacles, and earthquake drills based on the citizens' participation are important.
- Function b) • Public schools located in the suburbs should be improved.
- Function c) • Periodic identification and confirmation of available land for the large scaled refuge with temporary houses.
- Land use management of unused areas in residential areas.
 - Regularisation/resettlement of squatter houses, that are reported to be 2,000 households in 50 areas inside the Ring Road.

At present, the eligible sites proposed as new urban areas are located at 27 points along the perimeter of the Ring Road, that are more than 3 km to 5 km from the central business district (CBD) of KMC as shown in Figure 5.5.1. The total area of 27 points exceeds 1,500 ha. In those sites, very little urban infrastructure has been constructed. It is however noted that those sites have development potential and will be developed on a long term basis, since the present land use is agricultural land and hill areas only. The sites have advantages in terms of accessibility to the old city core in KMC. It is proposed that the urban functions as mentioned above should be considered carefully during planning and design stages for new urban areas.

5.6 Public Health Care

From the viewpoint of public health, the situation just after a large-scale earthquake will be difficult. There are several important elements in public health, such as maintaining the accessibility of safe drinking water, and assurance and distribution of the food supply. These basic concerns that constitute the foundation of public health care problems will be more important and critical than other public health problems, because in developing countries like Nepal, these basic components themselves should not be considered as granted. Prevention of epidemics, mental health and other concerns that are commonly understood as public health problems will be secondary. Overall, these health care issues in a disaster are closely related to other areas of disaster management.

5.7 Remains and Treatment of Remains

The ceremony of traditional mourning in Nepal is cremation. Generally speaking, about 300 kg of firewood and 3 hours are needed to cremate one corpse. It is said that there are 27 or more cremation sites (Ghate) in the Kathmandu Valley and every ethnic group has their specific cremation site. All sites face the river or small

stream and after cremation the ashes are scattered in the river or stream. Although the ceremony of mourning is the important pause for family members and relatives to recognise the passing of loved ones, the proper ministry of this ceremony in case of a large-scale earthquake disaster will be very difficult. The biggest difficulty will be acquisition and distribution of firewood. There is high potential that the Tribhuvan Highway will be closed by landslides and main roads will be cut off by collapsed heating and cooking. Fuel oil may be used for cremation but the primary usage of fuel will be for vehicles. Therefore, there will be two primary options: group cremation and group burial, with consideration to religion and ethnicity. These religion-based group cremations/burials should be avoided as far as the situation permits because of the mental anguish to the bereaved. However, other alternatives are unlikely. After the disaster, religious leaders with political leaders will decide how to conduct the funeral ceremonies. From a practical viewpoint, group burial is the most feasible.

5.8 Other Key Functions

(1) Management of Volunteers

Initial rescue efforts are invariably performed by local people, the majority being citizens without any special training. However, often the rescuers can become victims when they enter dangerous situations. It is recommended that municipality and national police stationed in the Valley receive orientation and training on how to manage convergent volunteers during disaster response, especially for rescue operations, as well as specialized volunteers such as engineers, amateur radio operators, and computer specialists.

(2) Safety Inspections of Structures and Infrastructure

One of the most important tasks when an earthquake has occurred is inspecting and evaluating the safety of major structures and elements of the infrastructure (such as dams, bridges, and electrical power plants) that potentially may have been seriously damaged in the quake. Essential facilities such as hospitals should be evaluated immediately by engineering personnel. An existing system for inspecting and posting buildings as safe or unsafe can be adopted from California.

(3) Debris Removal and Disposal

A major earthquake in the Kathmandu Valley will create mountains of debris which must be removed and relocated before large-scale repairs and reconstruction can begin in earnest. Temporary sites must be set up to allow for recycling of usable materials; there will be insufficient equipment for collecting, loading, and

transporting debris; access to all rubble-filled areas will be difficult; some debris may be contaminated by hazardous materials; and decisions will have to be reached regarding the location of final disposal sites. Because of these issues, initial discussions and planning should be conducted at the municipality, regional, and central government levels before a major earthquake occurs.

