

# NATIONAL DISASTER MANAGEMENT GUIDELINES

## MANAGEMENT OF FLOODS



January 2008



NATIONAL DISASTER MANAGEMENT AUTHORITY  
GOVERNMENT OF INDIA

# National Disaster Management Guidelines

## Management of Floods



# National Disaster Management Guidelines

## Management of Floods



National Disaster Management Authority  
Government of India



# Mission

To minimise vulnerability to floods and consequent loss of lives, livelihood systems, property and damage to infrastructure and public utilities.



# Contents

---

<i>Mission</i>	V
<i>Contents</i>	VII
<i>Foreword</i>	XI
<i>Acknowledgements</i>	XIII
<i>Abbreviations</i>	XV
<i>Executive Summary</i>	XIX
<i>Overview of the Guidelines</i>	XXIX
<b>1 Floods-Status and Context</b>	<b>1</b>
1.1 The Flood Hazard	1
1.2 Regions in the Country Prone to Floods	2
1.3 Flooding/Drainage Congestion/Erosion in Andaman and Nicobar Islands and Lakshadweep	3
1.4 Flash Floods	3
1.5 Areas Prone to Floods	4
1.6 Damages Caused by Floods	4
1.7 Drainage Congestion and Water-logging	5
1.8 River Erosion	5
1.9 Urban Flooding	6
1.10 Littoral Drift in River Estuaries	6
1.11 Snowmelt/Glacial Lake Outbursts, Formation and Subsequent Bursting of Landslide Dams	6
1.12 Monsoon/Cyclones/Cyclonic Circulations	7
1.13 Cloudbursts	7
1.14 International Dimensions of the Flood Hazard	7
1.15 Past Initiatives of the Government of India	8
1.16 Implementation of the Recommendations of the Experts' Committees/Working Groups/Task Forces	9



## CONTENTS

1.17	Achievements in Respect of Flood Management	10
1.18	Gaps in Flood Management	10
1.19	Approach to Guidelines	11
1.20	Action Plan	13
<b>2</b>	<b>Institutional Framework and Financial Arrangements</b>	<b>14</b>
2.1	Constitutional Provisions	14
2.2	National Institutions/Agencies	14
2.3	State-level Organisations	20
2.4	Techno-economic Appraisal of Flood Management Schemes	22
2.5	Funding of Flood Management Schemes	22
2.6	Flood Insurance	24
2.7	Action Plan	25
<b>3</b>	<b>Flood Prevention, Preparedness and Mitigation</b>	<b>26</b>
3.1	Introduction	26
3.2	Structural Measures for Flood Management	26
3.3	Inspection, Rehabilitation and Maintenance	30
3.4	Action Plan for Structural Measures	31
3.5	Non-structural Measures	32
3.6	Integrated Water Resources Management	32
3.7	Action Plan for Non-structural Measures	33
3.8	Medical Preparedness	34
<b>4</b>	<b>Flood Forecasting and Warning in India</b>	<b>36</b>
4.1	Concept	36
4.2	Methodology	36
4.3	The Central Water Commission's Flood Forecasting Network in India	37
4.4	Expansion and Modernisation of Flood Forecasting Services	38
4.5	Coordination amongst the Central Water Commission, India Meteorological Department and the States	39
4.6	International Cooperation	39
4.7	Action Plan for Flood Forecasting and Warning	41

<b>5</b>	<b>Dams, Reservoirs and Other Water Storages</b>	<b>42</b>
5.1	Introduction	42
5.2	Natural Detention Basins	42
5.3	Dams and Reservoirs	42
5.4	Regulation of Reservoirs	43
5.5	Dam Safety Aspects	44
5.6	Action Plan	45
<b>6</b>	<b>Regulation and Enforcement</b>	<b>46</b>
6.1	Flood Plain Zoning	46
6.2	Incentives and Disincentives to States for Enacting and Enforcement of Flood Plain Zoning Regulation	48
6.3	Encroachment into the Waterways and Natural Drainage Lines	48
6.4	Bye-laws for Buildings in Flood Prone Areas	48
6.5	Legal Framework for Making Infrastructure Flood Resilient	48
6.6	Survey of Flood Prone Areas	49
6.7	Wetlands: Conservation and Restoration	50
6.8	Watershed Management Including Catchment Area Treatment and Afforestation	50
6.9	Coordination and Enforcement	50
6.10	Action Plan	51
<b>7</b>	<b>Capacity Development</b>	<b>52</b>
7.1	Flood Education	52
7.2	Target Groups for Capacity Development	53
7.3	Capacity Building of Professionals	53
7.4	Training	53
7.5	Research and Development	54
7.6	Documentation	55
7.7	Action Plan for Capacity Building	56
<b>8</b>	<b>Flood Response</b>	<b>57</b>
8.1	Introduction	57
8.2	Emergency Search and Rescue	58
8.3	Emergency Relief	58
8.4	Incident Command System	59

## CONTENTS

8.5	Community-based Disaster Preparedness and Response Coordination among Various Organisations	59
8.6	Involvement of the Corporate Sector	59
8.7	Specialised Teams for Response	60
8.8	Improving Flood Response	61
8.9	Emergency Logistics	61
8.10	Emergency Medical Response	62
8.11	Action Plan for Strengthening Flood Response	63
<b>9</b>	<b>Implementation of Guidelines – Preparation of Flood Management Plans</b>	<b>64</b>
9.1	Flood Management Plans	64
9.2	Flood Management Plans of Central Ministries and Departments	66
9.3	Flood Management Plans of State Governments	66
9.4	Flood Management Plans of Nodal Agencies	67
9.5	Implementation of Flood Management Plans	67
9.6	Action Plan	68
<b>10</b>	<b>Summary of Action Points</b>	<b>69</b>
	<b>Annexures</b>	<b>86</b>
Annex-I/I	Map Showing Flood Prone Areas	86
Annex-I/II	State-wise Break-up of Flood Prone Areas	87
Annex-I/III	Statement Showing Damage Due to Floods/Heavy Rains	89
Annex-I/IV	Estimate of Area Suffering from Drainage Congestion/Water -logging	91
Annex-I/V	Brief Particulars of Important Committees/Working Groups/Task Forces on Flood Management Appointed by the Government of India	92
Annex-I/VI	Important Recommendations of the Rashtriya Barh Ayog as Identified by the Experts Committee and Status of their Implementation	103
Annex-I/VII	State-wise Details of Achievements on Structural Measures	111
Annex- IV/I	Flowchart for Flood Forecasting and Early Warning	112
Annex-V/I	Case Study for Effectiveness of Hirakud Dam in Flood Moderation	113
Annex-VI/I	Model Bill for Flood Plain Zoning	116
	<b>Core Group on Management of Floods</b>	<b>126</b>
	<b>Extended Core Group on Management of Floods</b>	<b>127</b>
	<b>List of Persons who Contributed to the Development of the Guidelines on Flood Management</b>	<b>129</b>
	<b>Contact Us</b>	<b>135</b>



Vice Chairman  
**National Disaster Management Authority**  
Government of India

## **FOREWORD**

India is highly vulnerable to floods and out of the total geographical area of 329 mha, more than 40 mha is flood prone. Floods are recurrent phenomenon, which cause huge loss of lives and damage to livelihood system, property, infrastructure and public utilities. It is a cause for concern that the flood related damages are showing an increasing trend. The average annual flood damage during the last 10 years (1996-2005) was Rs. 4745 crore as compared to Rs. 1805 crore, the corresponding average for the last 53 years. This can be attributed to many reasons including rapid increase in population and urbanisation coupled with growing developmental and economic activities in the flood plains and global warming.

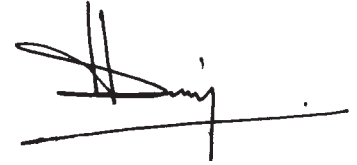
From the past experience, it is observed that though the various Expert Committees/ Working Groups headed by eminent dignitaries have made several useful recommendations/ suggestions, these have mostly remained unimplemented, which is a cause of concern. These guidelines have highlighted those recommendations and actions required to be taken on them.

While formulating these guidelines, we have involved 161 experts from various concerned central ministries and departments, state governments, scientific and technical institutions, academics, professionals and eminent personalities from the society and non-governmental organisations and tried to make the document as comprehensive as possible, so that it provides the desired direction in the work to be done in flood management in the country. The central ministries and state governments can accordingly make their Disaster Management plans based on these guidelines, which will minimise the vulnerability to floods and ensure better preparedness over a defined period of time.

I express my deep appreciation of the commitment of various stakeholders for their wholehearted support and cooperation in the preparation of these guidelines. I would also like to commend the significant contribution made by the Ministry of Water Resources and Central Water Commission and the members of the Core and the Extended Groups, for their long hours of work in drafting and finalising the guidelines.

I also wish to express my sincere appreciation of the efforts of Dr. Mohan Kanda, Member, NDMA, and his team for formulation and finalisation of these guidelines.

New Delhi  
17 January, 2008

A handwritten signature in black ink, consisting of several loops and a long horizontal stroke at the end.

**General NC Vij**  
**PVSM, UYSM, AVSM (Retd)**



Member  
**National Disaster Management Authority**  
Government of India

## **ACKNOWLEDGEMENTS**

I am thankful to the Core Group members for their unrelenting cooperation in the extensive effort that went into the formulation of the National Guidelines for Flood Management by the National Disaster Management Authority (NDMA). I would like to place on record the significant contributions made by the Ministries of Water Resources, Earth Sciences, the Central Water Commission, the India Meteorological Department, governments of the States and the administration of the Union Territories from time to time.

I express my sincere thanks to the representatives of the other central ministries and departments concerned, representatives of the scientific and technical institutions, eminent professionals, the National Institute of Disaster Management, non-governmental organisations and the representatives of the Corporate Sector for their valuable inputs which helped us improve the content and the presentation of this document.


The efforts of Shri S. K. Agrawal, Specialist (Floods), NDMA and former Member, CWC in providing knowledge-based technical inputs to the core group and drafting the report, deserve high appreciation.

I thank Shri H.S Brahma, Additional Secretary and the staff of the NDMA for their cooperation. My thanks are also due to my staff including Sarvashri G .V Satyanarayana, Dr. Pavan Kumar Singh, M. Kankaji, Ms Sajneet Kaur, Sarvashri Anil Kumar and Mahipal Singh Khatana for their help in organising the various workshops, meetings and preparation of this document. I also thank Mr. Sanjay Shrivastva and Ms. Neena Gupta who have helped me in editing the report.

Finally, I would like to express my gratitude to General N.C Vij, PVSM, UYSM, AVSM (Retd.), Vice Chairman, NDMA, and all Members of the NDMA for their patient reading of various drafts, constructive criticism, guidance and suggestions in formulating these guidelines.

It is hoped that this humble effort will prove useful to the Central Ministries and Departments, the States and the Union territories in formulating effective Flood Management Plans that will improve the management of this phenomenon in the future.

New Delhi  
17 January, 2008



**Dr. Mohan Kanda, IAS (Retd.)**

# Abbreviations

---

AICTE	All India Council of Technical Education
AIR	All India Radio
ALTM	Air-born Laser Terrain Mapping
ARMVs	Accident Relief Medical Vans
ARG	Automatic Rain Gauge
ATI	Administrative Training Institute
BCM	Billion Cubic Meter
BIS	Bureau of Indian Standards
BMTPC	Building Materials and Technology Promotion Council,
BRO	Border Roads Organisation
CAT	Catchment Area Treatment
CBO	Community Based Organisation
CBRI	Central Building Research Institute, Roorkee
CBSE	Central Board of Secondary Education
CD	Civil Defence
CFCB	Central Flood Control Board
CFI	Construction Federation of India
COA	Council of Architecture
CPWD	Central Public Works Department
CRF	Calamity Relief Fund
CSR	Corporate Social Responsibility
cumec	cubic meter per second
cusec	cubic feet per second
CWC	Central Water Commission
CWPRS	Central Water and Power Research Station
D	Quarter ending December
DAE	Department of Atomic Energy,
DART	Disaster Assistance Response Team
DD	Doordarshan



## ABBREVIATIONS

DDMA	District Disaster Management Authority
DEM	Digital Elevation Model
DI	Drainage Improvement
DM	Disaster Management
DMA	Disaster Management Authority
DMS	Disaster Management Support
DMP	Disaster Management Plan
DST	Department of Science and Technology
DPR	Detailed Project Report
DRM	Disaster Risk Management
DSS	Decision Support System
DVC	Damodar Valley Corporation
DWR	Doppler Weather Radar
EEP	Emergency Evacuation Plan
EOC	Emergency Operations Centre
EREC	Earthquake Risk Evaluation Centre
FF	Flood Forecasting
FF and W	Flood Forecasting and Warning
FM	Flood Management
FMO	Flood Meteorological Office
FMP	Flood Management Plan
FP	Flood Protection
FRL	Full Reservoir Level
J	Quarter ending June
GFCC	Ganga Flood Control Commission
GIS	Geographical Information System
GLOFs	Glacial Lake Outburst Floods
GOI	Government of India
GSI	Geological Survey of India
ha	Hectare
HFL	Highest Flood Level
HPC	High Power Committee on Disaster Management
HSC	Hazard Safety Cell

HUDCO	Housing and Urban Development Corporation
ICS	Incident Command System
ISRO	Indian Space Research Organisation
IDNDR	United Nations International Decade for Natural Disaster Reduction
IDRN	Indian Disaster Resource Network
IE(I)	Institution of Engineers (India)
IIT	Indian Institute of Technology
IMD	India Meteorological Department
IIA	Indian Institute of Architects
IWRM	Integrated Water Resources Management
M	Quarter ending March
mha	major accident hazard
MEA	Ministry of External Affairs
MES	Military Engineering Services
MFR	Medical First Responder
MHA	Ministry of Home Affairs
mha	million hectares
MHRD	Ministry of Human Resource Development
MOA	Ministry of Agriculture
MOD	Ministry of Defence
MOES	Ministry of Earth Sciences
MOHFW	Ministry of Health and Family Welfare
MOR	Ministry of Railways
MOWR	Ministry of Water Resources
MOSRTH	Ministry of Shipping, Road Transport and Highways
MWL	Maximum Water Level
NCC	National Cadet Corps
NCDM	National Committee on Disaster Management
NCMP	National Common Minimum Programme
NCMRWF	National Centre of Medium Range Weather Forecasting
NDMA	National Disaster Management Authority
NR	National Reserve
NDRF	National Disaster Response Force

## ABBREVIATIONS

NEC	National Executive Committee
NFMI	National Flood Management Institute
NGO	Non-governmental Organisation
NHAI	National Highways Authority of India
NIC	National Informatics Centre
NIDM	National Institute of Disaster Management
NIT	National Institute of Technology
NRSA	National Remote Sensing Agency
NSS	National Service Scheme
NWA	National Water Academy
NWP	National Water Policy
NYKS	Nehru Yuvak Kendra Sangathan
PRI	Panchayati Raj Institution
PVO	Private Voluntary Organisation
QRMT	Quick Reaction Medical Team
RBA	Rashtriya Barh Ayog
RF	Rainfall
RM	River Management
RMC	Regional Meteorological Centre
RR	Rehabilitation and Resettlement
RRC	Regional Resource Centre
S	Quarter ending September
SDMA	State Disaster Management Authority
SOI	Survey of India
SOP	Standard Operating Procedure
SW	South-west
TAC	Technical Advisory Committee
TF	Task Force
UGC	University Grants Commission
ULB	Urban Local Body
UNDP	United Nations Development Programme
WL	Water Level
WAPCOS	Water and Power Consulting Services India Ltd

# Executive Summary

---

## Introduction

Following the enactment of the Disaster Management Act, 2005, (DM Act, 2005) the Government of India (GOI) constituted the National Disaster Management Authority (NDMA) as the apex body for Disaster Management (DM) in India with the mandate, inter alia, for laying down policies and guidelines on DM. At the national level, there is to be a paradigm shift from the erstwhile relief-centric and post-event syndrome to pro-active prevention-, mitigation- and preparedness-driven DM. These efforts will conserve developmental gains and also minimise loss of lives, livelihood systems and property. These Guidelines have been evolved by the NDMA, through a nine-step process. This approach ensures that all contemporary knowledge, experience and information are taken on board, clear destinations are identified, and road maps drawn with milestones duly marked off through a wide consultative process, involving all the stakeholders. Recognising the gravity of the risk and vulnerability of India to floods, the NDMA, soon after its constitution initiated a series of consultations with the various stakeholders to develop Guidelines for strengthening the existing arrangements for flood preparedness, mitigation, and post-flood emergency response, relief, rehabilitation and reconstruction. Senior representatives from the Central Ministries/ Departments and the state governments, related agencies, academics and professionals attended these meetings. The meetings acknowledged that, while several significant initiatives had been taken by government agencies in the past for addressing the risk and vulnerability of India to floods, it is necessary to undertake measures for the evolution of a holistic and integrated strategy to address the critical factors that accentuate flood risk. On

the basis of these deliberations, the NDMA has prepared these Guidelines for Flood Management (FM), to assist the ministries and departments of the GOI, the state governments and other agencies in preparing Flood Management plans (FMPs).

## Vulnerability to Floods

Floods have been a recurrent phenomenon in India and cause huge losses to lives, properties, livelihood systems, infrastructure and public utilities. India's high risk and vulnerability is highlighted by the fact that 40 million hectares out of a geographical area of 3290 lakh hectares is prone to floods. On an average every year, 75 lakh hectares of land is affected, 1600 lives are lost and the damage caused to crops, houses and public utilities is Rs. 1805 crores due to floods. The maximum number of lives (11,316) were lost in the year 1977. The frequency of major floods is more than once in five years. Floods have also occurred in areas, which were earlier not considered flood prone. An effort has been made in these Guidelines to cover the entire gamut of Flood Management. Eighty per cent of the precipitation takes place in the monsoon months from June to September. The rivers bring heavy sediment load from the catchments. These, coupled with inadequate carrying capacity of the rivers are responsible for causing floods, drainage congestion and erosion of river-banks. Cyclones, cyclonic circulations and cloud bursts cause flash floods and lead to huge losses. The fact that some of the rivers causing damage in India originate in neighboring countries, adds another complex dimension to the problem. Continuing and large-scale loss of lives and damage to public and private property due to floods indicate that we are still to develop an effective response to floods. These

Guidelines have been prepared to enable the various implementers and stakeholder agencies to address effectively the critical areas for minimising flood damages.

### Urban Flooding

Flooding in the cities and the towns is a recent phenomenon caused by increasing incidence of heavy rainfall in a short period of time, indiscriminate encroachment of waterways, inadequate capacity of drains and lack of maintenance of the drainage infrastructure. Keeping in view the fact that the problem is becoming more severe and losses are mounting every year, the subject of urban flooding has been recognised by the NDMA as one meriting exclusive attention and separate guidelines for its management are being prepared and will be issued soon.

### Action Plans at Various Levels

These Guidelines have been drawn up in the context of a rigorous risk management framework to ensure the effectiveness of action plans that are developed by various agencies. All key agencies, including the central ministries, and departments, state governments, local bodies including Panchayati Raj Institutions (PRIs), and Urban Local Bodies (ULBs) like metropolitan development authorities, municipal corporations, municipal councils and district authorities will develop detailed FMPs based on these Guidelines. State governments and local authorities will play an important role in the formulation and effective implementation of such action plans. The communities and other stakeholders will play an important part in ensuring compliance to the regulations and their effective enforcement. The State Disaster Management Authorities (SDMAs) will be responsible for reviewing and monitoring the implementation of the action plans at the state-level.

### The Objectives of the Guidelines

These Guidelines rest on the following objectives aimed at increasing the efficacy of the FMPs, which will be prepared at various levels:

1. Shifting the focus to preparedness by implementing, in a time-bound manner, an optimal combination of techno-economically viable, socially acceptable and eco-friendly structural and non-structural measures of FM.
2. Ensuring regular monitoring of the effectiveness and sustainability of various structures and taking appropriate measures for their restoration and strengthening.
3. Continuous modernisation of flood forecasting, early warning and decision support systems.
4. Ensuring the incorporation of flood resistant features in the design and construction of new structures in the flood prone areas.
5. Drawing up time-bound plans for the flood proofing of strategic and public utility structures in flood prone areas.
6. Improving the awareness and preparedness of all stakeholders in the flood prone areas.
7. Introducing appropriate capacity development interventions for effective FM (including education, training, capacity building, research and development, and documentation.)
8. Improving the compliance regime through appropriate mechanisms.
9. Strengthening the emergency response capabilities.