5.9 Transportation System

The main road network inside the Kathmandu Valley consists of corridors, one from east to west and the other from north to south, along with a Ring Road surrounding the cities of Kathmandu and Patan. Several radial roads also exist, some radiating from the city core area and others from the Ring Road. Apart from these, there are urban roads, most of which are narrow, heavily built-up on both sides of the road, less planned and managed and, without any definite standards.

A total of 54 bridges, 33 in Kathmandu District, 10 in Lalitpur District and 11 in Bhaktapur District exist according to the Department of Roads database. Most of the bridges were built with various sources of foreign assistance and hence a uniform bridge design standard does not exist.

The Valley has only one airport and is also the only international airport in the country. The airport is built on terrace deposits with stiff ground. In case of earthquake disasters, if this sole international airport is damaged, not only the Kathmandu Valley but also the whole nation is in danger of complete isolation from the outside world.

The damage to the existing road network from the scenario earthquake was analysed. The weak points of the road network including bridges, were discovered and suggestions were made to rectify the problems.

The road network must continue to function during and after the occurrence of the earthquake, so that lifelines can continue to provide emergency services and to minimise further loss of life and economic distress. The parts of the road network that will play a vital role during an earthquake were identified and termed the **Strategic Road Network** (See Figure 5.9.1) for Earthquake Disaster Mitigation in the Kathmandu Valley. It includes the road network linking the Valley to other parts of the nation, to the international airport and boundaries, to districts, city centres, municipalities of the Valley, and to water sources in and around the Valley, etc. The Ring Road and other basic networks important for conducting socio-economic activities smoothly even after an earthquake were also included in the Strategic Road Network.

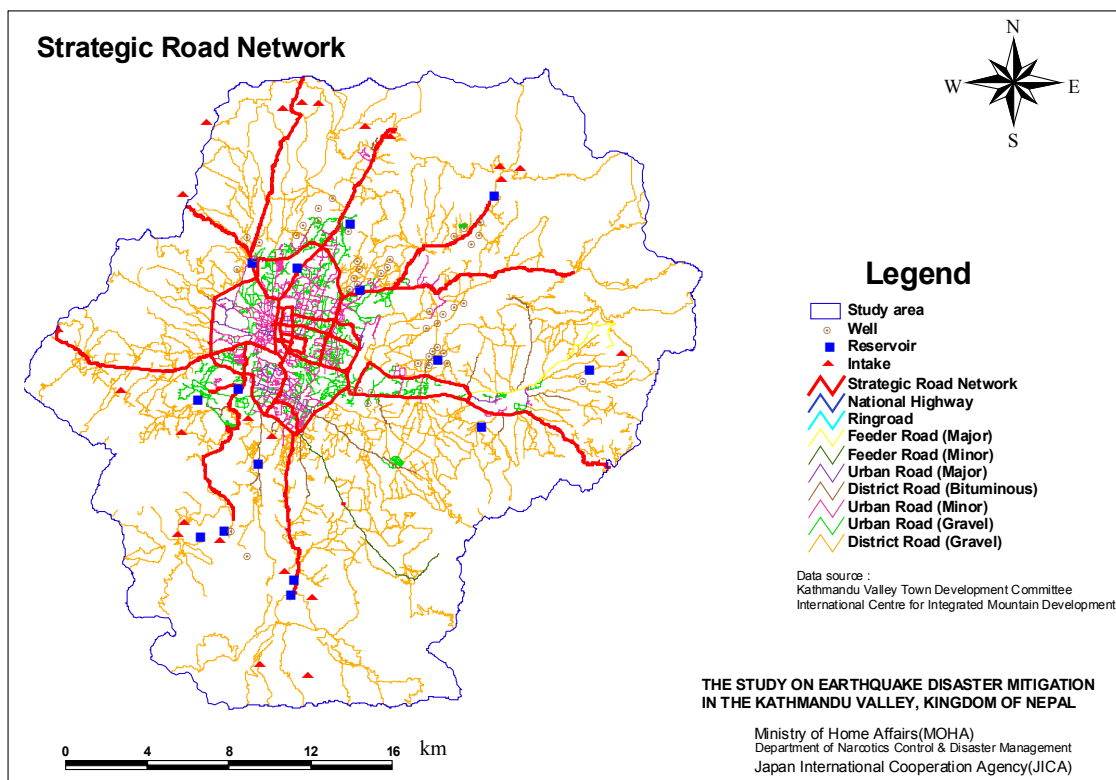


Figure 5.9.1 Strategic Road Network

One of the most important activities after the earthquake is the emergency clearance of debris from the roads. It will not be possible to clear all blocked sections in the road network at once, and it will be necessary to prioritise the work based on their importance. Though priority shall be given to the Strategic Road Network, further prioritising even inside the Strategic Road Network may be needed since the heavy equipment and manpower available for emergency clearance work may be far less than what is required. An example of analysis is given for prioritising the work in the debris clearance plan based on the GIS database prepared in this study.

Similarly, the problem arising from the damage to bridges was also addressed and the necessity of constructing temporary access roads as well as bridges was observed.

During the emergency response and relief phase, gathering information and assessing the extent of damage and response planning based on the gathered information will be required for smooth and safe movement of traffic. However, a responsible organisation does not exist at present to undertake such important activities.

Establishment of a responsible organisation to maintain a database of information on the road network is recommended to undertake the above mentioned activities. Another recommendation is to secure enough temporary bridges (Bailey bridges) that can be constructed in a short time at the place of bridge collapse during

earthquake disasters.

5.10 Electricity Supply

Most of the hydropower generating facilities in Nepal are interconnected to the Central Nepal Power System (CNPS) by 132 kV or 66 kV transmission lines. This interconnected system is operated following instructions of the Load Dispatching Centre (LDC). When a failure occurs, the operation of all switches is done under the instructions of LDC. The city area of Kathmandu and Patan is covered by a Ring Main System of 11 kV line connecting most of the distribution substations. From the distribution substations, 11 kV primary distribution Feeder Lines are used to supply power to consumers on low voltage of 400 V/ 230 V through 11 kV / 400 V-230 V pole mounted transformers.

From the results of the damage estimation, the damage to the power supply lines caused by the scenario earthquake was concentrated more in the city core areas of the Valley. It was primarily due to the fact that the city cores had the highest density of power supply lines.

The residents of the Valley are used to frequent power failures every rainy season and thus can ironically be presumed to be less vulnerable in their social activities to power failures during earthquake disasters also. However, important facilities like hospitals, government buildings and other agencies that have to take active roles during earthquake disasters, are recommended to provide themselves with sufficient alternative power sources such as auxiliary generators.

A brief discussion is also made regarding various alternative power generation/sources (local level and not national level) like solar, wind and diesel generators. Solar and wind power generations were found to be less practical and diesel generators may be more practical in the present context as a sustainable alternative power supply to individual organisations during earthquake disasters.

Establishment of a responsible organisation to prepare and manage a database system as well as gather information, assess the extent of damage to the electricity network, and conduct response planning and management for smooth operation and maintenance during a disaster, is also recommended.

5.11 Allocation and Prioritisation of Staging Areas

In a great disaster, rescue and relief work will need to be undertaken in many locations, requiring the establishment of staging areas for the management and coordination of rescue and relief personnel including volunteers and enormous

amounts of goods and supplies, including international donations. Some staging areas will be located near the source, such as Tribhuvan Airport, where international rescue and relief teams and goods will arrive. The International Convention Centre would also provide a good staging area for Kathmandu and Lalithpur Municipalities, as it provides a large area where stockpiles of supplies can be secured and controlled. There may be a need for additional staging areas where volunteers and other rescue or relief personnel can gather, check in, be assigned equipment and tasks, and report back for food and rest when their tasks are fulfilled.