## Earlier Initiatives of the Government of India

Following the unprecedented floods of 1954, the then Union Minister for Planning, Irrigation and Power placed before Parliament on 3 September 1954, the statements on floods which set the objective of reducing the menace of floods. Later on, in a subsequent statement in Parliament on 27 July 1956, the emphasis was laid on doing all that was possible to contain floods in the country. Since then the government has taken various initiatives and set up a number of committees to study the problem and recommend several remedial measures. The most important ones are the High Level Committee on Floods (1957), the Ministers Committee on Flood Control (1964), the Rashtriya Barh Ayog (1980) and Task Force on Flood Management/Erosion Control (2004).

## Institutional Framework

As per the constitutional provisions, FM is a state subject and as such the primary responsibility for flood management lies with the states. The central government has taken various initiatives and set up a number of organisations dealing with the floods. The most notable one is the enactment of the National Disaster Management Act, December 2005 and setting up of the NDMA, which has been assigned to deal with all types of disasters including the floods. The National Executive Committee (NEC) with the Secretary of GOI of the ministry or department having administrative control of the subject of the DM as the Chairman and Secretaries of other ministries concerned and the Chief of the Integrated Defence Staff to the Chairman Chiefs of the Staff Committee (CISC) as Members, will assist the NDMA in the discharge of its functions and ensure compliance of the directions issued by the central government apart from preparing the National Disaster Management Plan. The state governments

are to set up State Disaster Management Authorities (SDMAs) and State Executive Committees (SECs) to perform similar functions at the state level. These are in addition to existing organisations dealing with the floods in the states.

There is a need to set up a central organisation to lay down policy and implement FM measures in consultation with the states and other stakeholders as floods are not confined to one state and flooding in one state leads to flooding in adjoining states. Accordingly, it has been proposed to set up River Basin Organisations to deal with the management of water resources at river basin level. It is also proposed to set up a National Flood Management Institute (NFMI) at an appropriate location in one of the flood prone states, to impart training to engineers, administrators, personnel of the police departments, Non-governmental Organisations (NGOs) and Community Based Organisations (CBOs) etc.

## Flood Prevention, Preparedness and Mitigation

Floods being the most common natural disaster, people have, out of experience, devised many ways of coping with them. However, encroachments into the flood plains over the years has aggravated the flood problem and a need to take effective and sustained FM measures has been felt. Various measures, structural and non-structural, have been taken by the central and state governments and as a result, considerable protection has been provided to the people. However, more efforts are required in this direction and there is a need to put in place a techno-legal regime to make structures flood-proof and regulate the activities in the flood plains of the rivers. Flood forecasting and warning and Decision Support System (DSS) will be established on a scientific basis taking into account the latest technological developments in the world.

## Capacity Development and Flood Response

The central government and the state governments are required to take steps for capacity development for taking effective and sustainable preventive, preparatory and mitigative measures in pre-floods stage and effective and prompt response during- and post-floods stages. Appropriate recommendations have been made in this regard.

## Activities for Minimising Flood Risk and Losses

The activities proposed to be undertaken aim at minimising the flood risk and losses and are to be implemented in three phases in addition to recurring activities.

### Phase-I

These activities include identification and marking of flood prone areas on maps, preparation of close contour and flood vulnerability maps, formulating plans for expansion and modernisation of flood forecasting and warning systems, identification of priority flood protection and drainage improvement works, identification of reservoirs for review and modification of operation manuals and rule curves and undertaking special studies on problems of river erosion. These will be initiated immediately and efforts will be made to complete them in a phased manner with the last of these activities scheduled for completion by January 2010.

### Phase-II

These include implementation of the schemes for expansion and modernisation of the flood forecasting and warning network, execution of flood protection and drainage improvement schemes, modification and adoption of revised reservoir

operation manuals, enactment and enforcement of flood plain zoning regulations and planning and preparation of Detailed Project Reports (DPRs) for storage reservoirs and implementation of the schemes for real-time collection of hydro-meteorological data on rivers in Nepal, Bhutan and China. These activities, which aim at implementation of FMPs, will commence immediately after the completion of the link activities of Phase-I and will be completed by March 2012.

### Phase-III

Implementation of activities, which include construction of dams and catchment area treatment (CAT) works in India as well as neighboring countries, is likely to take considerable time as they entail major environmental, social, inter-state and international implications. These need careful study and interaction with the stakeholders. It is envisaged that all feasible schemes will be completed by the year 2025.

## Recurring Activities

These activities which include inspection of dams, embankments and other structural measures, execution of restoration and strengthening works and expansion and modernisation of flood forecasting and warning systems, are to be taken on a regular basis for ensuring the effectiveness and sustainability of various measures for minimising flood risk.

The relevance and status of various activities will be continuously monitored and reviewed. The activities will be modified, if felt necessary. The preparedness of the central ministries and departments concerned and the state governments will be reviewed in April/May every year and appropriate corrective measures will be taken before the commencement of the monsoon. A post-monsoon review will be held every year in November/December so as to finalise the action



plan for preparatory measures to be implemented before the onset of the next monsoon.

## Flood Management Plans

It is expected that based on these guidelines the central ministries and departments concerned and the state governments will prepare their FMPs which will be holistic, participatory, inclusive, eco-friendly and gender-sensitive in nature and the implementation of which will result in a flood-resilient India. The plans will focus on the community and the collective efforts of the government and NGOs.

## Important Milestones in the Road-map for the Implementation of the Guidelines

### Phase – I (Works to Commence Immediately)

- Mechanism for joint formulation of forecasts by the CWC/IMD/NRSA/states-May 2008.
- Identification of flood prone areas (villages/blocks/tehsils/districts) and marking on national, state and district level maps by the Central Water Commission (CWC)/Ganga Flood Control Commission (GFCC)/Brahmaputra Board and the state governments in collaboration with the National Remote Sensing Agency (NRSA) and Survey of India (SOI) - June 2008.
- Finalisation of plans for expansion and modernisation of flood forecasting and warning systems and development of DSS for management of floods by the CWC, India Meteorological Department (IMD) and the state governments - June 2008.
- Making an assessment of the area suffering from drainage congestion by the state governments- June 2008.
- Making an assessment of the area suffering from erosion by the state governments-June 2008.
- Categorization of flood disaster by NDMA/SDMAs- June 2008.
- Introduction of module on FM in education in schools/technical institutions/defence forces/academies, Administrative Training Institutes (ATIs) etc., by the Ministry of Human Resources Development (MHRD), Ministry of Defence (MOD), Ministry of Home Affairs (MHA), state governments/SDMAs- June 2008.
- Documentation of floods by state governments- June 2008.
- Identification of reservoirs for reviewing and modifying the operation manuals/rule curves by the state governments in consultation with the CWC, GFCC and Brahmaputra Board – June 2008.
- Amendment of building bye-laws to make future buildings in flood prone areas flood-safe by the state governments/SDMAs and ULBs-June 2008.
- Establishing a mechanism for intra-state coordination by the state governments/SDMAs-June 2008.
- Establishing a mechanism for joint operation for reservoirs on inter-state rivers by the state governments/SDMAs – June 2008.
- Establishing a system for monitoring of landslides causing blockages in the rivers, by the CWC/NRSA/ state governments/SDMAs-December 2008.
- Preparation of FM plans by the central ministries and departments- December 2008.



- Preparation of FM plans by the state governments/SDMAs- December 2008.
  - Notification of regulation for prohibiting reclamation of wetlands and natural depressions by the state governments/SDMAs- December 2008.
  - Carrying out special studies on problem of erosion on the rivers Brahmaputra, Mahananda and Gandak by the NDMA in collaboration with the state governments and the CWC/GFCC/Brahmaputra Board – March 2009.
  - Approval and beginning of implementation of National Flood Mitigation Project by the NDMA/state governments – March 2009.
  - Construction of flood shelters by the state governments/SDMAs - March 2009.
  - Identification and preparation of proposals and implementation of priority Flood Protection and Drainage Improvement (FP and DI) works (embankments, anti erosion measures, drainage improvement works and sea walls/coastal protection works) by the state governments in consultation with the CWC/GFCC/Brahmaputra Board – June 2009.
  - Preparation of maps to a scale of 1:10,000 with contours at an interval of 0.5 m/1.0 m and digital elevation model of the flood prone areas by the NRSA and SOI using satellite data and Air-borne Laser Terrain Mapping (ALTM) - June 2010.
  - Preparation of flood vulnerability/flood hazard maps by the CWC, GFCC and the Brahmaputra Board in collaboration with NRSA - January 2010.
- Phase-II (Works to Commence on Completion of Link Activities in Phase-I)**
- Institutionalising the role of CBOs, NGOs, Women's Groups, Youth Organisations, Corporate Houses and other stake holders in flood response by the SDMAs/ Distric Disaster Management Authorities (DDMAs)-June 2008.
  - Reorganisation /reorientation of fire and emergency services, police forces, Civil Defence Organisations (CDOs), home guards for flood response by the SDMAs/DDMAs-June 2008.
  - Raising and operationalising State Disaster Response Forces (SDRFs) by the SDMAs-June 2008.
  - Strengthening/restructuring of the GFCC by the Ministry of Water Resources (MOWR)-September 2008.
  - Strengthening/restructuring of the Brahmaputra Board by the MOWR-September 2008.
  - Enactment and enforcement of the flood plain zoning regulation by the state governments – December 2008.
  - Developing Integrated Water Resources Management (IWRM) models for intra-state rivers by the state governments-March 2009.
  - Establishing a system for forecasting of flash floods by IMD - September 2009.
  - Developing basin wise IWRM models for inter-state rivers by the CWC and state governments-September 2009.

- Notification of modified operation manuals/ rule curves of reservoirs identified under Phase – I and implementation of arrangements for inflow forecasts by the state governments and CWC – December 2009.
- Implementation of the scheme on expansion and modernisation of the flood forecasting network and development of the DSS by the CWC, IMD and the state governments-March 2010.
- Finalising Memoranda of Understandings (MOUs) and implementation of the network for collection and exchange of hydro meteorological data including strengthening and modernisation of existing networks on rivers originating in Nepal, Bhutan and China by the MOWR and Ministry of External Affairs (MEA)-March 2010.
- Setting up of National Flood Management Institute (NFMI) by the MOWR/NDMA – June 2010.
- Examining adequacy and if required, increasing the waterways of bridges/ culverts under roads and railways embankments by the Ministry of Shipping, Road Transport and Highways (MOSRTH), Ministry of Railways (MOR), Ministry of Defence (MOD), National Highways Authority of India (NHAI), Border Road Organisation (BRO) and state governments-June 2010.
- Studies and consultations and finalization of the proposal for flood insurance by the MOWR in collaboration with the Ministry of Finance (MOF), insurance companies and state governments and implementation of a pilot project – December 2008 and on large scale-June 2010.
- Preparation of DM plans for reservoirs by the state governments – December 2010.
- Making public utility buildings/installations flood-safe by the GOI, state governments and ULBs/PRIIs-December 2010.
- Establishing river basin organisations by the MOWR and state governments-June 2010.
- Preparation of DPRs for storage reservoirs in India by the state governments/central organisations – December 2010 and in Bhutan and Nepal-March 2012.
- Preparation of DPRs for long-term FP and DI measures such as embankments, anti-erosion measures, drainage improvement works, and sea walls/coastal protection works by the state governments/central organisations – December 2008 and completion of the works-March 2012.

### Phase – III (Commences with Completion of Link Activities in Phase – II)

- Water shed management, Catchment Area Treatment (CAT) and afforestation schemes in critical areas by the state governments/ central organisations-March 2012.
- Construction of storage reservoirs by the state governments/central organisations – December 2017.
- Negotiations with Nepal and Bhutan for construction of reservoirs, watershed management, CAT and afforestation measures in their territories and preparation of DPRs and implementation of the schemes by the GOI and the governments of Nepal and Bhutan- December 2025.

## Recurring Activities

- Inspections of dams, embankments and other structural measures by the state governments – twice every year, once before monsoon (April-May) and second time after monsoon (November-December).
- Restoration/strengthening works by the state governments—every year.
- Monitoring of structural measures—by the state governments—throughout the year with special attention during monsoon.
- Expansion and modernisation of flood forecasting and warning network and DSS for flood management as and when required.

## Important Aspects of the Guidelines

While all the activities under the Guidelines are important for minimising flood risk and loss of lives and properties, the issues which need special attention are the following:

- Indiscriminate encroachment of the flood plains of the rivers and waterways of natural and man-made drainage channels and reclamation of ponds, chauras, lakes and depressions have led to increased flood risk to lives and properties. The regulation of developmental activities in these areas and an appropriate techno-legal regime based on the model bill circulated by the CWC, is an urgent necessity.
- The change in priority in use of storage space of the multi-purpose reservoirs for irrigation, hydropower, drinking and industrial water supply by ignoring flood

moderation has led to large scale flooding. The operation manuals and rule curves of all the reservoirs will be reviewed and modified to give priority to flood moderation.

- Flood forecasting and warning is a non-structural measure, which aims at minimising losses and enabling the agencies concerned to plan rescue and relief measures. The efforts of the CWC, IMD, NRSA and the state governments will be integrated and a mechanism developed wherein during the monsoon, the representatives of all these organisations and the basin states work together in formulation and dissemination of reliable forecasts and warning.

The national vision is to minimise the vulnerability to floods and the consequent loss of lives, livelihood systems, property and damage to infrastructure and public utilities and to build a safer India by developing a holistic, proactive, multi-disaster and technology driven strategy for DM. This is to be achieved through a combination of preventive, mitigative and preparatory measures to generate a prompt and efficient response after the occurrence of floods. The entire process will focus on the community and will be sustained through the collective efforts of the government and NGOs.

The value of these guidelines will lie essentially, in the efficacy of the FMPs that will consequently be made and implemented by the central ministries and departments and the state governments.

The central government and the state governments will provide necessary resources, both financial and managerial for creating adequate structures at all levels to take measures required to minimise risk and vulnerability to floods

Floods and famines have ravaged mankind from time immemorial and a vast store of knowledge

and experience is available on handling these disasters. An attempt has been made in these Guidelines to build on this precious heritage while, simultaneously, factoring in the benefits of modern technology and scientific advantages apart from emphasising the value of concerted action and sustained efforts at mitigation.

### Schedule of Completion of Action Points

The timelines proposed for the implementation

of various activities in the guidelines are considered both important and desirable, especially in the case of those non-structural measures for which no clearances are required from central or other agencies. Precise schedules for structural measures will, however, be evolved in the FMPs that will follow at the level of central ministries/states duly taking into account the availability of financial, technical and managerial resources. In case of compelling circumstances warranting a change, consultation with NDMA will be undertaken, well in advance, for any adjustment, on a case to case basis.



# Overview of the Guidelines

---

## General

It has been recognised that, while floods cannot be prevented, they can certainly be managed to minimise loss of lives, livelihood systems, property and damage to infrastructure and public utilities. Various measures for management of floods will ultimately lead to reduction in vulnerability to floods. These guidelines on FM have been prepared keeping this reality in mind. Sustained efforts are required to address the problem to reduce the impact of floods in the short term and flood risk in the medium and the long term. So far the response to floods has been reactive in nature and has focused on rescue and relief in the post-flood situation. Preparatory, preventive and mitigative aspects of the FM have not received due attention. With the enactment of the DM Act, 2005 and the constitution of the NDMA, there has been a paradigm shift from the reactive response-centric regime where most of the efforts and resources were used for providing emergency response and relief after floods, to an approach that lays greater emphasis on efforts and resources for strengthening preparedness and mitigation through appropriate intervention apart from consolidating capacity for emergency response. This shift in approach is expected to be achieved with the active participation of the communities and the other stakeholders in all aspects of FM. The guidelines cover all aspects of FM and aim at increasing the efficacy of the FMPs that will be prepared by various key agencies including the central ministries and departments concerned, state governments, districts authorities, local bodies (both rural and urban), including PRIs, metropolitan development authorities, municipal corporations, municipal councils etc. The implementation of the FMPs prepared by them will result in a safer country

capable of managing the floods effectively and thus promote the economic development of the flood prone areas in the country.

## Structure of the Guidelines

These Guidelines have been divided into 10 chapters.

### Floods: Status and Context

The first chapter is general in nature. The nature and extent of the flood problem in the country, various initiatives taken by the GOI in managing them, the actions required for a reasonable and reliable assessment of the problem and collection of the data for the studies leading to systematic and scientific planning and implementation of various interventions to manage floods are briefly described therein.

### Institutional Framework and Financial Arrangements

The second chapter titled 'Institutional Framework and Financial Arrangements' outlines the existing and proposed institutions to deal with the problem of floods and manage them effectively. It also deals with the financial system in place and arrangements that are proposed for meeting the requirement of funds for implementation of the various proposed interventions and FM measures, both structural and non-structural.

### Prevention, Preparedness and Mitigation

The third chapter on flood prevention, prepared-

ness and mitigation presents an outline of the various types of structural and non-structural measures for managing the floods. Action plans for their implementation have also been prepared.

### Flood Forecasting and Warning

Flood forecasting and warning (FF and W) is an important measure for minimising loss of lives and properties and assists the authorities concerned, in prompt and effective response during and after floods. These aspects have been dealt with in the fourth chapter and the action plan for the strengthening and modernisation of existing FF and W network as well as development of a DSS for management of floods has been drawn.

### Dams, Reservoirs and Other Water Storages

Dams, reservoirs and other water storages, both natural and man-made, are an effective means for reducing the flood peaks in the rivers. The important role played by them in flood moderation and comprehensive mechanism for operation and regulation of reservoirs, which takes into account the international, inter-state and inter-regional aspects, have been dealt with in the fifth chapter. As large dams and reservoirs have potential for huge damage guidelines for ensuring safety thereof have also been detailed therein.

### Regulation and Enforcement

Unplanned and unregulated developmental activities in the flood plains of the rivers and encroachments into the waterways have led to increase in flood losses as well as flood risk. The colossal loss of lives and property due to the flooding of the towns and cities and the areas which get flooded almost every alternate year is a recent

phenomenon and effective steps are required for regulating unplanned growth in the flood plains and preventing encroachment in the waterways. These aspects have been dealt with in the sixth chapter titled 'Regulation and Enforcement'. The measures for making the structures and buildings capable of withstanding the floods and serving as temporary shelters for the flood affected people have also been dealt with in this chapter. The coordination required among the various agencies and state governments for effective FM in inter-state rivers and among various stakeholders for effective response has also been highlighted.

### Capacity Development

The seventh chapter on capacity development covers the aspects of education, training, research and development and documentation with respect to FM. The proposals for strengthening the existing systems are also given therein. An action plan for capacity development has also been formulated.

### Flood Response

An effective and prompt response to floods is very important for minimising the loss of lives and properties and providing immediate relief to the affected people. The role of communities and NGOs is vital in search, rescue and relief operations. Immediate medical assistance to the affected people and steps for prevention of outbreak of epidemics after the floods are essential components of flood response. As per provisions of the DM Act, 2005, the GOI has constituted National Disaster Response Force (NDRF) for the purpose of specialised response to disasters. Over and above this, a mechanism for coordinated approach and efforts are required for effective response. All these aspects have been covered in the eighth chapter titled 'Flood Response'.

## Implementation of Guidelines-Flood Management Plans

The NEC has been entrusted with the responsibility of preparing the National Plan for DM and getting it approved by the NDMA. These guidelines on FM will assist various stakeholders i.e. central ministries/ departments, state governments/ SDMA, PRIs, and ULBs, DDMA, NGOs and the communities at large, in the preparation of FMPs which, in turn, will form the basis for preparing the national flood management and overall DM plan. The factors to be taken into account while preparing

FMPs and aspects for implementation thereof have been dealt with in the ninth chapter.

## Summary of Action Points

The last chapter of the Guidelines lists out various action points to be implemented by central ministries and departments concerned and the state governments/SDMA/DDMA. There are, in all, 94 action points which will assist them in the formulation of FMPs and the implementation thereof will result in effective management of floods in India.