In addition, various other types of operations will have to be located in available open space areas, including temporary sheltering and feeding, triage sites and field hospitals for the injured, temporary morgue sites for identification of the deceased, and temporary dumping sites for debris to allow for recycling and recovery of household goods. Because of these and other potentially conflicting needs for open space, it is advisable to identify potential needs and evaluate potential sites in advance. This will allow the characteristics of the sites, such as proximity and road access to the airport, the city core and other high-risk areas, to be best matched with their potential uses.

CHAPTER 6 STRENGTHEN SOCIO-ECONOMIC SYSTEM

Urban societies are highly dependent on the socio-economic infrastructure. Even damage at only one point of an urban system will initiate a chain reaction, which increases and expands to affect the functioning of the urban society. This has a long-term effect on the sustainability of the development process. This points out the vulnerability and weakness of urban societies.

The Kathmandu Valley is home to the national capital city, and it bears various important functions. The Valley is in the process of rapid urbanisation. Once a major earthquake hits, it would affect the social and economic functions, as well as physical infrastructure. Moreover, by affecting the capital city, the damage will have far-reaching consequences.

In case of disaster, there are always direct and indirect economic losses. The direct economic loss is primarily the damage to buildings and infrastructure, which is doubled due to functional loss and the cost of recovery. Strengthening social stock and their functions will lessen economic losses that will generate ripple effects.

The cost of disaster losses as a percentage of total assets or of national wealth is higher in developing countries such as Nepal. The environmental and poverty effects should be considered as well.

Development is “the process by which a nation’s capacities are increased and its vulnerabilities reduced.” Any development investment should include concrete measures to improve the nation’s capacity to cope with disasters. Disaster mitigation, incorporated into development planning, is an important step to achieve sustainable development.

To secure the budget, effective linkages among the economic, industrial and financial circles is necessary. Infrastructure is a crucial issue to take interlinked urban systems and city structures into consideration. Some facilities and services are susceptible to disasters, and others are nuclear to the city. Steady steps should be made for reinforcement with regard to the budget and priority.

6.1 Building Structures

Nepal has suffered losses of life and property due to earthquake over 10 times since the 12th century. Although the Draft National Building Code of Nepal (NBC) was already prepared in 1994 following the 1988 earthquake, it is not yet being enforced. The structural regulations of the Draft NBC provide the seismic design method for the mid-class earthquake of VI to VII in MMI (Modified Mercalli Intensity).

(1) Status of Building Structures

Most of the existing buildings have problems regarding earthquake resistance as mentioned below.

a) Reinforced concrete with/without masonry wall (RC)

RC buildings are most common buildings being constructed in the last 20 or 30 years in urban areas. Although most building owners and constructors think that RC buildings are safer and strong enough, most buildings are designed without a structural engineer and are constructed with supervision by unskilled craftsmen/masons who have no fundamental practice or structural knowledge of RC work. The initial plan such as the size of columns and beams was probably for three-story buildings, but existing RC buildings extend up to four to six stories without strengthening the columns and beams, which may be due to the rapid increase of the urban population. Furthermore, the floors of the second and upper stories on the roadside extend beyond the floors of the lower stories. The walls of the widened floors are supported by cantilever beams and are located outside the RC frames. The latter case in particular has high fragility in case of a great earthquake.

b) Brick masonry buildings (BC and BM)

BC buildings, built also in the past 20 or 30 years, comprise more or less half of the buildings in the Valley. This type of building is still poor regarding horizontal rigidity due to poor workmanship and lack of structural consideration regarding the joints from wall to wall, wall to wooden floor and roof, and non-integration of the masonry wall itself. Although buildings of this type less than four stories are generally constructed with suitable workmanship and good wall balance, those of more than four stories have high fragility during a great earthquake.