# 1

## Floods-Status and Context

---

### 1.1 The Flood Hazard

#### 1.1.1 Floods-A Natural Disaster

Floods have been recurrent phenomena in India from time immemorial. Almost every year floods of varying magnitude affect some parts of the country or the other. Different regions of the country have different climates and rainfall patterns and, therefore, while some parts face devastating floods, other parts may, at the same time, experience drought conditions. The monsoon regime is a regular phenomenon. Year-to-year variations occur with regard to the onset of the monsoon, its progress over the Indian landmass, and the amount of rainfall distribution. In some years the variation is quite significant. Nevertheless, there is a fundamental regularity and dependability about the monsoon that sets the seasonal rhythms of life, although it also causes unfortunate losses across much of this part of the world. The annual precipitation including snowfall over India is estimated at 4,00,000 crore cubic meters (4,000 Billion Cubic Meters [BCM]) with the seasonal rainfall in the monsoons being of the order of 3,00,000 crore cubic meters (3,000 BCM). The Indian subcontinent receives maximum rainfall during the south-west (SW) monsoon (summer monsoon) for a period of about 100 days, starting from the first week of June to the end September. Normal area-weighted rainfall over the Indian land mass is 89 cms during this period. Around 80 per cent of the annual total rainfall over India occurs in the SW monsoon season. The balance (20 per cent) rainfall is mainly due to convective activities

in the pre-monsoon period (March-June) in the form of local storms/thunderstorms, cyclones and post-monsoon cyclones (October-mid December). Winter rains/snowfall over the northern part of India caused by western disturbances and the north-east (NE) monsoon in the state of Tamil Nadu and adjoining region also contribute to the total rainfall. The normal annual rainfall varies from less than 600 mms in the north-western part to over 2,500 mms in the north-eastern part. It varies from about 1,200 mms in the north to 2,900 mms in the south.

#### 1.1.2 Causes of Floods

Inadequate capacity of the rivers to contain within their banks the high flows brought down from the upper catchment areas following heavy rainfall, leads to flooding. The tendency to occupy the flood plains has been a serious concern over the years. Because of the varying rainfall distribution, many a time, areas which are not traditionally prone to floods also experience severe inundation. Areas with poor drainage facilities get flooded by accumulation of water from heavy rainfall. Excess irrigation water applied to command areas and increase in ground water levels due to seepage from canals and irrigated fields also are factors that accentuate the problem of water-logging. The problem is exacerbated by factors such as silting of the riverbeds, reduction in the carrying capacity of river channels, erosion of beds and banks leading to changes in river courses, obstructions to flow due to landslides, synchronisation of floods in the main and tributary rivers and retardation due to tidal effects.

### 1.1.3 Flood Dimensions

Floods have different dimensions - inundation due to spills over the banks, drainage congestion due to poor drainage characteristics and erosion due to changes in water courses.

### 1.1.4 Flood Prone Area's Estimate

According to the estimate of the National Commission on Floods, the area prone to floods in the country is of the order of 400 lakh hectares. It is considered that 80 per cent of it, i.e., 320 lakh hectares can be provided with a reasonable degree of protection.

## 1.2 Regions in the Country Prone to Floods

India can be broadly divided into the following four regions for a study of flood hazard. In addition the Andaman and Nicobar Islands and Lakshadweep have peculiar characteristics, which result in drainage congestion, flooding and erosion in coastal areas, as described in Para 1.3.

### 1.2.1 The Brahmaputra River Region:

This region consists of the rivers Brahmaputra and Barak and their tributaries, and covers the states of Assam, Arunachal Pradesh, Meghalaya, Mizoram, Manipur, Tripura, Nagaland, Sikkim and the northern parts of West Bengal. The catchments of these rivers receive very heavy rainfall ranging from 1100 mms. to 6350 mms which occurs mostly during the months of May-June to September. As a result, floods in this region are severe and quite frequent. Further the hills, where these rivers originate, are fragile and susceptible to erosion and thereby cause exceptionally high silt discharge in the rivers. In addition, the region is subject to severe and frequent earthquakes, which cause numerous landslides in the hills and upset the regime of the

rivers. The predominant problems in this region are cloud bursts followed by flash floods, soil erosion in the watershed and bank erosion along the rivers, flooding caused by the spilling of rivers over their banks, drainage congestion and the tendency of some of the rivers to change their courses. The plain areas of the region suffer from the inundation caused by spilling of the Brahmaputra.

### 1.2.2 The Ganga River Region:

The river Ganga has many tributaries, the important ones being Yamuna, Sone, Ghaghra, Raphti, Gandak, Burhi Gandak, Bagmati, Kamla Balan, Adhwara group of rivers, Kosi and the Mahananda. It covers the states of Uttarakhand, Uttar Pradesh, Jharkand, Bihar, south and central parts of West Bengal, Punjab, parts of Haryana, Himachal Pradesh, Rajasthan, Madhya Pradesh and Delhi. The normal annual rainfall in this region varies from about 600 mms to 1900 mms of which more than 80 per cent occurs during the SW monsoon. The rainfall increases from west to east and from south to north. The flood problem is mostly confined to the areas on the northern bank of the river Ganga. Most of the damage is caused by the northern tributaries of the Ganga. They spill over their banks and change their courses frequently. Even though the Ganga is a mighty river carrying huge discharges of 57,000 to 85,000 cubic meter per second, the inundation and erosion problems are confined to relatively few places. In general, the flood problem increases from the west to the east and from south to north. In the north-western parts of the region, there is the problem of drainage congestion. The drainage problem also exists in the southern parts of West Bengal. The flooding and erosion problem is serious in the states of Uttar Pradesh, Bihar and West Bengal. In recent years, the states of Rajasthan and Madhya Pradesh have also experienced some incidents of heavy floods. The problem of flooding and drainage congestion is getting accentuated due to large-

scale encroachment of flood plains of the rivers for habitation and various developmental activities.

### 1.2.3 The North-west River Region:

The main rivers in this region are the Indus, Sutlej, Beas, Ravi, Chenab and Jhelum. These rivers are the tributaries of the Indus. They carry quite substantial discharges during the monsoon and also large volumes of sediment. They change their courses frequently and leave behind vast tracts of sandy waste. This region covers the states of Jammu and Kashmir, Punjab and parts of Himachal Pradesh, Haryana and Rajasthan. Compared to the Ganga and the Brahmaputra river regions, the flood problem is relatively less in this region. The major problem is that of inadequate surface drainage which causes inundation and water-logging over vast areas. Indiscriminate use of water for irrigation and development of low-lying areas and depressions has created problem of drainage congestion and water logging.

### 1.2.4 The Central India and Deccan Region:

Important rivers in this region are the Narmada, Tapi, Mahanadi, Godavari, Krishna and Cauvery. These rivers have mostly well defined and stable courses. They have adequate capacities within the natural banks to carry the flood discharge except in the delta area. The lower reaches of the important rivers on the east coast have been embanked, thus largely eliminating the flood problem. However the embankments need to be raised and strengthened to latest standards to continue to provide protection against floods and erosion. This region covers the states of Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, Orissa, Maharashtra, Gujarat and parts of Madhya Pradesh. The region does not have serious flood problem except that some of the rivers in Orissa State namely Mahanadi, Brahmini, Baitarni, and Subarnarekha are prone to floods every

year. The delta and coastal areas of the states on the east coast periodically face flood and drainage problems in the wake of monsoon depression and cyclonic storms. The problem is accentuated when the floods synchronize with high tide. The rivers Tapi and Narmada, are occasionally in high floods affecting areas in the lower reaches in Gujarat.

## 1.3 Flooding/Drainage Congestion/ Erosion in Andaman and Nicobar Islands and Lakshadweep

The Andaman and Nicobar archipelago consists of 572 islands, islets and coral rocks spreading over a stretch of 726 Km in the Bay of Bengal, out of which, 38 are inhabited. The population has settled in the plain table areas all along the coastline. The islands may be categorised as heavy rainfall area with average annual rainfall of 318 cms. The coastline of the islands is deeply indented and broken by creeks, backwaters and lagoons on both sides. When incessant rains synchronise with high tide, the settlements along the coastline and creeks go under water. Some areas/islands have poor natural drainage caused by peculiar geographical features and soil characteristics. These are vulnerable to flooding in case of heavy downpour. Storm surges, associated with cyclones, also cause inundation and erosion in areas along the sea coast.

Lakshadweep, a group of Islands, is located 200-300 km off the coast of Kerala in the Arabian sea. The total geographical area is 32 sq km. Out of the 36 islands, 11 are inhabited. The average annual rainfall varies from 1100-1850 mm. The islands are affected by sea erosion and inundation in times of high tides.

## 1.4 Flash Floods

Flash floods are characterised by very fast rise and recession of flow of small volume and high

discharge, which causes high damages because of suddenness. This occurs in hilly and not too hilly regions and sloping lands where heavy rainfall and thunderstorms or cloudbursts are common. Depression and cyclonic storms in the coastal areas of Orissa, West Bengal, Andhra Pradesh, Karnataka, and Tamil Nadu also cause flash floods. Arunachal Pradesh, Assam, Orissa, Himachal Pradesh, Uttarakhand, the Western Ghats in Maharashtra and Kerala are more vulnerable to flash floods caused by cloud bursts. Sudden release of waters from upstream reservoirs, breaches in landslide dams and embankments on the banks of the rivers leads to disastrous floods. Severe floods in Himachal Pradesh in August 2000 and June 2005, and in Arunachal Pradesh in 2000 are a few examples of flash floods caused by breaches in landslide dams. Floods in Assam, Bihar, Uttar Pradesh, Orissa and Andhra Pradesh are generally caused by breaches in embankments. Incidents of high intensity rainfall over short durations, which cause flash floods even in the area where rains are rare phenomena, are on the rise and the problem needs to be tackled in a scientific manner.

- i) *Flash floods forecasting and warning systems using Doppler radars will be installed by the India Meteorological Department (IMD) by September 2009.*
- ii) *As a preventive measure, the inhabitation of low-lying areas along the rivers, nallas and drains will be regulated by the state governments/State Disaster Management Authorities (SDMAs)/District Disaster Management Authorities (DDMAs).*
- iii) *Landslides and blockages in rivers will be monitored by the Central Water Commission (CWC)/National Remote Sensing Agency (NRSA)/state governments/SDMAs with the help of satellite imageries and in case of their occurrence, warning systems will be set up to reduce losses. If possible,*

*appropriate structural measures to eliminate the damage in case of sudden collapse of the blockages will also be taken up.*

## 1.5 Area Prone to Floods

The details of annual damage due to floods are available from the year 1953 onwards. The maximum area affected due to floods in any one of the years under consideration which has not been effectively protected, is taken as the area liable to flood in that state. Considering all such figures for all the States for the period from 1953 to 1978, the Rashtriya Barh Ayog (RBA) has assessed the total area liable to flood in the country as 400 lakh hectares. About 80 per cent of this, i.e., 320 lakh hectares areas could be provided with reasonable degree of protection. The severity of the problem can be appreciated that this area constitutes about 1/8th of the total geographical area of the country. In recent years, areas not prone to floods are also getting flooded. An indicative map showing flood prone areas in India is given in **Annex- I/I**. The State-wise break up of areas prone to floods is given in **Annex- I/II**. In recent years, areas once considered free from floods are also getting flooded.

*The Ministry of Water Resources (MOWR) and the state governments/SDMAs/DDMAs concerned will urgently undertake identification of areas prone to floods along with names of villages/talukas or tehsils/districts in a scientific manner in collaboration with the NRSA and Survey of India (SOI).*

## 1.6 Damages Caused by Floods

More than the loss of life and damage to property, the sense of insecurity and fear in the minds of people living in the flood plains is a cause of great concern. The after effects of floods such as the agony of survivors, spread of epidemics, non availability of drinking water, essential commodities and medicines, loss of the dwellings etc. make floods the most feared among the natural disasters

faced by mankind. Heavy flood damages had occurred in the country during the monsoons of the years 1955, 1971, 1973, 1977, 1978, 1980, 1984, 1988, 1989, 1998 and 2004. Highlights of the flood damages are given below:

	Maximum	Average
Area affected (in lakh hectares)	175 (1978)	75.1
Crop area affected (in lakh hectares)	101.5 (1988)	35.1
Population affected (in crores)	7.045 (1978)	3.284
Houses damaged (in lakhs)	35.1 (1978)	12.2
Cattle heads lost	618248 (1979)	94830
Human lives lost	11316 (1977)	1587
Damage to public utilities (in Rs. crores)	5604.46 (1998)	820.67
Total damages (in Rs. crores)	8864.54 (1998)	1805.18

A statement showing flood damage during the 1953 to 2005 is given in **Annex- I/III**.

*There is lack of documentation on floods and flood damage. The state governments will ensure that each and every flood event is properly documented and flood damage assessment is made on a scientific basis with the help of latest technological advancements in the field of remote sensing through satellites etc.*

### 1.7 Drainage Congestion and Water-logging

An area is said to be waterlogged when the water table rises to an extent that the soil pores in the root zone of a crop become saturated, resulting in restriction of the normal circulation of air, decline in

the level of oxygen and increase in the level of carbon dioxide. Drainage congestion and consequent water-logging may be either due to surface flooding or rise in water table, as a result of excess inflow as compared to outflow which may be either on account of excess rain and/ or over-irrigation. Various agencies/ committees/commissions have studied the problem and assessed the area liable to water-logging in the country. The Irrigation Commission (1972) estimated the total area liable to water-logging in the country as 48.4 lakh hectares. The National Commission on Agriculture (1976) estimated total waterlogged area as 60 lakh hectares. The Ministry of Agriculture (MOA) made a reassessment in 1984-85 and revised the estimate of the area suffering from drainage congestion and water logging as 85.3 lakh hectares. As per latest figures reported by the states, the total area prone to water logging/drainage congestion is 90 lakh hectares. State wise breakup is at **Annex-I/IV**.

*The MOWR along with the MOA and the state governments will, by the end of March 2008, make a scientific assessment of the area suffering from drainage congestion and water-logging.*

### 1.8 River Erosion

The erosion of banks by the rivers and the consequent loss of life and property are major problems. Rivers tend to erode their beds and banks in the hilly regions resulting in the deepening and widening of rivers. When a river enters the flood plains, it shows a tendency to braid and develop number of channels causing silting of the riverbed, change in course and bank erosion. In the plains, a river shows a meandering tendency with meanders moving downstream causing erosion on the concave and deposition on the convex side and cut offs. This causes large-scale bank erosion. In deltaic reaches near the outfall into sea, the river divides itself into a number of branches resulting in bank erosion. Thus bank erosion and consequent loss



of land and properties is a constant phenomenon all along the course of the river. The study of the problem and remedial measures for training of the river into defined channel has gained importance due to increase in population pressure and want of alternative sources of livelihood for the people whose land and properties are lost to rivers.

*The MOWR along with the state governments will undertake river-wise studies of the problem of erosion and estimate the area liable to erosion by rivers, identify vulnerable spots and plan remedial measures to protect such areas. Latest technological developments for low cost measures, such as reinforced cement concrete (RCC) porcupines, will be considered while planning such measures.*

## 1.9 Urban Flooding

Historically, civilisations have developed along river courses. Towns have grown faster on account of increase/influx of population. Owing to lack of regulation/control, there has been considerable encroachment of flood plains. Damages become serious as a result of inadequate capacity of storm water drainage system. The problem of urban flooding has become serious as evidenced by the floods in Mumbai, Bangalore, Chennai, Vadodara, Ahmedabad, Surat, Kolkata, Hyderabad, Visakhapatnam and Vijayawada. The National Disaster Management Authority (NDMA) has, in recognition of the dimensions, this phenomenon has acquired, identified urban flooding as a distinct discipline, in regard to the management of which separate guidelines will be formulated and issued soon.

## 1.10 Littoral Drift in River Estuaries

The flood problems of deltaic regions are attributed to various causes like flatter slope of drains and back flow due to tides. Littoral drift of sand in the form of sand dunes formation and consequent

choking of outfalls of rivers into the sea is one of the causes for flood in deltaic regions. The Biccavole and Tulabhaga drains in the Godavari eastern delta and the Panchanadi, Lower Kowsika, Vasalatippa and Kunavaram drains in Godavari central delta are some of the problem reaches.

*Straight cuts into the sea with a view to make the slope steeper in outfall reaches are sometimes considered as an effective measure to overcome the problem. These measures must be taken only after an intensive study on the mathematical and hydraulic models is carried out so as to avoid the risk of increased flooding in case of high tides, cyclonic storms and tsunamis.*

## 1.11 Snow-melt/Glacial Lake Outbursts, Formation and Subsequent Bursting of Landslide Dams

Snowmelt is a gradual process and usually does not cause major floods. Glacial melt is usually slower than snowmelt and is not capable of causing severe flood. But sometimes glaciers hold large quantity of bounded water, which may be suddenly released with melting of ice block resulting into Glacial Lake Outburst Floods (GLOFs). The rivers originating from the Himalayas in the northern part of the country, which are also fed by snowmelt from glaciers, are prone to flash floods. In 1929, the outburst of the Chong Khundam glacier (Karakoram) caused a flood peak of over 22,000 m<sup>3</sup> / second at Attock. Glacial outburst is one of the suspected reasons for the flash flood experienced in Sutlej River on the night intervening 31 July and 1 August 2000. The blockage in the course of the Parechu in China (Tibet) caused by the landslide in 2004 gave way in 2005 and caused severe flooding and damage to infrastructure in Himachal Pradesh.

*While the guidelines for landslides will be issued by the NDMA separately the MOWR/CWC and the state governments will, in collaboration with NRSA,*

*monitor the hilly areas liable to snow avalanches, blockages in rivers due to landslides etc for such events and in the case of their occurrences, install warning systems for reducing the loss of life and property in the areas likely to be affected. They will also take remedial structural measures, if feasible, for averting the danger.*

### 1.12 Monsoon/Cyclones/Cyclonic Circulations

Floods in the Indian river basins are also caused by rainstorms which are generally associated with low-pressure systems like well-marked lows, depressions or tropical cyclones. During the past 100 years, over 1000 tropical cyclones, depressions and low-pressure systems originating in the Bay of Bengal and Arabian Sea moved across the Indian subcontinent. Nearly 466 cyclones of which about 40 per cent were severe, affected the country during the past century. The passage of such storms in quick succession over a river basin invariably leads to severe floods. Parts of the country, mainly the coastal areas of Andhra Pradesh, Assam, Orissa, Tamil Nadu and West Bengal, experience such cyclones leading to extensive flooding. The flood caused by the super cyclone combined with a huge storm surge during October 1999 in the coastal belt of Orissa was the worst in recent history.

Guidelines on this subject will be issued separately by the NDMA.

### 1.13 Cloudbursts

Due to peculiar climatic conditions, some parts of the country experience sudden unprecedented heavy rain known as cloud bursts. Principal rain bearing meteorological systems that lead to short duration heavy rainfall and which may also cause floods are:

- (i) monsoon depressions.

- (ii) fluctuations in the intensity and location of the monsoon trough over the plains of India.
- (iii) a mid-troposphere circulation/low pressure off the coasts of India particularly over Gujarat.
- (iv) off shore vortices.

Apart from these, land-based lows or depressions during monsoon cyclones and persistence of low pressure areas over adjoining coastal areas may sometimes lead to floods.

Hilly areas in Himachal Pradesh, Uttarakhand, the northern areas of West Bengal, Sikkim, Arunachal Pradesh, Manipur, Mizoram, Meghalaya, Nagaland and Tripura and the coastal areas in the states of West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Maharashtra and Gujarat and Union Territories (UTs) of Andaman and Nicobar Islands and Lakshadweep are more prone to such phenomena. Such events have also occurred in the states of Rajasthan, Chattisgarh, Madhya Pradesh and Uttar Pradesh.

*The IMD and CWC in association with state governments will develop forecasting and warning systems in areas prone to floods caused by cloudbursts.*

### 1.14 International Dimensions of the Flood Hazard

The rivers originating in China, Nepal and Bhutan cause severe floods in the states of Uttar Pradesh, Bihar, West Bengal, Arunachal Pradesh and Assam. For flood management (FM), cooperation with the neighbouring countries viz. China (Tibet), Nepal and Bhutan is essential.

*Negotiations upon issues such as establishment of hydro-meteorological stations and transmission of*

*their data to India on a real time basis, afforestation, catchment area treatment (CAT) works and construction of reservoirs will be expedited by the MOWR and Ministry of External Affairs (MEA).*

### 1.15 Past Initiatives of the Government of India

The Government of India (GOI) has taken a number of initiatives in the field of FM and appointed many committees/working groups/task forces from time to time to look into the problem of floods and suggest remedial measures for their management. It has also issued a number of policy statements in this regard. Some of the important committees/working groups/task forces appointed and the policy statements made by the GOI are listed as follows:

- The Policy Statement – 1954 and Supplementary Statement -1956.
- The High Level Committee on Floods – 1957 and Policy Statement of – 1958.
- The Ministers' Committee on Flood Control - 1964.
- The Working Groups on Flood Control for the Five-Year Plans.
- The Rashtriya Barh Ayog – 1980.
- The Pritam Singh Committee Report – 1980.
- The National Water Policy -1987.
- The Report of the Committee on Flood Management in the North-Eastern States – 1988.
- The Report of the Committee on FM in the states of Bihar, West Bengal, Uttar Pradesh and Orissa – 1988.
- The Regional Task Forces -1996.
- The Experts' Committee for Bank Erosion Problem of River Ganga-Padma in the Districts of Malda and Murshidabad in West Bengal -1996.
- The National Commission for Integrated Water Resources Development Plan -1999.
- The Expert Group for Flood Management in Uttar Pradesh and Bihar – 1999.
- The Working Group on Flood Control Programme for the Tenth Five-Year Plan – 2001.
- Report of the Committee on Silting of Rivers in India – 2002.
- National Water Policy – 2002.
- The Expert Committee to Review the Implementation of the Recommendations of Rashtriya Barh Ayog – 2003.
- The Committee for Identification of critical Anti-Erosion Schemes of Ganga Basin States for Inclusion in centrally sponsored scheme to be implemented during Tenth Plan – 2003.
- Report of the Technical Group on Flood and Erosion Problems of North Bengal – July 2004.
- The Task Force on Flood Management/ Erosion Control -2004.

While the Policy Statement -1954 was the first major initiative by the GOI taken up after the floods of 1954, other important committees appointed by the Government of India are the High Level Committee



on Floods-1957, the Ministers' Committee on Flood Control-1964, the Rashtriya Barh Ayog-1980 and the Task Force on Flood Management/Erosion Control -2004. Brief particulars relating to the reports of these Committees are in **Annex-I/V**

### 1.16 Implementation of the Recommendations of the Experts' Committees/Working Groups/Task Forces

The implementation of the recommendations of various committees/ working groups/task forces has been rather slow and action on a majority of them has not been taken or at best taken partially due to various administrative, social, financial and political reasons. After the Policy Statement of 1954 and Supplementary Statement of 1956, High Level Committee on Flood Control-1957, Ministers' Committee on Floods-1964 were the important initiatives taken by the GOI. The GOI set up the RBA in 1976 to study in depth the approach towards programmes of flood control measures, their effectiveness and recommend future measures and the National policy to be followed so as to progressively mitigate the resultant damage from floods. The RBA, looked into the problem of floods in the whole of the country in a most comprehensive manner. It took into account the recommendations of the various past committees and the status of implementation thereof and submitted its report in 1980. The report contained 207 recommendations, implementation of which has been reviewed from time to time. The latest one was by the Experts' Committee under the Chairmanship of Shri. R. Rangachari former Member, CWC in 2003. It noted that the implementation has been slow and identified 40 recommendations, which need to be followed. These are given in **Annex-I/VI**. The brief details of the most important ones, which need to be followed, are as follows:-

- Flood damage assessment be made on a realistic and scientific basis and recorded basin-/sub-basin-wise.
- Performance evaluation of a large number of FM schemes be carried out and their impact on the socio economic development of the protected area be assessed.
- The use of flood plains be regulated and a suitable legislation for flood plain zoning be enacted and enforced.
- Water Resources planning and construction be basin wise and basin organisations be set up.
- Storages in various forms is an important component of the package of measures for FM and flood space in reservoirs be provided to the extent feasible and flood control not relegated to a non- priority activity as against competing water requirements for hydropower and Irrigation purposes.
- International dimensions of problem of floods be kept in mind and the GOI should play an important role in the matter.
- Requisite funds be made available for construction of new and maintenance of existing works.
- Emphasis be laid on research, education and training on FM.

The Task Force on Flood Control/Erosion Control considered the status of implementation of recommendations of all the past committees/ working groups/ task forces and submitted its report to the MOWR in December 2004. The MOWR is in the process of taking appropriate action on its various recommendations.

*The MOWR and the CWC will, in collaboration with the state governments, closely monitor the implementation of the recommendations of the Experts Committee to review the implementation of the recommendations of the RBA-2003 and the Task Force on Flood Management/Erosion Control-2004.*

## 1.17 Achievements in Respect of Flood Management.

### 1.17.1 Structural Measures

Since 1954, 33,928 km of new embankments and 38,809 km of drainage channels have been constructed in the country. In addition, 2,450 town protection works have been completed and 4,721 villages have been raised above flood levels. Barring occasional breaches in embankments, these works have given reasonable protection to an area of about 18.22 million hectares. The state-wise progress of FM works is given in **Annex-I/VII**

### 1.17.2 Non-structural Measures

The MOWR and CWC had circulated in 1975, the draft bill for flood plain zoning regulations to the state governments for enactment and enforcement. However their response is not satisfactory. Rajasthan and Manipur are the only states which have passed the bill but steps for its enforcement have not been taken.

The CWC has established a flood forecasting system comprising 175 stations on all major inter-state rivers and is implementing the scheme for its modernisation and expansion. The MOWR had launched a centrally sponsored scheme for raising of villages/construction of ring bunds etc, in U.P and Bihar. The scheme was, however, discontinued in the Tenth Plan pending evaluation of the performance of the works executed under it.

## 1.18 Gaps in Flood Management

- Non-availability of close contour maps and digital elevation models of flood prone areas are impediments to make reliable forecasts of the area likely to be inundated corresponding to expected river water levels.
- Flood forecasting and warning (FF and W) network of the CWC, though developed on scientific basis, does not cover all the flood prone rivers and rivulets. Most of the state governments do not have their own reliable FF and W networks.
- Even the FF and W network of the CWC is mostly based on hydro-meteorological data recorded by observers and communicated by wireless and/or telephone. Very few river basins have been covered with automatic sensors for observations and telemetry system for communication of data.
- Though web-based system of communication of forecasts has been developed by the CWC in the last two-three years, it is yet to be made fully functional.
- Flood plain zoning regulations have not been enacted and enforced by most of the states, although a draft bill was circulated to them by the MOWR and CWC in 1975 and in spite of such recommendations of various committees/ task forces/ working groups etc.
- Implementation of the flood proofing measures such as raising of villages, constructions of floods shelters, making public utility installations flood safe by the state governments, is far from satisfactory.

- Operation of reservoirs is often carried out disregarding flood moderation aspects and there is lack of flow of information among the basin-states resulting in gaps in preparedness on their part to face incoming floods.
- There is also a lack of inflow forecasting systems for the reservoirs resulting in sudden release of large quantity of water causing floods in the downstream. Dam safety aspects are also often not given due importance by the state governments.
- Though sufficient progress has been made in respect of structural measures of flood management and an area of 182.2 lakh hectare has been provided with reasonable degree of protection against floods, the remaining flood prone area is yet to be protected.
- Rivers erode a significant amount of land every year. Conventional anti-erosion measures often induce erosion in the upstream and downstream or on the opposite bank of the river and these require high investment. There is a need to evolve economical and eco-friendly measure for prevention of river-erosion.
- The flood response system lacks public participation. There is also lack of awareness among the people about simple ways of safeguarding their lives and properties during floods. They are also not aware of the role they can play in the preparedness, mitigation, rescue and relief during floods.
- Flood management measures are generally planned on an adhoc basis to give immediate relief on public demand. The problem and impact of the measures

adopted especially the embankments and anti-erosion works in adjoining areas is not comprehensively studied on scientific basis.

- There is no proper documentation about floods, their impact and the manner in which these were tackled. Proper documentation will go a long way in improving the preparedness, mitigation and response system.

### 1.19 Approach to Guidelines

- Though sufficient knowledge about floods and their management is available with different organisations and the communities and the problem of floods has been studied by a number of committees, task forces, working groups and commissions and recommendations have been made about the measures for their management, yet there are no set guidelines to be followed by the various central ministries and departments, state governments and other stakeholders, on the basis of which, they can formulate their flood management plans (FMPs). These guidelines have been formulated to address this gap.
- With the enactment of the Disaster Management (DM) Act in December 2005 and constitution of the NDMA, there has been a paradigm shift from erstwhile relief-centric approach to the entire DM continuum with equal emphasis being given on preparedness, prevention and mitigation along with response and relief.
- The FM guidelines emphasis on measures for preparedness, prevention, mitigation in the pre-floods stage and on prompt and effective response, relief and recovery during – and post floods stages.

- The emphasis of the state governments has so far been on structural measures of FM requiring huge investment and long gestation period. They have not given due importance to non-structural measures, which are very effective in reducing loss of life and properties and do not require huge investment and can be implemented in a short time. These guidelines emphasise on their time bound implementation by the central ministries and departments and the state governments.
- The guidelines recognise the fact that there is a lack of coordination among the agencies of the central government and the state governments as well as among the various departments of the state government. These also recognise lack of institutional framework for coordinating the efforts of various agencies and lay emphasis on setting up basin-wise organisations for FM and a National Flood Management Institute (NFMI) for training, education and research in FM. The mechanisms for inter-state and intra-state coordination have also been proposed.
- The financial aspects for implementation of FMPs by the central ministries and departments and the state governments have also been covered in the guidelines.
- The guidelines have been evolved with the active participation of all the stakeholders i.e the central ministries and departments, the state governments, academics, experts, NGOs, corporate sector and eminent people.
- The timelines proposed for the implementation of various activities in the guidelines are considered both important and desirable, especially in case of those non-structural measures for which no clearances are required from central or other agencies. Precise schedules for structural measures will, however, be evolved in the FMPs that will be formulated at the central ministries/states level duly taking into account the availability of financial, technical and managerial resources. In case of compelling circumstances warranting a change, consultation with NDMA will be undertaken, well in advance, for any adjustment, on a case to case basis.
- The guidelines will lead to the formulation of FMPs by the central ministries and departments, the state governments and other stakeholders, implementation of which is expected to assist the process of minimising vulnerability to floods and consequent loss of lives, livelihood systems, property and damage to infrastructure and public utilities and thus make India flood resilient.

## 1.20 Action Plan

S.No	Activity	Commencement	2008				2009				2010			
			M	J	S	D	M	J	S	D	M	J	S	D
1	Flash floods forecasting and warning system by IMD	Immediate	Planning and approval				Implement							
2	Monitoring of landslides causing blockages in the rivers, by CWC/NRSA/ state governments/ SDMA's	Immediate	Planning and approval				Implement							
3	Identification of flood prone areas and marking on maps by CWC/GFCC/ Brahmaputra Board/state governments	Immediate	Implement											
4	Documentation of floods	Immediate	Implement											
5	Assessment of area suffering from drainage congestion	Immediate	Implement											
6	Assessment of area prone to river erosion	Immediate	Implement											

# 2

## Institutional Framework and Financial Arrangements

### 2.1 Constitutional Provisions

The subject of flood control, unlike irrigation, does not figure as such in any of the three legislative lists included in the Constitution of India. However, Drainage and Embankments, are the two measures specifically mentioned in entry 17 of List II (State List), reproduced below:

‘Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to the provision of entry 56 of List I (Union List).’

Entry 56 of List I (Union List) reads as follows:

‘Regulation and development of inter-State rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest.’

The primary responsibility for flood control thus lies with the states.

### 2.2 National Institutions/Agencies

#### 2.2.1 National Disaster Management Authority

The Disaster Management Act, 2005 (DM Act, 2005) lays down institutional, legal, financial and coordination mechanisms at the national, state, district and local levels. The new institutional framework will ensure operationalisation of the national desire for a paradigm shift in DM from a

post event and relief-centric syndrome to a regime that lays greater emphasis on preparedness, prevention and mitigation, leading to a more prompt and effective response to disasters.

The NDMA, as the main body under the GOI, has the responsibility of laying down policies, plans and guidelines for DM and coordinating their enforcement and implementation for ensuring a timely and effective response to disasters. It will approve the national DM plan prepared by the National Executive Committee (NEC) and plans of the central ministries and departments. The NDMA may take such other measures, as it may consider necessary, for the prevention of disasters, or mitigation, or preparedness and capacity building, for dealing with a threatening disaster situation or disaster. Its statutory functions include the responsibility to:

- a) lay down policies on DM;
- b) approve the national plan and the plans prepared by the central ministries/departments in accordance with the national plan;
- c) lay down guidelines to be followed by the state authorities in drawing up the state plans;
- d) lay down guidelines to be followed by the different central ministries/departments for the purpose of integrating the measures for prevention of disaster or the mitigation of its effects in their development plans and projects;

- e) coordinate the enforcement and implementation of the policy and plan for DM;
- f) recommend provision of funds for the purpose of mitigation;
- g) provide such support to other countries affected by major disasters as may be determined by the central government;
- h) take such other measures for the prevention of disaster, or its mitigation, or preparedness and capacity building for dealing with a threatening disaster situation or disaster as it may consider necessary;
- i) lay down broad policies and guidelines for the functioning of the National Institute of Disaster Management(NIDM);
- j) authorise the concerned department or authority to make emergency procurement of provisions or materials for rescue and relief in a threatening disaster situation or disaster;
- k) exercise general superintendence, direction and control of the National Disaster Response Force (NDRF), constituted under the Act for the purpose of specialist response to a threatening disaster situation or disaster;
- l) recommend guidelines for the minimum standards of relief to be provided to the persons affected by disasters.

In essence, the NDMA will concentrate on prevention, preparedness, mitigation, rehabilitation, reconstruction and recovery and also formulate appropriate policies and guidelines for effective and synergised national disaster response and relief. It will also coordinate the enforcement and implementation of policies and plans.

### 2.2.2 National Executive Committee

The National Executive Committee (NEC) comprises the secretary to the GOI in the ministry or department having administrative control of the subject of DM, as the chairperson and the secretaries to the GOI in the ministries/departments of Agriculture, Atomic Energy, Defence, Drinking Water Supply, Environment and Forests, Finance (Expenditure), Health, Power, Rural Development, Science and Technology, Space, Communications, Urban Development, Water Resources and the Chief of the Integrated Defence Staff to Chairman of the Chiefs of Staff Committee as members. It is the executive committee of the NDMA, and is statutorily mandated to assist the Authority in the discharge of its functions and ensure compliance of the directions issued by the central government, apart from preparing the National Plan and securing its approval by the NDMA and performing such other functions as required by the NDMA. Based on the policy and guidelines, the NEC will be responsible for preparing the national plan, getting it approved by the NDMA and then operationalising it. The NEC will also require any department or agency of the government to make available such men or material resources for the purposes of handling threatening disasters, emergency response, rescue and relief, as required by the NDMA. It will coordinate the response in the event of any threatening disaster situation or disaster. It will also perform such other functions as the NDMA may require it to perform.

### 2.2.3 National Disaster Response Force

For the purpose of specialised response to a threatening disaster situation or disasters both natural and man-made, the DM Act, 2005 has mandated the creation of a National Disaster Response Force (NDRF). The general superintendence, direction and control of this force shall be vested in and exercised by the NDMA and the command and supervision of the NDRF shall vest in an officer to be appointed



by the central government as the Director General of the NDRF

*synthesising research activities and will be geared towards emerging as a 'centre of excellence' at the national and international levels.*

#### 2.2.4 Central Government

In accordance with the provisions of the DM Act 2005, the central government will take all such measures, as it deems necessary or expedient, for the purpose of DM and will coordinate actions of all agencies. It will ensure that central ministries and departments integrate measures for the prevention and mitigation of disasters into their developmental plans and projects, make appropriate allocation of funds for pre-disaster requirements and take necessary measures for preparedness to effectively respond to any disaster situation or disaster. As FM is a multi-disciplinary process, all central ministries and departments concerned will play a key role in assisting the NDMA in the discharge of its functions. The nodal ministry for the disaster management is the Ministry of Home Affairs (MHA), the MOWR along with other department is responsible for the technical aspects of FM besides others. The Ministries of Agriculture, Civil Aviation, Environment and Forests, Health, Space, Earth Sciences, Mines, Railways etc. also have important role in management of floods in their respective fields.

#### 2.2.5 National Institute of Disaster Management

The National Institute of Disaster Management (NIDM), which functions within the framework of the broad policy and guidelines laid down by the NDMA, has capacity development as one of its major responsibilities, along with training, research, documentation and the development of a national level information base.

*It will network with other knowledge-based institutions and assist in imparting training to trainers, DM officials, etc. It will also be responsible for*

#### 2.2.6 The Central Flood Control Board (CFCB)/Irrigation Ministers Conference

In 1954, when for the first time the flood programme in the country attracted the serious attention of the GOI, the Central Flood Control Board (CFCB) was constituted to draw up a comprehensive plan of flood control with the following functions: -

- (i) to lay down general principles and policies in connection with flood control measures;
- (ii) to consider and approve master plans for flood control submitted by the states/river commission; and
- (iii) to arrange for necessary assistance in connection with planning and execution of flood control works.

As a follow-up to a decision of the CFCB in 1954, a Flood Wing was added to the then Central Water and Power Commission; the Flood Wing served as the Secretariat of the CFCB.

In 1977, it was decided to merge the CFCB with the Conference of State Ministers of Irrigation. The first meeting after the amalgamation of the CFCB with the ministers' conference was held in February 1979; thereafter the meeting has been held almost every year.

#### 2.2.7 Central Water Commission

The Central Water Commission (CWC) is an apex agency in the field of water resources including flood management in India. The River Management Wing headed by the Member (RM) and ex-officio



Additional Secretary to the Government of India looks after FM in the country excepting the Ganga and the Brahmaputra river basins for which the GOI has created separate organisations. Member (RM) is required to advise the MOWR and also look after policy issues and other aspects of the FM in the whole country including the Ganga and the Brahmaputra basins. This wing is also responsible for flood forecasting and the hydrological observations' network in the country. It has offices under its control throughout India for performing these functions.

*The MOWR will strengthen and equip appropriately the RM wing of CWC.*

### 2.2.8 Ganga Flood Control Commission/ Ganga Flood Control Board

The Ganga Flood Control Commission (GFCC) was set up by GOI in 1972 for the preparation of comprehensive plan of flood control for Ganga basin and to draw out a phased coordinated programme for the implementation of works. It has also been assigned the work of monitoring and appraisal of FM schemes of Ganga basin states. The Task Force on Flood Management/Erosion control – 2004 has recommended its strengthening to enable it to play a more effective role in FM in the Ganga basin.

*The MOWR will take steps for strengthening the GFCC appropriately.*

### 2.2.9 Brahmaputra Board/High Powered Review Board

Floods and erosion in the Brahmaputra and Barak basins are regional problems. Both, the Brahmaputra and the Barak and most of their major tributaries are inter-state as they flow in more than one state. The Brahmaputra Board was set up by the GOI as a statutory body, under the Brahmaputra Board Act, 1980. The Board was to perform such

functions and exercise such powers as the central government may specify from time to time by notification in the official Gazette. It has been given the task of carrying out surveys and investigations in the Brahmaputra valley and preparing a Master Plan for control of floods, bank erosion and improvement of drainage, planning and integrated implementation of measures for control of floods and bank erosion in the Brahmaputra and Barak valleys. The Board, with the approval of the central government, is also to take up the construction of multipurpose dams and works connected therewith proposed in the Master Plan and operate such dams and works. The Board consists of four full-time members i.e chairman, vice-chairman, general manager and financial advisor to be appointed by the GOI and part-time members one each to represent respectively the state governments of Assam, Meghalaya, Nagaland, Mizoram, Sikkim, Manipur, Tripura, Arunachal Pradesh and West Bengal and the central ministries dealing with Water Resources, Transport, Agriculture, Power and Finance and the central government departments namely the CWC, the Central Electricity Authority(CEA), the Geological Survey of India(GSI) and the IMD. The Task Force on Flood Management/Erosion control – 2004 has recommended its restructuring/strengthening.