BM buildings still remain in urban and rural areas. These buildings have very poor horizontal rigidity because of the low bond strength and high absorption of moisture in the mud joints, and the wooden floors and roof. During a great earthquake, BM buildings of less than three stories seem fragile and BM buildings of three stories or higher seem more fragile.

c) Adobe and stone buildings (AD and ST)

AD and ST buildings have high fragility during a moderate earthquake.

d) Structural mixed type

Buildings with AD or BM for lower stories and with BC or RC for the upper parts

are vulnerable because of over-weight upper parts and weak lower parts. These buildings have fragility against a moderate earthquake.

e) Hospital buildings

According to visual inspection, seismic evaluation and retrofitting work will be necessary.

f) School buildings

Two thirds of the public school buildings are made of masonry with mud joints and the seismic resilience is expected to be low.

g) Public buildings

It is roughly estimated that large scale or new buildings are mostly improved, but smaller or older buildings, which are mostly unimproved, are fragile to earthquakes.

h) Historical buildings

There are many historical buildings of mainly the Newar style in the Valley. There are many vulnerable houses with heavy deterioration of the adobe and the mud joints without seismic consideration.

(2) Recommendations for Improving Buildings

The Valley has a wide variety of buildings located in both urban and rural areas that have high fragility during great earthquakes. The following items for improving buildings against great earthquake are recommended.

a) Establishment of building construction system and suggestions on the Draft National Building Code of Nepal (NBC)

The most effective and urgent measure is to implement the Draft NBC within the next fiscal year throughout Nepal. Establishment of responsible and trustworthy building/construction institution and systems is also an effective measure.

- Education, training and drills.
- Establishment of registers and license system with incentives.
- Revision of the Draft NBC on re-evaluation of structural performance factors, revision of sizes for plinth beams, columns and reinforcing bars.
- Guidelines and their dissemination: Some fundamental and detailed improvements in the construction stage can be accomplished by a small effort one by one, and thus providing effectiveness in seismic resistant force.
- The building construction system should include all the stakeholders such as owners, builders, engineer and officers.

b) Recommendations for BM, BC and RC buildings

- Structural engineers should review and design all structural types of buildings.
- Construction supervisors should manage and guide correct construction processes considering earthquake resilience.
- The number of stories has to be kept to less than four, and specific design has to be provided for additional stories.

c) Recommendations for AD and ST buildings

AD and ST buildings need to be significantly improved regarding seismic capacity against great earthquakes. Besides reinforcement, replacement with BC or RC structures is recommended for some old and deteriorated AD and ST buildings.

d) Recommendation for hospital and public buildings for government offices

Since hospital and public buildings for government offices must perform as the centre of relief activity in an earthquake disaster, they are recommended to be evaluated and to be improved for further strengthening.

e) Recommendation for school buildings

School buildings in Nepal are made of very poor structures without seismic design nor proper maintenance. Since schools are the site of education of children as well as for local communities, urgent investigation and necessary strengthening or rebuilding must be conducted.

f) Recommendation for historical buildings

Historical and traditional buildings have not only cultural and religious values, but are utilised by people in their daily lives. For this reason, these buildings have to be maintained and retrofitted to be made safer against earthquakes.

6.2 Transportation Facilities

Three conceptual approaches to strengthen the road network system of the Valley against earthquake disasters are presented, which are:

- a) Roads to improve access to the Valley (roads outside of the Valley),
- b) Roads to improve mobility inside the Valley,
- c) Bridges.

Review of the master plan studies was also done corresponding to the above two cases and the following proposals are made:

- a) Roads to improve access to the Valley:
 - Kathmandu – Naubise Alternate Road Project: The Feasibility Study was

recently completed in March 2001 by JICA and the implementation is proposed as soon as possible since it is very important as a short-term measure.

- Naubise – Narayanghat Road Disaster Mitigation.
 - Kathmandu – Terai Alternate Road (long-term measure).
 - Construction of Second International Airport (long-term measure).
 - Sindhuli Road Construction Project (under construction by Japanese Grant).
- b) Roads to improve mobility inside the Valley.
- Widening of Arniko Highway inside the Valley.
 - Widening of Ring Road.
 - Construction of outer Ring Road.
 - Construction of inner Ring Road.
 - Upgrading and maintenance of the radial Feeder and District Roads.
 - Construction of parking lots and traffic management plan of the urban areas.
 - Improvement of intersections in the urban areas (first phase under implementation by Japanese Grant).
- c) Bridges.
- Strengthening of bridges in the Valley against earthquake disasters.
 - Preparation and implementation of earthquake resistant design manual for bridges.