*The MOWR will take immediate action for restructuring/strengthening of the Brahmaputra Board.*

### 2.2.10 India Meteorological Department

The IMD established in 1875, is responsible for the National Meteorological Service and the principal government agency in all matters relating to meteorology, seismology and allied subjects. The IMD is mandated as follows:

- To take meteorological observations and to provide current and forecast

meteorological information for optimum operation of weather-sensitive activities like agriculture, irrigation, shipping, aviation, offshore oil explorations, etc.

- To warn against severe weather phenomena like tropical cyclones, northwesterly dust storms, heavy rains and snow, cold and heat waves, etc., which cause destruction of life and property.
- To provide meteorological statistics required for agriculture, water resource management, industries, oil exploration and other nation building activities.
- To conduct and promote research in meteorology and allied disciplines.
- To detect and locate earthquakes and to evaluate seismicity in different parts of the country for development projects.

For the convenience of administrative and technical control, there are six Regional Meteorological Centres (RMCs) located at Mumbai, Chennai, New Delhi, Kolkata, Nagpur and Guwahati. Under each RMC, there are different types of operational units such as meteorological centres at state capitals, forecasting offices, agro-meteorological advisory service centres, flood meteorological offices (FMOs) and area cyclone warning centres.

### 2.2.11 National Centre for Medium Range Weather Forecasting

The National Centre for Medium Range Weather Forecasting (NCMRWF) is the premier institution in India under the Department of Science and Technology (DST) to provide medium range weather forecasts through deterministic methods and to render agro advisory services (AAS) to the farmers. The centre offers research opportunities in

numerical weather prediction, diagnostic studies, crop weather modeling and computer science.

### 2.2.12 National Remote Sensing Agency

The Department of Space has established a Decision Support Centre (DSC) at National Remote Sensing Agency (NRSA) under the Indian Space Research Organisation's (ISRO) disaster management support (DMS) programme. DSC is an operational service provider for space-enabled inputs together with other important data layers for its use in disaster management by the central ministries and departments and the state governments in pre-disaster, during disaster and post-disaster phases. A VSAT based satellite communication network has been put in place for online transfer of space-enabled inputs to the concerned state and central government user departments. The DSC has the provision to mobilise aircraft for obtaining aerial data. At present, the DSC is addressing natural disasters viz. floods, cyclone, drought, forest fires, earthquakes and landslides. Besides these, it also provides support services for specific events such as tsunami impact assessment, monitoring of landslide and manmade lakes in the remote areas of India and adjoining areas of other countries. Near real information on the extent of flood inundation derived from space data are made available to the NDMA, MHA, CWC and state agencies for planning relief and rescue operations.

The DSC is also working on preparation of maps showing hazard zonation. Flood hazard zone maps for the Brahmaputra river in Assam were prepared. Similar maps are also being prepared for Bihar. The NRSA also prepares maps in river configuration and bank erosion. It also maps flood controls works such as embankments and spurs along selected river reaches and provides this information the concerned departments.

The DSC aims at building a comprehensive geo-spatial database of the disaster vulnerable

regions of the country. As for the 60 odd flood and cyclone prone districts a digital database on a scale of 1:50,000 was developed.

Capability has been established for acquisition of close contour information. Planning is being done for systematic acquisition, in a phased manner, of close contour information over chronic flood prone areas.

### 2.2.13 National Flood Management Institute

Various Institutes and academic institutions deal with different aspects of water resources. The MOWR has established the National Water Academy (NWA) at Pune under the administrative control of the CWC for training the working professionals of CWC and the states in different aspects of water resources including FM.

There is, however, no national or state level institution dealing with all facets of FM exclusively and in a holistic and comprehensive manner. Such an Institute is required as it can serve the purpose of imparting training to the engineers and administrators of the central government and the state governments in all fields of FM. It can, in a subsequent phase, train personnel belonging to the police departments, civil defence, home guards, the SDMAs, non-governmental organisations (NGOs) and also public representatives in flood fighting, rescue and relief. It can also undertake activities to create awareness among all the stakeholders about their role in handling flood events and promote adaptive research relating to FM measures including FF&W. It will work in close collaboration with other Institutes of the central government and state governments, especially the institutes proposed for management of cyclone disasters and training of NDRF

*The MOWR in close collaboration with the NDMA will establish a National Flood Management*

*Institute (NFMI) as a centre of excellence with experts as its faculty and having state-of-the-art equipment at an appropriate location, in one of the flood prone states. The institute will be functional by the end of December 2010. Till then the NWA will undertake these activities in addition to its current functions.*

### 2.2.14 River Basin Organisations-Inter-state Coordination

FM being a state subject, each state government has naturally been dealing with it separately and in its own best interests. Implications of the measures taken by one state for the states located in the upstream or downstream have not often been taken into cognisance. It has been felt that FM needs to be dealt with in a comprehensive way especially on rivers that are international/interstate in nature. The rivers Ganga, Brahmaputra, Indus etc. originate in neighboring countries and information is required from these countries for the effective management of flood-related disasters. These rivers, after entering India, flow through many states before out falling into the sea. In between, they are joined by many tributaries, flowing through more than one state. The rivers, which are confined within India, also originate in one state and then flow through other states before out falling into the sea.

Various committees/task forces/working groups appointed by the GOI to look into the problem of floods and FM have highlighted the need for basin approach to FM. The RBA, the Experts Committee on the implementation of the recommendations of the RBA, the sub-group on FM for the Eleventh Five-Year Plan, etc. have expressed the need for the establishment of a central organisation to deal with the problem of floods in a comprehensive manner.

*The MOWR has set up the Brahmaputra Board and GFCC to look after FM in Brahmaputra and*

*the Ganga river basins respectively. The MOWR in consultation with the state governments, will take appropriate action in regard to the establishment of such organisations in other flood prone river basins and in strengthening of the CWC, Brahmaputra Board and GFCC.*

## 2.3 State-level Organisations

### 2.3.1 Disaster Management Departments/Commissioners

Disaster Management departments/Commissioners in the states deal with rescue/relief operations during floods.

### 2.3.2 State Disaster Management Authority

At the state level, the State Disaster Management Authority (SDMA), headed by the chief minister will be established by the state governments to lay down policies and plans for DM in the state. It will, inter-alia, approve the state plan in accordance with the guidelines laid down by the NDMA, coordinate the implementation of the state plan, recommend provision of funds for mitigation and preparedness measures and review the developmental plans of the different departments of the state to ensure the integration of prevention, preparedness and mitigation measures.

### 2.3.3 State Executive Committee

*All state governments will appoint experts in FM in the faculty of their administrative training institutes, which will collaborate with the NFMI in organising the training of personnel in the field of FM.*

Every state government will constitute a State Executive Committee (SEC) to assist the SDMA in the performance of its functions. The SEC will be headed by the chief secretary to the state government and coordinate and monitor the implementation of the national policy, the

national plan and the state plan. It will also provide information to the NDMA relating to different aspects of DM.

### 2.3.4 State Flood Control Boards/State Flood Control Technical Advisory Committees

Flood being a state subject, FM schemes are planned and executed by the State governments. The role of the central government is advisory, catalytic and promotional in nature. The states have to investigate, plan, construct, maintain and operate all flood works. Flood Control Boards were set up in some of the states along with the CFCB.

### 2.3.5 Irrigation/Water Resources/Flood Control Departments

The nodal organization is the Irrigation Department, which may or may not have a separate wing dealing with flood control in some states. The Public Works Department (PWD) deals with all the public works including flood control. In the state of West Bengal the Irrigation and Waterways Directorate under the Irrigation and Waterways Department, deals with irrigation, waterways and flood control. The Ministers' Committee on Flood Control, 1964, had stated 'that at least in the States with serious flood problems, proper flood control departments should be organized under a Chief Engineer with appropriate number of regular field circles and divisions to look after investigations, construction and maintenance of flood control works as distinct from the regular Department'.

### 2.3.6 District Disaster Management Authority

At the cutting edge level, the District Disaster Management Authority (DDMA) headed by the District Magistrate, with the elected representative of the local authority as the co-chairperson, will act

as the planning, coordinating and implementing body for DM and take all necessary measures for the purposes of DM in the district in accordance with the guidelines laid down by the NDMA and SDMA. It will, inter-alia prepare the district DM plan including the response plan for the district, coordinate and monitor the implementation of the national policy, the state policy, the national plan, the state plan and the district plan and ensure that the guidelines for prevention, mitigation, preparedness and response measures laid down by the NDMA and the SDMA are followed by all departments of the government at the district level and the local authorities in the district.

### 2.3.7 Local Authorities

These include Panchayati Raj Institutions (PRIs) and Urban Local Bodies (ULBs), such as municipal corporations, municipalities, district and cantonment boards and town planning authorities for control and management of civic services.

*PRIs and ULBs will ensure capacity building of their officers and employees in DM, carry out relief, rehabilitation and reconstruction activities in the affected areas and will prepare DM plans in consonance with the guidelines of the NDMA, SDMA and DDMA.*

### 2.3.8 State Disaster Response Force

For the purpose of a specialised response to a threatening disaster situation or disasters both natural and man-made, the DM Act, 2005 has mandated the creation of a NDRF . *To augment their capacities, all state governments/SDMAs will organise, from within their armed police force, adequate personnel for the constitution of State Disaster Response Force (SDRF) with appropriate disaster response capabilities. Under the aegis of the NDMA, the states will raise the SDRF*

### 2.3.9 Intra-state Multi-sectoral Coordination

While the state irrigation/water resources/flood control departments are responsible for planning, implementation and operation and maintenance of structural measures of FM in the state, civil authorities at the district/taluka/block/village level are responsible for search, rescue and relief. Further, the activities of one department, such as the construction of roads by the PWD, or railway lines by the Ministry of Railways (MOR), urbanisation/industrialisation regulated by the ULBs and town and country planning organisations etc can affect the vulnerability of an area to floods and drainage congestion. The floods in the Krishna basin in 2005 are a case in point. It is therefore important that a mechanism is established for ensuring coordination among the various departments of state governments. In most of the flood prone states, State Flood Control Advisory Committees have been constituted with representatives of the various departments of the state governments and central organisations concerned, where the FM schemes proposed by the state irrigation/water resources/flood control departments are considered and approved. There is no multi-disciplinary authority wherein the schemes of other departments for construction of irrigation works, roads, railway lines and development of residential, commercial and industrial estates etc., are considered with respect to their impact on the vulnerability of the areas to floods/drainage congestion and approved for implementation.

*Therefore, the state governments/SDMAs will establish appropriate multi-disciplinary mechanisms, whose clearance of the proposals of various departments with respect to the FM angle will be mandatory, before the works are sanctioned by them and taken up for implementation by the departments concerned. The mechanisms will be empowered to make recommendations for making the works flood*



*safe as well as ensuring that they do not lead to increase in vulnerability of the areas to floods and drainage congestion.*

*of Calamity Relief Fund (CRF) can also be utilised for purchase of equipment for flood preparedness , mitigation, rescue and relief .*

## 2.4 Techno-economic Appraisal of Flood Management Schemes

Most of the state governments affected by floods have set up multi-disciplinary State Flood Control Technical Advisory Committees (TAC) for clearance of FM schemes before approval as per the procedure laid down by the Planning Commission. The TACs have representatives from the concerned departments/organisations of the state as well as the central government.

## 2.5.2 State Plans

Flood control is a state subject and thus flood control schemes are planned, funded, executed and maintained by state governments themselves as per their own priorities. Central plan assistance is in the form of block loans and grants and is not tied to any sector or project. Allocations for the flood sector within the overall plan outlay are made by the state governments themselves.

## 2.5 Funding of Flood Management Schemes

*The various measures for FM recommended in these guidelines will accordingly be included by the state governments in their state plans.*

### 2.5.1 Plans of Central Ministries/Departments

Mainstreaming of DM concerns into the developmental plans and underlying special mitigation projects at various levels is a major feature of the regime that has been ushered in, with the passage of the DM Act 2005. A working group on DM, constituted for the first time by the Planning Commission, has made several recommendations in this regard, whose incorporation in the Eleventh Five Year will significantly facilitate the funding of the plans (as also the mitigation projects) that will be made by the central ministries/departments and the state governments based on these guidelines.

### 2.5.3 Centrally sponsored/Central Sector Schemes

The role of the central government is advisory, promotional and catalytic in nature. The CWC and the GFCC, besides being responsible for techno-economic appraisal of flood control schemes above a certain cost, also inspect critical reaches and suggest remedial measures as and when required. The MOWR is operating a few centrally sponsored/central sector schemes for assisting the states in taking up critical anti river erosion works in the Ganga basin and north-eastern states, improvement of drainage in critical areas, flood proofing etc. The overall allocation for these schemes is far too small to make an impact on FM in the country. The funding pattern of the centrally sponsored schemes is not uniform. It varies from 75:25 (Centre: State) for the Ganga basin states to 90:10 for the northeastern states.

*The various measures for FM recommended in the guidelines will be funded respectively by the central ministries and departments and state governments concerned by making provisions in their annual and Five Year plans. Funding will also be available through special mitigation projects to be formulated and implemented by the state governments/SDMAs under the overall guidance and supervision of the NDMA. In addition 10 per cent*

*The MOWR on the request of the state governments and subject to availability of funds*

*will include some of the schemes recommended in the guidelines for funding under these schemes.*

#### 2.5.4 District Planning and Development Council Funds

Certain percentage of funds available to District Planning and Development Council in the flood prone areas will be allocated for implementation of FM schemes in the districts.

#### 2.5.5 Calamity Relief Fund

Many of the state governments have represented that the guidelines for the utilisation of the money under CRF envisage that immediate repairs to infrastructure damaged in floods must be completed within a period of 30 days after occurrence of the damage. They consider this period to be inadequate as the assessment of the damage and preparation and approval of the estimates of cost for repairs and award of works after call of tenders etc., take considerable time. There is a view that this period be extended to at least 90 days. The representative from the government of Punjab requested for revision of guidelines so that the CRF is also available for drainage improvement works in waterlogged areas.

*These issues of extending duration by which the state governments are required to complete repair of damaged infrastructure and inclusion of drainage improvement works within the ambit of CRF, will be resolved after the deliberations of the Thirteenth Finance Commission.*

#### 2.5.6 National Flood Mitigation Project

The NDMA has proposed to take up a National Flood Mitigation Project in the Eleventh Five Year plan whose aims and objectives will be evolved in due course. Broadly, it will address the following issues:

- (i) assessment of the risk and vulnerabilities associated with various flood disasters;
- (ii) mitigation and reduction of the risk, severity or consequences of floods;
- (iii) capacity development including enhancing the capabilities of communities and training functionaries.
- (iv) effective preparedness to deal with floods;
- (v) improving the promptness and efficacy of response to impending threats of floods or actual occurrence;
- (vi) ensuring that arrangements are in place to organise rescue, relief and rehabilitation;
- (vii) improving the quality and increasing the speed of rehabilitation and reconstruction processes;
- (viii) creating awareness and preparedness and providing advice and training to the agencies involved in flood DM and the community.

Tentatively the component-wise activities including structural and non-structural measures (e.g. infrastructural, equipment, stores, capacity-building, etc.) that will be funded under the project include:

- Carrying out special studies on threat perception/vulnerability analysis/flood disaster risk assessment of the flood prone areas.
- Facilitating the establishment of state-level training institutions for imparting training for flood disaster preparedness/mitigation etc creating awareness of flood disaster,

and training and educating people to cope up with floods at district/block levels.

- Securing prompt and people-friendly dissemination of information to the public.
- Establishing a dedicated communication network that can remain functional during floods.
- Setting up of Flood shelters.
- Suitably locating flood disaster relief centres/basic infrastructure like hospitals, stores, etc., on high ground, so that they remain functional during floods.
- Creating and maintaining an adequately trained disaster response force.
- Identifying road transport/rail/communication networks that connect flood disaster relief/supply centres to flood prone areas and including construction of new rail/road infrastructure that may be reliably used during floods.
- Identifying suitable high grounds where people can be shifted during floods.
- Strengthening the flood forecasting and warning network.

*The NDMA will take action to expedite preparation of DPR and its approval for implementation by the central ministries and departments and state governments.*

## 2.6 Flood Insurance

The CRF provides for gratuitous relief for survival of people affected by floods. It does not compensate them for the losses suffered by them

during floods. Insurance against losses of lives and property in the flood is an important tool for transfer of risk compensating them for the losses suffered by them in floods. Flood insurance has not been adopted widely in India. Though flood risk has been included in 'cover' issued by the general insurance companies in India, it is more popular in urban areas and big towns where damage due to inundation caused mostly by excessive rainfall is taken care of. The insurance companies have not been able to arrive at the different rates of insurance premium for different flood prone regions in the country. As such, they continue to charge uniform rate irrespective of the fact that a property may be located in a high flood risk area or other areas. The problem being faced by the insurance companies is with regard to the collection of basic data for working out a fair and equitable premium for all areas according to flood risk. The insurance cover works successfully for a class of people who are subjected to such risks more or less equally. In case of floods, the risk of loss even in areas liable to flood is not equal. Comprehensive studies in this regard are required to be taken up by insurance companies in association with experts.

*The Ministries of Finance, Agriculture and Water Resources, the state governments and the insurance companies will jointly take up studies for a graded system of insurance premium according to flood risk in flood prone areas of the country. The MOWR in consultation with the state governments will explore the possibility of introducing schemes where insurance of structures, buildings and crops in flood plains is made compulsory. Consultations on the proposal will be held with all the players and stakeholders and the scheme implemented in a few selected areas on experimental basis. Once successful, the scheme will be implemented on a larger scale. The value of such scheme can not be over-stated.*



## 2.7 Action Plan

S.No	Activity	2008				2009				2010				2011				2012
		M	J	S	D	M	J	S	D	M	J	S	D	M	J	S	D	M
1.	Strengthening/restructuring of GFCC	App roval → Implement																
2.	Strengthening/restructuring of Brahmaputra Board	App roval → Implement																
3.	National Flood Management Institute	App roval → Develop infrastructure → Implement																
4.	River basin organisations	App roval → Establish → Implement																
5.	National Flood Mitigation Project	App roval → Implement																
6.	Flood insurance	Stu- dies and consultations → Implement a pilot project → Implement on large scale																
7.	Mechanism for intra-state coordination	Est- ablish → Implement																

# 3

## Flood Prevention, Preparedness and Mitigation

### 3.1 Introduction

On account of frequent occurrence of floods since time immemorial, people have learnt to live with them. They have generally set up settlements away from frequently flooded areas, which have been used for less important activities such as agriculture, grazing of cattle etc. The crops that can sustain submergence, are grown in the flood prone areas, during monsoon. The crops grown in the areas that were inundated during floods, result in bumper yields. Traditional methods based on locally available resources have been used to minimise the damage during floods. With the increase in population, these areas have been occupied and as a result floods cause huge damage to lives, cattle, property and infrastructure. The FM measures can be categorised into structural and non-structural measures. Structural measures for FM are physical in nature and aim to prevent flood waters from reaching potential damage centres, whereas non-structural measures strive to keep the people away from flood waters.

### 3.2 Structural Measures for Flood Management

The main thrust of the flood protection programme undertaken in India so far has been on structural measures.

#### 3.2.1 Embankments/Banks, Flood Walls, Flood Levees

The embankment system in the river restricts

the river to its existing course and prevents it from overflowing the banks. Embankments are constructed generally with earth easily available from nearby areas. In developed areas where adequate space is not available or land is very expensive, concrete or masonry floodwalls are constructed. Embankments (including ring-bunds and town-protection works) are the most popular method of flood protection and have been constructed extensively in the past. Embankments are designed and constructed to afford a degree of protection against floods of a certain frequency and intensity or against the maximum recorded flood depending upon the location protected and their economic justification.

In the nineteenth century a number of well-planned embankments were constructed on some of the rivers to provide protection to the command areas of the canal systems in northern India and the deltaic tracts of east-flowing rivers in Orissa, Andhra Pradesh and Tamil Nadu.

Divergent views have however emerged on the utility of embankments as a means for flood protection. While some NGOs have voiced serious criticism of existing embankments and advocated their removal, others favour construction of additional lengths of embankments as the only practical medium/short-term solution for the flood problem. Embankments have provided positive benefits by ensuring protection against floods and river spills. Embankments with proper roads have provided useful communication link in the area. These are generally the only means of communication during floods and thereafter. They also provide shelter to

the villagers during floods. However, breaches in them have resulted in large-scale flooding in the protected areas. Poor drainage in the protected area also leads to drainage congestion. The embankments may lead to deposition of silt and rise in bed levels, thus decreasing the carrying capacity of the river and aggravating drainage congestion. They interfere with natural drainage and deprive protected areas of fertile soil and groundwater recharge. They are also generally unable to withstand erosion unless adequately protected. These concerns can, however, be taken care of while designing the embankments i.e. by locating them away from active river edge, keeping sufficient space between the embankments on two banks of the river, keeping height, width, side slopes and slope protection to withstand the design flood, providing required number of sluices of adequate size for drainage and spilling sections/ breaching sections for allowing water to spill/flood the protected area after water level in the river reaches a certain stage etc.

*The circumstances, in which embankments/ flood walls/flood levees will be constructed for prevention of flooding, can only be decided after carrying out detailed hydrological and morphological studies regarding their favourable and adverse effects. State governments/SDMAs will evolve date lines and priorities for carrying out studies in their States. It is only then that embankments with properly designed and located drainage sluices, spilling sections and anti-erosion measures in combination with other works such as reservoirs, channel improvement works, drainage improvement structures, etc, will be planned and implemented as a short-term and/ or long-term solution to the flood problem. Ongoing embankment projects will also be reviewed with respect to their location and designs.*

### 3.2.2 Dams, Reservoirs and other Water Storages

Lakes, low lying depressions, tanks, dams

and reservoirs store significant proportions of flood water and the stored water can be released subsequently when the flood has receded. The stored water can also be used subsequently for irrigation, power generation, and meeting industrial and drinking water needs. In the case of large multi-purpose reservoirs, a proper reservoir regulation schedule can be worked out for optimum benefit from the project as a whole. Keeping the importance of these measures in view, a separate chapter has been devoted to these works.

### 3.2.3 Channel Improvement

A channel can be made to carry flood discharge at levels lower than its prevailing high flood level by improving its discharge carrying capacity. Channel improvement aims at increasing the area of flow or the velocity of flow (or both) to increase its carrying capacity. Channel improvement has not been resorted to widely in India mainly because of the high costs involved and topographical constraints. However, it is of advantage to take up such work for local reaches.

*Therefore wherever required and subject to techno-economic considerations, the state governments will identify the locations and take up appropriate channel improvement works to increase the velocity and/or the area of flow and reduce the flood level in the river depending upon site-specific conditions.*

### 3.2.4 Desilting/Dredging of Rivers

The studies carried out so far indicate aggradation/degradation of riverbeds in certain reaches, but they do not confirm the common belief of a general rise in river beds. Silting at places where the rivers emerge from the hills into the plains, at convex bends and near their outfall into another river or lake or sea, is a natural phenomenon. Accordingly, rivers exhibit a tendency

to braid/meander/form deltas. Various committees/experts appointed to look into this problem have not recommended desilting/dredging of the rivers as a remedial measure. Selective desilting/dredging at outfalls/confluences or local reaches can, however, be adopted as a measure to tackle the problem locally.

*The MOWR, CWC and the state governments/SDMAs will study the problem of rise in riverbeds in a scientific manner with the help of science and technology, academic institutions and reputed corporate sector firms and explore the techno-economic viability of desilting/dredging as a remedial measure to mitigate the effects of rise in the riverbeds.*

### 3.2.5 Drainage Improvement

Surface water drainage congestion due to inadequacy of natural or manmade drainage channels results in flooding in many areas. In such cases constructing new channels and/or improving the capacity of existing channels constitute an effective means of flood control. However, the possibility of drainage congestion and flooding in the downstream area is to be kept in mind while formulating such schemes.

The system of dhars' or old channels', efficiently serve the function of draining away the spillage and surface flows generated by local rains. The blocking of these natural drainage channels, which is normally done in the name of 'reclamation for development', may result in drainage congestion/water-logging.

*The state governments/SDMAs will review the adequacy of existing sluices and drainage channels in areas suffering from drainage congestion. If the capacities of existing sluices in embankments and drainage channels are inadequate, they will be improved by increasing the vents and improving*

*outfall conditions. State governments/SDMAs will prohibit the blocking of the natural drainage channels and sluices by an appropriate law and improve their capacity and construct new channels and sluices to ensure flow of excess rainwater in the area.*

### 3.2.6 Diversion of Flood Water

Diverting all or a part of the discharge into a natural or artificially constructed channel, lying within or in some cases outside the flood plains is a useful means of lowering water levels in the river. The diverted water may be taken away from the river without returning it further downstream or it may be returned to the river some distance downstream or to a lake or to the sea.

This measure can be used successfully to prevent flooding around cities. The flood spill channel skirting Srinagar city and the supplementary drain in Delhi are examples of diverting excess water to prevent flooding of the urbanised areas.

*Therefore, wherever the capacity of river channels passing through the towns and cities is inadequate and cannot be improved to the required extent, state governments/SDMAs will study the feasibility of implementing the schemes for diverting excess water to existing or new channels by bye-passing them to prevent flooding.*

### 3.2.7 Catchment Area Treatment/Afforestation

Watershed management measures such as developing the vegetative cover i.e. afforestation and conservation of soil cover in conjunction with structural works like check dams, detention basins etc. serve as an effective measure in reducing flood peaks and controlling the suddenness of the runoff. This, however is not very effective during a large flood although, it does help in reducing the siltation of reservoirs and to some extent, silt load in the rivers as well.

*The state governments/SDMAs will, therefore, take up appropriate watershed management measures including afforestation, check dams, detention basins etc. in the catchment of rivers to prevent soil erosion, enhance water conservation and minimise water and sediment runoff.*

### 3.2.8 Anti-erosion Works

Alluvial rivers are usually meandering in nature and, therefore, raise problems of erosion and silting at various locations. This is a natural phenomenon and results in loss of land at one location and gain at some other. Generally, there is a tendency of the meander to shift progressively downstream. The process of bank erosion is, therefore, consistently active and measures for protection of banks are a recurring necessity.

Anti-erosion works are normally taken up only for protection of towns, industrial areas, groups of thickly populated villages, railway lines and roads where re-location is not possible on socio-techno-economic grounds, long lengths of vital embankments benefitting large areas in case retirement is not technically or otherwise feasible and agricultural lands where the cost-benefit ratio justifies such works.

Bank erosion can be minimised by adopting measures that aim at deflecting the current away from the river bank or which aim at reducing the current along the bank of the river and induce silt. The anti-erosion measures in the form of revetment or pitching along with launching apron and spurs of earth protected by armour of stones or spurs of loose stones or stones in wire-mesh crates aim at increasing resistance of the bank to erosion and deflecting the current away from the bank. These generally shift the problem in the upstream or the downstream and necessitate further works to safeguard the land against erosion. Measures such

as permeable spurs, porcupine spurs made of bamboos or of reinforced cement concrete elements reduce the velocity of flow and thus prevent erosion and induce siltation in the vicinity of the bank.

Geo-synthetic material (woven geotextile) available in various forms like big bags and tubes etc. can be filled in-site with riverbed sand to form the groynes, spurs and revetments. The dredging of the channels in the selected reaches which have silted up can be tried. Geo web filled with concrete overlaid on geo-fabric filters in lieu of stone revetment and launching apron is also a new development. Pilot schemes using these and other new technologies will be taken up to evaluate their performance and techno-economic viability.

Since it is not techno-economically feasible to prevent river erosion completely, national and state rehabilitation and resettlement (RR) policies will be revisited to include provision for resettlement and rehabilitation of victims of river erosion.

*Therefore, the state governments/SDMAs/DDMAs, wherever required and if relocation is not possible on social, technical and economical considerations, will plan and implement appropriate anti-erosion measures such as revetments, slope pitching, permeable and impermeable spurs using conventional materials and/or geo-synthetics for protection of towns, cities, industrial areas, groups of thickly populated villages, railway lines, roads and embankments from erosion by rivers in a time-bound manner. They will also review Rehabilitation and Resettlement (RR) policies for including provision for RR of people who cannot be protected against river erosion on techno-economic considerations. Upon receipt of specific requests from the state governments, the CWC, the GFCC and the Brahmaputra Board will assist them in survey, planning, design and implementation of these measures.*

### 3.2.9 Sea Walls/Coastal Protection Works

The erosion of land by the sea waves in coastal areas is a serious problem. Sea walls/coastal protection works in the form of groynes etc. are constructed to prevent flooding erosion in coastal areas by sea water.

*Sea walls/coastal protection works will be planned and executed by the respective coastal states/port authorities, keeping in view the complexity of sea behaviour and other environmental aspects.*

### 3.2.10 Alignment, Location, Design and Provision of Waterway i.e. Vents, Culverts, Bridges and Causeways in National Highways, State Highways, District and Other Roads and Railways Embankments.

Roads and railway embankments cut across the drainage lines and may lead to increase in vulnerability of the area, through which they pass, to flooding and drainage congestion, if they are not properly aligned, located and designed. Inadequate waterway in the form of vents/culverts/bridges/causeways is another cause of increase in vulnerability to floods. Further, breaches in them may result in huge loss of life and properties. Insufficient height of embankments may result in overtopping and breaches.

*The Ministry of Shipping, Road Transport and Highways (MOSRTH), MOR, MOD, NHAI, BRO, state governments/SDMAs will ensure that national highways, state highways, district and other roads are aligned, located and designed properly with respect to height and width and provided with adequate waterway in the form of vents, culverts, bridges and causeways so as to make them flood safe and not increase the vulnerability of the area to flooding and drainage congestion.*

*The safety of existing roads/railway embankments against floods will also be checked by the MOSRTH, MOR, MOD, NHAI, BRO and state governments/SDMAs/DDMAs, and if found inadequate, measures by way of increasing height and width and augmenting water way by constructing additional bridges/culverts/causeways or by adding more spans to existing ones, will be taken up.*

## 3.3 Inspection, Rehabilitation and Maintenance

Structural works require a periodic and systematic inspection, rehabilitation and maintenance programme to ensure that the design capabilities are maintained. For example, embankments and levees may be subjected to weakening due to erosion during a flood event and during post-flood period by the action of burrowing animals, or the construction of utility lines such as water and gas pipelines, power cables etc. Of particular importance is an inspection programme and restoration/strengthening of vulnerable spots.

*The state governments/SDMAs will draw a programme of inspection of all structural measures twice a year, once before the commencement of the monsoon and again after the monsoon has withdrawn and ensure that restoration/strengthening measures of vulnerable spots are carried out before the commencement of monsoon every year. They will earmark adequate funds for the same in their annual budgets and assign responsibility to individual officials for completing the same.*

*Dams, flood embankments, levees and the works taken up for their protection against erosion etc. will be regularly inspected during floods for identification of vulnerable spots and immediate measures to strengthen them will be implemented. In case of apprehension of any breach or overtopping, people living in the area will be warned of the danger and the civil administration,*



with the help of NDRF, SDRF and/or the army will take steps for evacuation, rescue and relief.

The NDMA/MHA will take up with the Thirteenth Finance Commission the issue of earmarking

adequate funds for maintenance of the dams, embankments, levees and town protection works under appropriate heads of account in plan/non-plan budgets.

### 3.4 Action Plan for Structural Measures

S.No	Activity	Commen- cement	2008				2009				2010		2011	2012
			M	J	S	D	M	J	S	D	M	D	M	M
<b>Priority FP and DI works</b>														
1	Embankments	Immediate	P and A →				Imple- ment →							
2	Anti-erosion works	Immediate	P and A →				Imple- ment →							
3	Drainage channels	Immediate	P and A →				Imple- ment →							
4	Sea wall/coastal protection works	Immediate	P and A →				Imple- ment →							
<b>Other important works</b>														
5	Waterways in roads/railways embankments	Immediate	P and A →				Implement →							
<b>Long Term FP and DI works</b>														
6	Embankments	Immediate	P and A →				Implement →				→			
7	Anti-erosion works	Immediate	P and A →				Implement →				→			
8	Drainage channels	Immediate	P and A →				Implement →				→			
9	Sea wall/coastal protection works	Immediate	P and A →				Implement →				→			

P and A: Planning and Approval Stage--formulation of proposal and approval

### 3.5 Non-Structural Measures

Non-structural measures strive to keep people away from flood waters. It contemplates the use of flood plains judiciously, simultaneously permitting vacating of the same for use by the river whenever the situation demands. This technique allows the use of flood plains by reducing the disaster dimension, while retaining its beneficial effects.

#### 3.5.1 Flood Plain Zoning

It is natural for a river to overflow its banks in the event of heavy rainfall in its upper catchments and spill into the flood plains, which are basically its domain. Extensive and often unplanned use of flood plains by man disregarding the basic fact that it is part and parcel of the river leads to damage. This is one of the main factors responsible for the flood damage reported from different parts of the country in spite of substantial investments in the flood sector.

The basic concept of flood plain zoning is to regulate land use in the flood plains in order to restrict the damage due to floods, while deriving maximum benefits from the same. Keeping its importance in view, this has been dealt with in a separate chapter.

#### 3.5.2 Flood Proofing

Flood proofing measures help greatly in the mitigation of distress and provide immediate relief to the population in flood prone areas. It is essentially a combination of structural change and emergency action, not involving any evacuation. The techniques adopted consist of providing raised platforms for flood shelter for men and cattle, raising the public utility installation especially the platforms for drinking water hand pumps and bore wells above flood level, promoting construction of

double-storey buildings wherein the first floor can be used for taking shelter during floods.

*The state governments/SDMAs will provide adequate number of raised platforms/flood shelters at suitable locations in the flood plains with basic amenities such as drinking water, sanitation, medical treatment, cooking, tents, lantern etc. for the people to take shelter during floods.*

In case of urban areas, certain measures that should be taken up as soon as flood warning is received, are installation of removable covers such as steel or aluminium bulk heads over doors and windows, permanent closure of low level windows and other openings, keeping store counters on wheels, closing of sewer wells, anchoring and covering machinery and equipment with plastic sheets, etc.

In the existing developed areas, possibilities of protecting against submergence or relocating to safer areas vital installations like electricity sub-stations/power houses, telephone exchanges, the pumping stations meant for drinking water supply etc., will be seriously examined and appropriate measures will be undertaken by the state governments/SDMAs, to make them safe against floods.

*The state governments/SDMAs will take steps to make all public utility installations flood safe.*

#### 3.5.3 Flood Forecasting and Warning

Flood forecasting enables us to be forewarned as to when the river is going to use its flood plain, to what extent and for how long. A separate chapter has been devoted to the subject of flood forecasting and warning.

### 3.6 Integrated Water Resources Management

Integrated water resources management







(IWRM) is an alternative to the dominant sector-by-sector, top-down management style of the past. IWRM aims at integrating management of water resources at the basin or watershed scale.

IWRM looks outside the narrow ‘water sector’ for policies and activities to achieve sustainable water resources development. Focus areas for IWRM are water resources assessment, socio-economic assessment, water resources planning, implementation of action plans, day-to-day water resources management (adjustments of the plans) and water resources protection and conservation. Flood and water-related DM is a cross-cutting issue that touches upon all of these aspects. Given its holistic approach, IWRM takes into consideration several aspects besides water governance. These include:

- Water supply and health, e.g., sanitation systems and water-borne diseases;
- water and agriculture, e.g. water productivity and agricultural practices degrading water sources;
- water and bio-diversity, e.g. wetland loss and the need of water for eco-systems;
- water and energy, e.g. hydropower potential;
- water-related disaster reduction and response, e.g. floods and droughts.

*State governments/SDMAs with the cooperation of the CWC and other states will implement the IWRM system for all the river basins and sub-basins.*

### 3.7 Action Plan for Non-structural Measures

S.No	Activity	Commen- cement	2008				2009				2010				2011				2012			
			M	J	S	D	M	J	S	D	M	J	S	D	M	J	S	D	M	J	S	D
1	Flood shelters	Immediate	Implement 																			
2	Making public utility installations flood- safe	Immediate	Implement 																			
<b>IWRM-basin-wise development</b>																						
3	Inter-state river basins	Immediate	Collect data and develop model  Implement																			
4	Intra-state river basins	Immediate	Collect data and develop model  Implement																			

## 3.8 Medical Preparedness

### 3.8.1 After-effects of Floods Requiring Medical Attention

Floods as a natural disaster have a high potential of precipitating the incidences of mass casualties. There is the risk of drowning and physical trauma along with the threat of diseases associated with contamination of water and the creation of mosquito-breeding sites. Direct health effects of a flood may include: drowning; injuries like cuts, sprains, fractures, electric shocks; diarrhoea, vector-and rodent-borne diseases like malaria, leptospirosis; skin and eye infections; and psychological stress. The indirect health consequences of floods are usually due to damage caused to health care infrastructure and loss of essential drugs, damage to water and sanitation infrastructure, damage to crops and disruption of food supplies, destruction of property causing lack of shelter that may lead to increased exposure to disease-vectors.

Adverse effects of floods on health can be prevented by medical preparedness. Medical preparedness for floods constitutes the following components.

#### 3.8.2 Creating Awareness

*The state governments/SDMAs will take steps to create awareness to the type of illnesses and other health problems that can result in the aftermath of floods, to all the medical teams and the community at large. Hygienic practices such as hand washing with soap and use of the toilet for defecation, use of boiled water or adding chlorine to water and safe food cooking by disease-free persons will be promoted.*

#### 3.8.3 Creation of Trained Medical First Responders

*The state governments/SDMAs will ensure*

*the creation of trained medical first responders for first aid and resuscitation measures for drowning cases.* Medical staff must know how to take out water from the respiratory tract and how to carry out cardiopulmonary resuscitation. A list of trained medical and paramedical staff must also be made available.

#### 3.8.4 Medical Stores

*Medical kits will be prepared for the management of flood casualties.* Intravenous (IV) fluid, ventilators, oxygen, dressing materials, tetanus toxoid, antibiotics, vaccines, anti-snake venom and anti-diarrhoea drugs will be the most commonly needed medical resources. Large-scale medical stores from where these materials can be procured will be identified.

#### 3.8.5 Patient Evacuation Plan

*State governments/SDMAs will make available emergency medical equipment and drugs for resuscitation.* Paramedical staff must be trained for resuscitation, triage and to maintain vital parameters like pulse, blood pressure, respiration and intravenous drip during evacuation. Helicopters need to be deployed to aid in the evacuation of flood casualties collected at high points. The ambulances should have Standard Operating Procedures (SOPs) for treatment .

#### 3.8.6 Disaster Management Plans

*Disaster Management Plans need to be prepared by all hospitals.* Medical facilities, training of medical personnel, creating awareness about drowning and its management will be a part of the plan. Hospitals must nominate an officer for coordinating management for flood casualties. Contingency plans will be made ready for providing additional beds. Oxygen cylinders, continuous positive air pressure (CPAP) ventilators, dressing

materials, blood and IV fluid for transfusion will be stocked. The hospital casualty room is to be equipped with resuscitation equipment like suction apparatus, airways laryngoscope, pulse oxymeter, defibrillator and life saving drugs. In the aftermath of a flood, public health response is one of the prime responsibilities of medical authorities.

They will ensure safe water supply and clean food availability along with maintenance of hygiene and sanitation by proper bio-waste disposal. Water testing and food inspection is required to be carried out regularly to prevent outbreak of any epidemic. An effective communication system is an essential requirement for prompt medical response.

# 4

## Flood Forecasting and Warning in India

### 4.1 Concept

Flood forecasting (FF) enables us to be forewarned as to when the river is going to use its flood plain, to what extent and for how long. The forecast of a flood may be for the water level (stage forecast), discharge (flow forecast) and area likely to be submerged (inundation forecast) at various points/particular stations at a specific time.