6.3 Electric Power Supply Facilities

An evaluation of the master plan studies on the transmission and distribution network in the Valley was performed. At present, there are mainly three substations (Syuchatar, Balaju, Bhaktapur) in which the power supply from the power stations is transmitted to the Valley mainly through 132 kV transmission lines. Additionally, Chapali and Matatirtha substations are under construction for this purpose and the connection of all these substations through 132 kV line, forming a Ring Main System of 132 kV, is also under construction. This will provide a stable transmission system in the Valley.

The voltage is then dropped to 66 kV and transmitted to other distribution substations, mainly four in Kathmandu Metropolis (Teku, Lainchaur, Chabahil and New Baneshore) and to Patan and Thimi substations in the respective areas. Though there exists an 11 kV Ring Main System among most of the distribution substations, the above mentioned main four distribution substations of Kathmandu Metropolis are not connected. Hence, an Inner Ring Main System is proposed among these four substations to provide a more reliable power supply in the city core areas of Kathmandu Metropolis from the viewpoint of earthquake disasters.

Other recommendations include preparation and implementation of earthquake resistant design manuals, study of the possibility of constructing more underground distribution systems in highly urbanised areas, and preparation and training of personnel for an effective technical support system, etc.

6.4 Water Supply and Sewerage Facilities

The condition of the water supply and sewerage systems in the Kathmandu Valley is very poor. The network system is very complicated since it was constructed through many different periods, some dating back to as much as 100 years ago. The network has been expanded with no definite plan other than to meet the increasing demand in newly constructed areas. Adding more to the problem is that there is very little information on the location and condition of the existing network.

At present, water is supplied to the Valley from in-Valley sources that include a number of small storage facilities, river sources, springs and spouts, and ground water, and a total of seven water supply systems under the jurisdiction of the Nepal Water Supply Corporation (NWSC). Similarly, sewerage facilities consist of four existing sewage treatment plants under NWSC and another two under Kathmandu Metropolitan City.

Though there has been a tremendous volume of study reports on the water supply and sewerage sector of the Kathmandu Valley, the most important one is the study on the Melamchi Water Supply Development, which is now at the implementation stage. This is a unique study to this date in terms that it is the first approach to consider the water supply to the Valley from an out-of-valley source. The scope of the project includes construction of a diversion scheme, water treatment plants, Bulk Distribution System (important aspect in terms of earthquake disasters also), distribution network improvement, and wastewater system improvement. The project is funded by a number of international agencies including ADB, OPEC, JICA, JBIC, IDA, NDF etc. The initial capacity of the project is 170 MLD (Milliom Litre per Day) of water supply with a plan to increase to a maximum of 510 MLD in the long term.

Although a major overhauling of the water supply and sewerage network system is expected to be covered by the Melamchi Project, securing a water supply distribution system by water tankers, preservation of existing wells and spouts at the local level, and preparation and implementation of earthquake resistant design manuals (during the Melamchi Project itself) are also proposed.

6.5 Telecommunications Facilities

The communications facilities are composed of various kinds of sub-system equipment installed indoors and outside buildings. There is a need to thoroughly examine the status of public communication, TV, radio, and police communications installations with respect to crisis management. Subsequent actions necessary for them to withstand a strong earthquake would then need to be taken. From the network layout point of view, it is ideal to establish the multiple diversity routing composition (SDH loop system), which prevents circuit unavailability and is expected to create a reliable network against disaster. In the Kathmandu Valley, the trunk network uses an SDH system except the long distance transmission system. NTC aims at application of SDH (Synchronous Digital Hierarchy) for the long distant transmission system in the master plan but it has not yet been realised.

In terms of equipment reinforcement, the only necessary measure is to secure it to the floor, wall and/or ceiling to protect it against falling down during the earthquake. By this reinforcement, indoor equipment has sufficient resistance to the earthquake.

For outside installations, especially aerial cable and antenna supporting structures, it is necessary to thoroughly examine the resistance to earthquake.

The ideal situation would be to establish all at once an integrated communication system for disaster management, all in one project; however, it is not realistic. This goal should be pursued so that such systems would be realised to some practical extent, in the course of development of individual projects, to construct or improve individual communications systems. In order to achieve the anticipated goal, however, it is desirable that a master plan be designed for an integrated communication system, so that the development of individual components of the system is compatible with other components. As part of this overall master plan, certain protocols should be prepared, e.g. planning of appropriate emergency frequencies.

6.6 Urban Structure

It is necessary to implement a strategy for development and reinforcement of the urban structure, considering the characteristics of city structures of Kathmandu Municipality and surrounding areas. In this Study, Kathmandu Municipality was divided into eight zones and clarified functions, by reviewing a master plan of the Kathmandu Valley Town Development Committee and performing reconnaissance and having discussions with concerned organisations. The characteristics of the urban structure (land use) are shown in Figure 6.6.1 and summarised for Table 6.6.1 below.

Table 6.6.1 Zoning and Characteristics

Zone	Characteristics
A1	The area between Durbar Square and Tundikhel Plaza (120 ha), the most densely populated area in the city (700 to 1,100 persons/ha.)
A2	The area stretches from the low land on the east bank of the Bishnumati River, and downtown Chetrapati on the west hillside up to Thamel which is surrounding the area of A1(500 ha.), a highly populated area (400 to 700 persons/ha.).
B	The area surrounding the Tundikhel Plaza (15 ha.).
C	The Government offices area.
D	The tourism centre area (bus terminal, tourist information area).
E	Large scale agricultural fields mixed with sprawling individual residential development. Relatively low density compared with the city centre.
F	Encompasses long strips of land for recreational use (river bank).
G	Suitable vast land for future development of new settlements of the next generation for self-contained communities in earthquake resistant new towns.

The following are the disaster mitigation measures targeted for intensive development of the disaster-resistant city structure, which are based on suggestions of “Development Plan 2020” (KVTDC).

(1) Assignment of Intensive Development Areas for Disaster Prevention

Several separate areas within the city centre of Kathmandu should be designated as intensive development areas for disaster prevention by strengthening the urban structure. Securing emergency evacuation routes and preserving evacuation areas in some areas of the city are effective measures that can be applied to Kathmandu. Each of these areas should be installed with facilities to reinforce the city against disasters. The designated area is expected to be in Area A-1, B, and C.

The following systems would be developed to link city core areas, concerning utilisation and implementation of public open space.

- To promote “public space centres” by constructing seismic safer facilities in future.
- To create green-belt networks and promenades by utilising public open space in front of public buildings.
- To designate “Rescue and Relief Network Roads”, which link small evacuation areas.
- To ensure spatial continuity of “Rescue and Relief Network Roads”.
- To prioritise implementation plan of lifelines.

The above mentioned systems shall be promoted to be realised as urban facilities of disaster mitigation information and communication centres by government and municipality initiatives with participation of the private sector.

(2) Controlling Unplanned High Density Areas

At present, unplanned urban sprawl and high-rise buildings are the main cause of earthquake vulnerability increase in the city. For a safer city, designation of “Areas

for utilising open spaces” is recommended. “Areas for utilising open spaces” shall be located in the fringe area of the city, and multi-purpose public use will be encouraged. The most feasible area is in Area A-2, D, and E. Guidelines will be decided. The plan will be developed involving landowners, and a cooperative development method is recommended with the participation of central government, municipalities, and the public sector. The following are concrete suggestions.

- a) Evacuation networks and reserving small open space shall be included in the plan. (Area A-2, Bhimsensthan Case has been delineated as a case of a completed local area plan. See Figure 6.6.2)
- b) Promote land pooling including selection of possible land areas, phase wise implementation.

(3) Temporary Land Use Plan in Satellite Cities

The four satellite cities of Kathmandu (Lalitpur, Bhaktapur, Madhyapur-Thimi, Kirtipur) have highly inhabited city core areas. They are at high risk of road blockages. Under the local area plans for these cities, evacuation and rescue bypass routes should be available in more than one alternative course. In case of road blockages, rescue bypass routes are proposed in order to ensure passage to outside areas.