Of all the non-structural measures for FM, which rely on the modification of susceptibility to flood damage, the one which is gaining sustained attention of the planners and acceptance of the public is flood-forecasting and warning. A nationwide flood forecasting and warning system covering major inter-state rivers has been established by the Central Water Commission (CWC). The system under CWC is often supplemented by the states that make arrangements for advance warning at other stations strategically important to them. The CWC also extends FF services to such stations at the request of the states concerned. With reliable advance information/warning about impending floods, loss of life and property can be reduced to a considerable extent. People, cattle and valuable assets can be shifted in advance to safer places.

### 4.2 Methodology

Flood forecasting services include the following phases:

#### 4.2.1 Data Collection

Real time hydrological data viz. gauge and

discharge and meteorological data, viz. rainfall, are the basic requirements for the formulation of a flood forecast. The hydrological and hydro-meteorological data from over 945 stations in the 62 river sub-basins are daily collected, analysed and utilised for formulation of flood forecasts. While most of the hydro-meteorological data are observed and collected by the field formations of CWC, FMOs of the IMD supply the daily rainfall data of their rain gauge stations besides synoptic situation including heavy rainfall warning for next 24 hours and range of quantitative precipitation forecasts for various river basins to the respective FF centres of the CWC. The CWC provides communication facilities to the FMOs in transmission of rainfall data of rain gauge stations located at the various CWC gauge and discharge stations.

#### 4.2.2 Transmission of Data to the Forecasting Centers

Transmission of data on a real-time basis from the hydrological and hydrometeorological stations to the flood forecasting centers is a vital factor in the FF system. Landline communication i.e., by telephone/telegram was the commonly used mode for data transmission in FF services till the beginning of the 1970s. The communication is mainly by VHF/HF wireless sets at the data observation/collection sites and at the FF centers. There are over 500 wireless stations of the CWC all over the country for communication of real-time data related to flood forecast.

In addition to wireless communication, telephone/telex/fax/V-SAT/Internet facilities are

also being utilised. During the Tenth Five-Year Plan, automatic water level/rainfall sensors with satellite-based transmitters were installed in the Chambal and lower Mahanadi basins. Installation of such equipment in the Krishna, Godavari, Brahmaputra, Damodar, Sutlej and Yamuna river basins is in progress. The system will be extended to other river basins in the Eleventh Plan period.

During the flood season, the data is communicated two to three times in a day. The frequency of transmission is increased to an hourly basis, if the flood situation so demands.

Thus, the CWC is maintaining a reliable and quick system of data transmission .

#### 4.2.3 Data Processing and Formulation of Forecasts

Historical data like gauge, discharge and rainfall are utilised for the development of techniques for formulation of forecasts on a real-time basis. Forecasts are formulated at the FF stations by predicting river stage/inflow with time of occurrence. After receipt of the hydrological and meteorological data from field formations, the data is processed in FF centers/control rooms to check its consistency and the data is modified, if any inaccuracy is found, before using in forecast formulation. All the forecasting centres of the CWC have been provided with computer facilities for data processing.

The inflow forecasts are mainly formulated by using rainfall runoff correlation developed for the particular catchment. Computer-based watershed model MIKE-11, developed under CWC-DHI collaboration, is being used for inflow forecasts. Computers enable frequent updating of predictions based on the observed part of the flood hydrographs of FF and base stations during the flood period.

The forecasts obtained from the coaxial correlation diagram or mathematical models/computerised watershed models are modified,

if required, to obtain the final forecast based on the prevailing conditions in the river and heavy rainfall warnings etc. In the CWC, the forecasts are formulated by a dedicated and experienced team of hydro-meteorologists and hydrologists.

Forecasts (stage/inflow) are issued whenever the river stage at the FF site exceeds or is likely to exceed a specified level called warning level of the site which is fixed in consultation with the concerned state government. The warning level is generally 1 m below the danger level of the site, although there is no- common format designed for issuing flood forecasts by various field divisions, as forecasts are issued according to the users convenience. In the forecast, the current date and time of issue of forecast, present water level/inflow and anticipated water level/inflow with corresponding date and time are normally included.

#### 4.2.4 Dissemination of Flood Forecasts and Warnings

The final forecasts are then communicated to the user agencies such as the concerned administrative and engineering authorities of the state/central governments including railways, defence and other agencies connected with flood protection and DM by special messenger/telegram/wireless/ telephone/fax/e-mail etc. Flood forecasts are also passed on to the All India Radio (AIR), Doordarshan and local newspapers for wide publicity in the affected area.

A flowchart for FF and warning is given in **Annex-IV/I**.

### 4.3 The Central Water Commission's Flood Forecasting Network in India

The CWC's FF network covers most of the flood prone inter-state river basins in the country. The CWC is presently issuing flood forecasts for

175 stations of which 147 stations are for river stage forecast and 28 for inflow forecast.

### River Basin- wise Distribution of FF Stations

Sl. No	River System	No. of FF stations
1.	Ganga and its tributaries	87
2.	Brahmaputra, and its tributaries	27
3.	Barak and its tributaries	05
4.	Eastern rivers	09
5.	Mahanadi basin	04
6.	Godavari basin	18
7.	Krishna basin	09
8.	West flowing rivers	15
9.	Pennar	01
Total		175

### State-wise Distribution of FF Stations

Sl. No.	States	No. of FF stations
1.	Andhra Pradesh	16
2.	Assam	24
3.	Bihar	33
4.	Jharkhand	05
5.	Gujarat	11
6.	Haryana	01
7.	Karnataka	04
8.	Madhya Pradesh	03
9.	Chhattisgarh	01
10.	Maharashtra	09
11.	Orissa	12
12.	Tripura	02
13.	Uttarakhand	03
14.	Uttar Pradesh	35
15.	West Bengal	14
16.	Dadra and Nagar Haveli	01
17.	NCT of Delhi	02
Total		175

## 4.4 Expansion and Modernisation of Flood Forecasting Services

Expansion and modernisation is a continuous process. The CWC has undertaken various expansion and modernisation schemes to cover more areas and to make forecasting more efficient and reliable. The IMD has also taken up the expansion of its network of Automatic Rain Gauges. The Ministry of Earth Sciences (MOES) is making efforts for the procurement of 12 Doppler Weather Radars (DWRs) for continuous monitoring of evolving extreme weather phenomena including heavy rainfall events along the coastal areas apart from tracking cyclones. Gradually, the DWR network would cover the whole country and in the process all the major river basins as well.

*The CWC, IMD and the state governments will increase the density of the basin-wise network of rain gauge and river gauge stations and establish basin-wise system of FF and early warning. Various FF initiatives, as listed below, will be taken by the CWC, IMD and the states.*

- a) *Data collection: Data will be collected using IMD, CWC and Bureau of Indian Standards (BIS) approved automatic sensors for rainfall and river flow measurements. A centralised mechanism for collection, archival and distribution of hydrological data from various river basins will be established on priority basis.*
- b) *Data transmission: Data will be transmitted using modern automatic telemetry data transmission techniques e.g. satellite, VSAT, Internet/e-mail, mobile phones etc.*
- c) *Flood forecast and impact assessment models: Computer-based comprehensive catchment scale hydrological and hydrodynamic models interfaced with flood plain inundation mapping tools will be developed.*

- d) *Forecast dissemination: Forecast will be disseminated using computer networks and satellite e.g. Internet, e-mail, VSAT, the terrestrial communication network, connectivity of the National Informatics Centre (NIC) etc.*
- e) *Flood hazard mitigation model: Basin-wise flood hazard mitigation models will be developed.*
- f) *Damage assessment and quantification models: Damage assessment and quantification models will be developed on priority.*
- g) *Advisories for flood relief routes: Advisories for facilitating flood relief routes will be formulated and issued.*
- h) *Value addition: Flood forecasts and warnings will be formulated, preferably, in the local language, in a format which is simple and easily understandable by the administrators and common people as well. CWC will also improve the usefulness of the forecasts and warnings by marking the area likely to be inundated, location of flood shelters etc. on the map of the area.*

#### 4.5 Coordination among the Central Water Commission, India Meteorological Department and the States

*The state governments will, as soon as possible, and not later than March 2008, establish a mechanism wherein representatives of the CWC, IMD, NRSA and the states interact with each other, exchange data on a real-time basis and formulate the flood forecasts and warnings, which are more reliable and understandable by the forecasters, administrators and the public to minimise loss of*

*lives and property on account of floods. The CWC will also forecast the area likely to be inundated corresponding to the expected river water level.*

## 4.6 International Cooperation

### 4.6.1 International Dimensions

A number of rivers originate beyond the borders of India in Nepal, Bhutan and China and flow into the country due to its geographical position. Some of these rivers constitute boundary between two countries over a part of their length. Therefore the cooperation of these countries in establishing a FF and W system that is reliable and gives enough lead time to the state governments for planning relief and rescue measures is required.

### 4.6.2 Cooperation with Nepal

The rivers Ghaghra, Sarda, Rapti, Gandak, Burhi-Gandak, Bagmati, Kamla, Kosi and Mahananda, which create flood situations in the states of Uttar Pradesh and Bihar in India, originate in Nepal. In order to make FF and advance warning in the flood plains of the above rivers flowing from Nepal, a scheme titled, 'Flood Forecasting and Warning System on Rivers Common to India and Nepal' which includes 42 hydro-meteorological sites in Nepal and 18 in India, has been in operation since 1989. To make it more effective and purposeful, a plan for modernisation of the system has been recently accepted by both countries. However, even this plan does not include installation of automatic water level, rainfall and climatic sensors and the transmission of data is either through wireless or post.

*The system of hydro-meteorological observations and transmission of data will be modernised by installing automatic sensors and satellite-based transmitters. Negotiations in*



*this regard with the government of Nepal will be expeditiously concluded by the MOWR/MEA.*

#### 4.6.3 Cooperation with Bhutan

Presently, 35 hydro-meteorological stations are located in Bhutan. These are being maintained by the government of Bhutan and their data is transmitted to India through a network of wireless stations. A Joint Experts' Team consisting of officials from the GOI and the government of Bhutan was set up during 1979. It monitors this network through regular inspections and meetings. The hydro-meteorological observations and data transmission network are manual and the data are liable to have observational errors apart from delay in transmission of data.

*The system will be modernised by the CWC with the installation of automatic sensors for observation of data and satellite-based transmitters for its transmission on a real-time basis.*

#### 4.6.4 Cooperation with China




As a result of landslides, the debris either naturally occurring or activated by various developmental activities, partially or fully block the river courses. The subsequent collapse of these blockages results in flash floods in the states of Jammu and Kashmir, Arunachal Pradesh, Assam and Himachal Pradesh. The sudden release of water from reservoirs constructed on the Sutlej and Tsangpo (Brahmaputra) and their tributaries also results in flash floods. This, combined with heavy rainfall in the area aggravates the problem. By way of cooperation with China in the field of exchange

of information on flood management, India has signed an agreement for data transmission in respect of the Tsangpo Siang/Brahmaputra during 2002 under which India has been receiving water level data from China with regard to three sites on the river, twice a day. This has helped to a certain extent in improving the warning time of flood forecasts in respect of the Brahmaputra basin. Another Memorandum of Understanding (MOU) was signed during April 2005 for establishing hydrological station on the Sutlej river in Tibet by China and hydro-meteorological data of this site will be received twice a day by India after the signing of an Implementation Plan. This will help India to establish a FF and W system on the river Sutlej in Himachal Pradesh. However, with the travel time of the water from the observation center to the damage centre in India, being small, more hourly exchange of information is required. The data on some more tributaries of these rivers and the river Indus is also required. Also a system of informing India of blockages in rivers' courses and advance warning about releases from the reservoirs is also required.

*Negotiations with China will be expedited by the MOWR and MEA for extending cooperation with respect to exchange of hydro-meteorological data of rivers common to China and India on more rivers and by increasing the frequency of transmission to an hourly basis. The ongoing effort for reaching an understanding for passing information on blockages in rivers and release of water from the reservoirs constructed on the rivers and their tributaries will also be expedited and a mechanism for exchange of information put in place at the earliest.*



### 4.7 Action Plan for Flood Forecasting and Warning

S.No	Activity	Commencement	2008				2009	2010	2011	2012	
			M	J	S	D	M	M	M	M	
1	Mechanism for joint formulation of forecasts by CWC/IMD/NRSA/states	Immediate	Me-  etings								
2	Expansion and modernisation of FF and W network by CWC/IMD/NRSA/state governments	Immediate	Me-  etings	Planning and approval			Implement				
3	Modernisation and strengthening of FF and W network in Nepal	Immediate	Me-  etings							Implement	
4	Modernisation and strengthening of FF and W network in Bhutan	Immediate	Me-  etings	Implement							
5	Modernisation and strengthening of FF and W network in China	Immediate	Meetings					Implement			

# 5

## Dams, Reservoirs and Other Water Storages

### 5.1 Introduction

Natural lakes, low-lying depressions, swamps etc., store substantial amount of water flows resulting from rains and help in reducing the discharge into the rivers and flood inundation. The water stored in these depressions etc., can be used for irrigation, power generation, industrial and drinking water needs. Their capacities can be improved by desilting and constructing embankments around them. Some of the water stored in these water bodies percolates below the ground thereby adding to the groundwater storage. Thus, in addition to flood moderation, these water storages also help in water conservation and groundwater recharge.

### 5.2 Natural Detention Basins

Detention basins are usually formed by utilising natural depressions/swamps and lakes by improving their capacity through construction of encircling embankments and providing suitable devices for regulating the release of stored water. Since the land under the marshes or low depressions may hardly require much compensation and rehabilitation measures, this method is relatively inexpensive. The Ghaggar diversion scheme in Rajasthan is a good example where water has been diverted into depressions. Depressions on the left bank of the river Jhelum, upstream of Srinagar city in Jammu and Kashmir; the Mokama Tal area in Bihar; the Ottu, Bhindawas and Kotla lakes in Haryana and various beels/hoars on the banks of the Brahmaputra and Barak rivers in Assam are a few examples of natural detention basins .

Moderation of floods by utilising natural depressions, swamps and lakes to which a portion of floodwater can be diverted, is an effective method of protection from floods depending on topography of the particular area. It is an economical alternative to construction of dams and reservoirs especially for flood moderation.

*Therefore the state governments/SDMAs will study the availability of natural depressions, swamps and lakes in the vicinity of the rivers and wherever required and feasible, utilise them for temporary storage of floodwaters.*

### 5.3 Dams and Reservoirs

Dams and reservoirs store water during floods the quantum of which depends on the availability of space in the reservoir thereby reducing the flood peak downstream. The stored water is released from the reservoir for meeting water requirements for irrigation, power generation, and drinking and industrial purposes. The water is also released into the river downstream subject to its safe carrying capacity to make space in the reservoir for accommodating future floods as per the reservoir regulation manual.

Reservoirs provide a good long-term solution to the problem of floods. They are more effective for flood control if a designated space is reserved. The National Water Policy 2002 has recommended the provision of an adequate flood cushion in water storage projects and that flood control be given overriding consideration in the reservoir regulation policy.

Reservoirs themselves may not offer complete flood protection for various reasons. Embankments along the river in the downstream reaches are often required as a supplementary measure to contain the residual floods. Reservoirs, to the extent technically and economically feasible, are an important component in any package of measures for FM. Reservoirs also ensure optimum utilisation of water resources.

*The state governments/SDMAs/central agencies, wherever feasible, will therefore plan all the new dams and reservoirs with specific flood cushion provisions, prepare their Detailed Project Reports (DPRs) and complete the works in India by the year 2020 and in Nepal and Bhutan by the year 2025.*

#### 5.4 Regulation of Reservoirs

Reservoirs in general have a beneficial effect on the flood problems of a basin. Their effectiveness in moderating flood would depend on the capacity available for absorbing flood runoff.

Reservoirs can, however, also accentuate the flood problem in the downstream areas if the rules for their regulation are not prepared considering the flow-carrying capacity of the rivers and the safety of the dams. Similarly, if the reservoirs are not operated according to the operation manual and the reservoir is filled at the beginning of the monsoon season for meeting water demands for irrigation, hydropower, drinking and industrial water supply, a large quantity of water may suddenly have to be released to prevent the crossing of Maximum Water Level (MWL) and for ensuring the safety of the dam which may lead to flooding downstream. The inability on the part of the agency in charge of operating the reservoir to anticipate intense rainfall in the catchment, and consequent large inflows into the reservoir, may also necessitate the release of a large quantity of water resulting in large-scale flooding.

The Experts' Committee to review the implementation of the recommendations of the RBA studied the working of five major storage dams viz., Bhakra, Hirakud, Rengali, Nagarjunasagar and Srisaillam, especially with regard to flood control. Among them, only the Rengali dam has a specially allocated flood reserve. The others are multi-purpose projects with flood control as one of the benefits. The general conclusions drawn by the Committee are:

- (i) The Hirakud dam moderated all the flood peaks that passed through it.
- (ii) The Bhakra dam also moderated the flood peaks excepting the flood peak in 1988.
- (iii) The other dams too generally helped in moderation of the floods peaks.
- (iv) The importance given to flood moderation as originally envisaged got diluted over the years by giving higher importance to hydropower generation and irrigation.
- (v) Reservoir regulation schedules could be vastly improved by revising the existing procedures and guidelines, and by giving FM its due importance.
- (vi) The flood plains downstream of the Dam have been encroached upon without considering the consequences.
- (vii) For each reservoir, the feasibility of improvement in operation manual should be studied by an expert group which will go into the past operations, priorities in the approved project and the manner in which the flood moderation can be improved upon without undue compromise on other benefits. In highly flood prone areas, in accordance with the provisions of the National Water Policy (2002), flood control

has to be given overriding consideration in the reservoir operation policy even at the cost of sacrificing some irrigation and power benefits.

A case study of Hirakud dam in order to illustrate these points is given in **Annex-V/I**.

It can be concluded that reservoirs do moderate floods. The extent of moderation depends upon available space in the reservoir for storage of water during floods. Full reservoir level is required to be achieved, as early as possible, for meeting water demands for irrigation, hydropower generation, drinking and industrial water supply. Reservoir operation manuals/rule curves are formulated to optimise flood moderation as well as other benefits.

*Every state government/SDMA will:*

- (i) draw up an action plan by June 2008 for completing the review/modification of rule curves and operation manuals within a period of three years.*
- (ii) set up experts committees/review committees by September 2008 with the CWC's representative as a member for review of rule curves/operation manuals for each of the major reservoirs.*
- (iii) review the operation rules of all the existing reservoirs and modify them by December 2009 making them appropriately consistent with the safety requirements of the structure, flood moderation and other uses.*
- (iv) make arrangements of forecast of inflows into the reservoirs incorporating latest technology for collection of real-time data, and analysis and mathematical modelling for formulation of forecast either on their own or through the CWC.*

*(v) install automatic water level sensors with satellite-based transmitters at all the reservoirs and share real-time data during the monsoon period among the basin states.*

*(vi) once the protocols are worked out and put in place, set up an appropriate mechanism for ensuring strict enforcement, without any deviation of the operational rules so that local compulsions do not cause avoidable loss of life and property elsewhere.*

*The state governments/SDMAs will be assisted by the CWC and the IMD in implementation of the above measures.*

## 5.5 Dam Safety Aspects

Dams will be subject to a dam safety programme, both at the national and state levels to ensure that the specialised expertise required for the inspection of all structures is available.

Dam safety programmes will be carried out strictly in accordance with the standards and guidelines laid down by the Dam Safety Organisation of the CWC. Dam Safety Review involves review of design flood, spillway capacity, structural soundness of the dam, spillway and appurtenant works and, if required, taking up of remedial measures in the form of augmenting the capacity of spillway by appropriate works or constructing additional spillways, strengthening of the dam, spillway and appurtenant works and completing the same in a fixed time frame.