Rescue bypass routes enable heavy vehicles for rescue and relief to pass. The route connects from designated emergency roads to the densely inhabited areas, through farmlands. These areas can be used for evacuation routes. In normal times, the space is used for farmland and open space right under the transmission lines, which limits construction of buildings. Therefore, definition of the temporary land use in the city planning process would be necessary. Furthermore, to ensure the space for temporary roads, those areas, which the land owner has agreed for such usage, would be recommended to be reserved for greenery promenades (See Figure 6.6.3 Area F).

(4) Designation of the Green Belts and their Placement in the Land-Use

It is necessary to control, manage, and operate the possible residential areas. It is necessary to take urgent measures in Area G to establish regulations and land use mechanisms for wider areas.

(5) Realising Safer Cities

The above mentioned basic concepts focused on disaster management issues in smaller zones, based on the recommendations of the “Development Plan 2020.” Concrete local area plans need to coincide with Land Use Zoning 2001, which is the future land-use plan of KMC, and KMC Urban Development Strategy 2001.

Concrete policy guidelines for re-development planning in the city core areas, satellite cities, and future development remain to be developed as a long term national plan. Since capital and satellite cities in the Kathmandu Valley are all historical and old, creation of new open spaces for parks and green belts is essential.

In implementing the above mentioned development projects, the collaboration of the citizens, NGOs, and private organisations is required for realising safer city structures along with effective legal institutionalisation and intensive implementation of the urban facilities.

6.7 Other Issues

6.7.1 Socio-economic Influence

Although Nepal is categorised among the Least Developed Countries (LDC) with a GDP per capita of around US\$ 200, Nepal's main sector, agriculture, is self-sufficient. The latest national GDP is approximately 400 BNRs (Billion Nepalese Rupees, equivalent to 667 Billion Japanese Yen), and agricultural production accounts for 40 %, which is followed by tourism, another major industry of the nation. There is a deficit in the trade balance due to a surplus of imports, in particular clothing and food from India. Securing the distribution networks based on roads and trucks as the main mode of transportation at the time of the earthquake disaster, is the primary issue to be confronted. Annual expenditures of the government amount to 60 BNRs (100 BJPY), including overseas grants, aid and loans. The accumulated overseas loans are estimated to be 195 BNRs (325 BJPY) in 2001, which presents a serious problem.

The economic losses caused by the earthquake in east Nepal in 1988 have hampered development of the nation and amounted to 5 BNRs (8 BJPY). In the event of the Mid Nepal Earthquake, the total cost of damage to the whole nation is estimated to be 300 BNRs (500 BJPY), which is equal to 70 % of the GDP, five times the national budget, and 1.5 times the accumulated loans. Moreover, disasters will result in commodity price inflation, confusion, and both economic and social disorder. The people who suffer most from disasters are almost always the poorer people in the society. Increasing demands for reconstruction may bring about monetary deficits and result in inflation.

Consequently, the fundamentals of the national economy will be endangered. Strengthening of the economic base and establishing crisis management systems are the most reasonable devices for avoiding a critical situation. Promoting the export industries of agriculture and tourism is an effective primary step along with constructing a safer city structure through urban and regional planning and

provision of stronger infrastructure.

6.7.2 Vulnerable Groups in Disaster

The Kathmandu Valley has been undergoing an urbanisation process. Those who engage in agriculture are gradually decreasing, and urban dwellers are rapidly increasing. Furthermore, Nepal is a world tourist destination; hence special consideration should be given to the tourist trade. When an earthquake disaster occurs, these and other groups will have specific needs as those affected may not have proper access to food, accommodations and information.

Past earthquake experiences in Nepal and elsewhere indicate that the elderly, infants, children, patients, pregnant women, and the poor present special needs in disasters. Preparation and dissemination of information regarding potential disasters, evacuation routes, and plans for crisis management and relief for victims will reduce the impact on the people at the time of the disaster.