*Pre-monsoon and post-monsoon inspections of dams will be carried out by experts and subsequent recommendations implemented by the state governments/SDMAs in a fixed time frame to ensure continued service and safety.*

5.6 Action Plan

S.No	Activity	Commencement	2008				2009				2010	2020	2025
			M	J	S	D	M	J	S	D	D	D	D
1	Natural depressions for temporary flood moderation	Immediate	S-▣ Im-▣ tudies plement										
2	New dams and reservoirs in India	Immediate	DPRs and approval → Implement →										
3	New dams and reservoirs in Nepal and Bhutan	Immediate	DPRs and approval → Implement →										
4	Reservoir operation manuals and rule curves	Immediate	IR → Review and modification →										
5	Mechanism for ensuring strict enforcement of reservoir operation manuals/rule curves	Immediate	M-▣ eetings Implement →										

IR: Identification of Reservoirs

# 6

## Regulation and Enforcement

### 6.1 Flood Plain Zoning

#### 6.1.1 Concept

The basic concept of flood plain zoning is to regulate land use in the flood plains to restrict the damage caused by floods. Flood plain zoning, therefore, aims at determining the locations and the extent of areas for developmental activities in such a fashion that the damage is reduced to a minimum. It, therefore, envisages laying down limitations on development of both the unprotected as well as protected areas. In the unprotected areas, boundaries of areas in which developmental activities will be banned, are to be established to prevent indiscriminate growth. In the protected areas, only such developmental activities can be allowed, which will not involve heavy damage in case the protective measures fail. Zoning cannot remedy existing situations, although, it will definitely help in minimising flood damage in new developments.

Flood plain zoning is not only necessary in the case of floods by rivers but it is also useful in reducing the damage caused by drainage congestion particularly in urban areas where, on grounds of economy and other considerations, urban drainage is not designed for the worst conditions and presupposes some damage during storms whose magnitude frequently exceeds that for which the drainage system is designed.

#### 6.1.2 Pre-requisites for the Enforcement of Flood Plain Zoning

The basic requirements to be taken care of

before implementing flood plain zoning are as follows:

- (i) Broad demarcation of areas vulnerable to floods.
- (ii) Preparation of a large-scale maps (1:10,000/1:15,000) of area vulnerable to floods with contours at an interval of 0.3 m or 0.5 m.
- (iii) Marking of reference river gauges with respect to which, the areas likely to be inundated for different magnitudes of floods will be determined.
- (iv) Demarcation of areas liable to inundation by floods of different frequencies, e.g., like once in two, five, ten, twenty years and so on. Similarly, demarcation of areas likely to be affected on account of accumulation of rainwater for different frequencies of rainfall like 5, 10, 25 and 50.
- (v) Marking of likely submersion areas for different flood stages or accumulation of rainwater on the maps.

#### 6.1.3 Regulation of Land Use in Flood Prone Areas

There can be different considerations for such regulations. For example, the area likely to be affected by floods up to a 10-year frequency should be kept reserved only for gardens, parks, playgrounds, etc. Residential or public buildings, or any commercial buildings, industries, and public

utilities should be prohibited in this zone. In area liable to flooding in a 25-year frequency flood, residential buildings could be permitted with certain stipulation of construction on stilts (columns), minimum plinth levels, prohibition for construction of basements and minimum levels of approach roads, etc. In urban areas there should be double-storeyed buildings. Ground floors could be utilised for schools and other non-residential purposes.

#### 6.1.4 Categorisation and Prioritisation of Structures in Flood Plains Zoning

In the regulation of land use in flood plains, different types of buildings and utility services can be grouped under three priorities from the point of view of the damage likely to occur and the flood plain zone in which they are to be located:

*Priority 1: Defence installations, industries, public utilities like hospitals, electricity installations, water supply, telephone exchanges, aerodromes, railway stations, commercial centres, etc. -Buildings should be located in such a fashion that they are above the levels corresponding to a 100-year frequency or the maximum observed flood levels. Similarly they should also be above the levels corresponding to a 50-year rainfall and the likely submersion due to drainage congestion.*

*Priority 2: Public institutions, government offices, universities, public libraries and residential areas. -Buildings should be above a level corresponding to a 25-year flood or a 10-year rainfall with stipulation that all buildings in vulnerable zones should be constructed on columns or stilts as indicated above.*

*Priority 3: Parks and playgrounds. -Infrastructure such as playgrounds and parks can be located in areas vulnerable to frequent floods. Since every city needs some open areas and gardens, by restricting building activity in a vulnerable area, it will be possible to develop parks*

*and play grounds, which would provide a proper environment for the growth of the city.*

On the same analogy, certain areas on either side of the existing and proposed drains (including rural drains) should be declared as green belts where no building or other activity should be allowed. This will not only facilitate improvement of these drains in future for taking discharges on account of growing urbanisation, but will also help in minimising the damage due to drainage congestion whenever rainfall of higher frequency than designed is experienced. These green belts, at suitable locations, can also be developed as parks and gardens.

#### 6.1.5 Flood Plain Zoning Regulations

The CWC has been continuously impressing upon the states the need to take follow-up action to implement the flood plain zoning approach. A model draft bill for flood plain zoning legislation was also circulated by the union government in 1975 to all the states. A copy of the model draft bill is at Annex-VI/I

There has been resistance on the part of the states to follow-up the various aspects of flood plain management including possible legislation. The state of Manipur had enacted the flood plain zoning legislation way back in 1978 but the demarcation of flood zones is yet to be done. The state of Rajasthan has also enacted legislation for flood plain management in the state. It has not taken any action to enforce it though. The governments of Assam, Goa, Himachal Pradesh, Sikkim and the Union Territories (UTs) of Chandigarh, Delhi and Lakshadweep have stated that they have not considered enactment of any type of legislation in their states. The government of Uttar Pradesh has decided to take suitable measures for regulating the economic/development activities in the flood plains. The government of Bihar initiated action to prepare



flood plain zoning maps, which are essential before any executive measures could be undertaken. The government of West Bengal had intimated that a draft bill on flood plain zoning was under process. The government of Madhya Pradesh had intimated that they had demarcated 36 towns affected by floods and that necessary administrative measures were taken towards the demarcation of flood zones. Other state governments have not even spelt out their approaches. The reluctance of the states to enact flood plain zoning regulation is mainly due to population pressure and want of alternative livelihood systems.

The lukewarm response of the states towards the enactment and enforcement of the flood plain regulations has fuelled a significant increase in the encroachments into the flood plains, sometimes authorised and duly approved by the town planning authorities.

*The state governments/SDMAs will enact and enforce appropriate laws for implementing flood plain zoning regulations by March 2009.*

## 6.2 Incentives and Disincentives to States for Enactment and Enforcement of Flood Plain Zoning Regulations

*The MOWR will, in consultation with the state government and the CWC evolve a scheme of incentives and disincentives with respect to the central assistance to encourage the states for enactment and enforcement of flood plain zoning regulations.*

## 6.3 Encroachment into the Waterways and Natural Drainage Lines

*The possibility of removing buildings/structures obstructing existing natural drainage lines will be seriously considered by state governments/*

*SDMAs. In any case, and with immediate effect, unplanned growth will be restricted by state governments/SDMAs so that the construction of structures obstructing natural drainage or resulting in increased flood hazard is not allowed.*

## 6.4 Bye-laws for Buildings in Flood Prone Areas

*The following provisions will be incorporated by the state governments/SDMAs/local bodies in the building bye-laws for buildings in flood prone areas:*

- (a) Plinth levels of all buildings should be 0.6 m above the drainage/flood submersion lines.*
- (b) In the areas liable to floods, all the buildings should preferably be double and multiple storeys.*

*Wherever there are single storey buildings, a stairway will invariably be provided to the roofs so that temporary shelter can be taken there. The roof levels of the single storey buildings and the first-floor level in double-storey buildings will be above 100-year flood levels so that the human beings and movable property can be temporarily sheltered there during periods of danger on account of floods.*

## 6.5 Legal Framework for Making Infrastructure Flood Resilient

The infrastructural activities by the different organisations, such as the Indian Railways, National Highway Authority of India (NHAI) the State Public Works Department, BRO etc. in the flood prone areas need to be carried out duly considering the requirements for making them flood resilient. While constructing railway lines and roads, care is sometimes not taken in aligning, locating and designing with respect to height and width of

embankments and providing adequate waterway i.e bridges, culverts, vents and causeways for passage of storm water. The top level of the railway/road embankments is also often not kept above the flood levels in the area. It may be mentioned here that flood levels are likely to increase with development taking place in the catchment such as reduction in vegetative cover, deforestation, paving of areas for settlements etc. as well as due to the afflux caused by obstruction to the flow due to inadequate size of bridges, culverts, vents and causeways. The result is increased vulnerability of the area to flooding and drainage congestion, submergence of roads and railway embankments and breaches in them.

*An appropriate legal framework will be developed by the state governments/SDMAs so as to make it mandatory for obtaining clearance for the plans for construction of the infrastructure in flood prone areas from states' irrigation/flood control/water resources departments with respect to their safety against floods and effects thereof on the vulnerability of the area to floods and drainage congestion, who will process the cases in a fixed time frame.*

## 6.6 Survey of Flood Prone Areas

One of the main requirements for implementation of flood plain zoning measure is the availability of survey maps, on a suitably large scale, to enable proper zoning of vulnerable areas and preparation of flood risk maps. The CWC had initiated, in 1978, a programme for surveying areas prone to floods under the central sector through the Survey of India (SOI) as a pilot scheme, to assist the state governments in preparing flood risk maps. Of the 106,000 sq km of area identified in the country as prone to frequent floods, about 55,000 sq. km. had been surveyed in the states of Bihar, Assam, Uttar Pradesh, West Bengal, Punjab, Haryana and Jammu and Kashmir. Maps on the scale of 1:15,000 with contour interval of 0.3 m/0.5 m were

made available to the states. These maps cover areas along the main river Ganga and its tributaries - the Yamuna, Ramganga, Roopnarayan, Jalangi and other flood prone rivers of West Bengal, the tributaries of the Brahmaputra like Burhi Dihing, Desang and Dikhoo, the rivers Sutlej and Ravi, which had been earlier identified by the state governments concerned and work taken up in a phased manner as per the priorities indicated by the states. A total of 570 maps (109,267 sheets) to the scale 1:15,000 were prepared and sent to the respective state governments as well as to the GFCC and Brahmaputra Board for preparation of flood risk zone maps. However, no progress has been made by any of the states to finalise and publicise such maps. It is felt that each state should select at least one basin for preparation of these maps on pilot basis and come out with a factual report giving the benefits of these and also the difficulties encountered by them in the task. In the event of maps of 1:15,000 scale not being available, the same exercise can be attempted on maps of larger scale 1: 25,000 or 1:50,000, which are available for all regions of India. A MOU was signed in March 2006 between the CWC and SOI for digitisation of the above maps and this is targeted for completion in two years.

*The Indian Space Research Organisation (ISRO) has formulated, for the Eleventh Five-Year Plan period, a programme for DMS services wherein "creation of digital, thematic and cartographic data base for hazard zonation and risk assessment and realization of national data base for emergency management have been identified as one of the programme elements. Under this programme, ISRO and NRSA have planned to cover about 1 lakh sq km (10 million ha) every year for development of close contour information of ground using the Air-borne Laser Terrain Mapping (ALTM) system thereby envisaging to cover all the priority flood prone areas in a period of five years. Phasing of the area to be surveyed will be done by them in consultation with*

*the CWC so that the most vulnerable areas are covered first.*

### 6.7 Wetlands: Conservation and Restoration

Wetlands provide effective flood moderation by being available to accommodate the flood water. The existing wetlands should be revived and maintained properly. The flow of fresh water into these wetlands must be ensured.

*The reclamation of the existing wetlands/natural depressions will be prohibited by state governments/SDMAs and they will formulate an action plan for using them for flood moderation.*

### 6.8 Watershed Management including Catchment Area Treatment and Afforestation

Watershed management though not very effective in the case of large floods, helps in the moderation of small and medium floods. It is also very effective in the overall land and water management. It also leads to reduction in soil erosion and overall reduction in sediment load of the rivers. A watershed is identified as the ideal geophysical unit for planning and executing development programmes aimed at achieving rational utilisation of all natural resources for sustainable development with least damage to the environment. It is essential to ensure efficient utilisation of rainfall and safe disposal of runoff and the watershed approach is best suited to meet this goal. The watershed approach can help enhance local and regional economic viability of the FM objective in ways that are environmentally sound and consistent with watershed objectives. The watershed approach strengthens teamwork between the public and private sectors at the national, state and local levels to achieve the greatest environmental improvements with the resources available. This emphasis gives

those people who depend on water resources for their health, livelihood or quality of life, a meaningful role in the management of the resources. Through such active and broad involvement, the watershed approach can help in developing a sense of community, reduce conflicts, increase commitment to the actions necessary to meet the goals of the society and, ultimately, improve the likelihood of sustaining long-term environmental improvements.

*The Ministry of Agriculture (MOA) and Ministry of Environment and Forests (MOEF) will, in collaboration with the NDMA, MOWR and state governments, implement watershed management including catchment area treatment and afforestation programmes to improve land and water management which will, in turn, result in flood moderation and sediment management in rivers.*

### 6.9 Coordination and Enforcement

It is important that an appropriate technological regime is put in place for the regulation of developmental activities in the flood plains, preventing blocking and encroachment of waterways, prohibiting reclamation, conservation and restoration of existing wetlands and depressions etc. Provisions are required in the bye-laws of ULBs and PRIs to ensure that buildings and the infrastructure in flood plains are flood resilient.

*The state governments will put in place mechanisms for the enforcement of the acts, laws and rules made by them and identify the officers who will be responsible for their implementation and make them accountable for any lapses/violations.*

The NDMA will coordinate the establishment of the mechanisms and enforcement by the central ministries and departments concerned and the state governments/SDMAs/DDMAs on the basis of these guidelines. The main objective of this effort will be to enable the

DM structures at various levels to expand their capacities and refocus their activities to enable them to respond rapidly and effectively to a flood situation.

### 6.10 Action Plan

S.No	Activity	Commencement	2008				2009				2010	2011	2012	
			M	J	S	D	M	J	S	D	M	M	M	
1.	Flood plain zoning regulation	Immediate	Legislative Action → Implement											
2.	Bye-laws for buildings in flood plains	Immediate	Not-ification → Implement											
3.	Legal framework to make infrastructure flood resilient	Immediate	Notification → Implement											
4.	Flood plain survey (close colour maps-DEM)		Surveys and preparation of maps →											
5.	Wetlands-conservation and restoration		Notification → Implement											
6.	Watershed management/ CAT/afforestation	Immediate	Implement →											
7.	Mechanism for coordination and enforcement of regulation	Immediate	Es-tablish → Implement											

## 7.1 Flood Education

*The state governments will strengthen FM education by facilitating the incorporation of the best available technical and non-technical inputs on FM in educational curricula.* This effort will address the multi-faceted aspects of FM covering the pre- and post-flood situations that include the inculcation of a culture of prevention, mitigation and preparedness as well as effective and prompt response, relief, rehabilitation and recovery. Case histories of major flood events will be used as valuable inputs in the process.

*The MHA and MOWR in consultation with the Ministry of Human Resource Development (MHRD) and the state governments will promote the efforts of flood education based on the development of high-quality education materials, textbooks and field training.*

Disaster-related curricula have already been introduced by the Central Board of Secondary Education (CBSE) for classes VIII, IX and X. *The MHA and MOWR, in consultation with the MHRD, will encourage the CBSE to introduce modules of FM in classes XI and XII as well. The state governments/SDMAs will encourage their school boards to develop similar content in their school curriculum.*

*The MHA and MOWR in consultation with the MHRD, All India Council of Technical Education (AICTE), University Grants Commission (UGC), Council of Architecture (COA), Institution of Engineers (IE) and the state governments will develop*

*suitable modules for inclusion in the curricula of architecture and engineering courses in the Indian Institutes of Technology (IITs), National Institutes of Technology (NITs) and other universities, colleges and polytechnics of engineering and architecture to equip the students with the requisite knowledge of flood-proof design and construction techniques.*

The subject of disaster medicine covers aspects such as trauma care, epidemic control, emergency medical care by paramedics and emergency medical technicians, and telemedicine. Disaster Management related aspects of medical education will receive detailed attention at the undergraduate level, so that graduating doctors are able to handle emergencies with a better understanding of the issues involved.

*The MHA will, in consultation with the Ministry of Health and Family Welfare (MOHFW), MOWR and other related agencies, facilitate the introduction of subjects related to the management of diseases caused by disasters including floods in the undergraduate medical curriculum.*

*The state governments will be encouraged to introduce a five-year quality improvement programme for teachers and professionals engaged in teaching the subjects related to FM.* The on-going technical education programmes for college teachers, will be strengthened and expanded to address the gap between the requirement and availability of quality teachers conversant with flood proof design and construction. All such training programmes will incorporate testing and certification of trainees.

## 7.2 Target Groups for Capacity Development

The target groups for capacity development will include elected representatives and government officials, concerned with the national and state level DM functions, professionals in visual and print media, urban planners, infrastructure development experts, engineers, architects and builders, NGOs, community-based organisations (CBOs), social activists, social scientists, youth organisations such as National Cadet Corps (NCC), National Service Scheme (NSS), Nehru Yuvak Kendra Sangathan (NYKS), school teachers and school children.

*Specially designed public awareness programmes will be developed by the state governments/SDMAs/DDMAs for addressing the needs of physically handicapped and mentally challenged people, women and the elderly. The states Police Force, Civil Defence, Home Guards and SDRFs will also be covered by such efforts. The people will be made aware of the need to keep special kits containing medicines, torch, identity cards, ration card and non-perishable eatables such as dry fruits, roasted chana etc. ready before commencement of monsoon so that, they can carry the same with them, in case, they have to be evacuated. The community will also be trained for preparation and utilisation of improvised flood rescue devices with household articles.*

## 7.3 Capacity Development of Professionals

*The NIDM will, in consultation with reputed knowledge institutions, develop comprehensive programmes and a national plan for creating a pool of trainers from among trained faculty members of engineering and architecture colleges as also among professionals. State governments/SDMAs will identify potential trainers to develop training programmes at basic, intermediate and advance levels. These training programmes will be pilot-*

*tested, critically evaluated, upgraded, documented, and peer-reviewed. Training modules will be developed and continuously upgraded based on the evaluation and feedback from participants.*

## 7.4 Training

In order to increase the thrust towards FM education in India, the MOWR will identify a number of leading institutes and universities and encourage the creation of dedicated chaired positions for faculty members working in the area of FM related education and research. Such institutions will also offer the services of such experienced faculty members to participate in the activities specified in these guidelines.

The NIDM and NFMI (when set up) under the guidance of the NDMA at the national level, and state governments/SDMAs and Administrative Training Institutes (ATIs) at the State level, will organise training of elected representatives MPs, MLAs and Counsellors, members at the district, taluka, city and village levels, administrative personnel from all central ministries and departments and state governments. Members of the police force, Civil Defence, Home Guards, SDRFs and the school teachers and NGOs will also be provided training in DM.

*In accordance with these guidelines, the NIDM and NFMI will evolve action plans and national strategy, in collaboration with the ATIs and other technical institutions, to offer a comprehensive curriculum related to flood mitigation management, preparedness and response in the form of training modules for the various target groups and initiate the design, development and delivery of the same at the earliest by June 2008. The NDRF, SDRF and Civil Defence coordinated by state governments/SDMAs/DDMAs, will impart training to public in flood preparedness, flood mitigation and response.*



## 7.5 Research and Development

*The state governments will proactively support application oriented research and developmental activities to address contemporary challenges, generate solutions, and develop new techniques to improve their sustainability in floods.*

Scenario analysis and simulation modelling are extremely useful for undertaking long-term DM programmes and for strengthening flood preparedness, mitigation and response efforts. Risk assessment and scenario projections require data on the existing built-environment, infrastructure, and economic activities. Absence of such data can lead to assumption-based scenarios.

*The MOWR will, with the support of the CWC, NRSA and the state governments arrange for systematic collection of data and incorporate the same in its data bank with an efficient retrieval system.*

It will encourage the development of standardised methods for flood risk assessment and scenario development. It will also evolve in collaboration with the NDMA, a procedure for undertaking pilot projects in risk assessment and scenario analysis and develop state-of-the art reports.

The quantification of flood risk for a specified area requires detailed information on a number of factors, such as rainfall, river flow, catchment characteristics, topography of the area including close contour large scale maps and Digital Elevation Model (DEM). Information on the type of construction with economic value of buildings, structures, infrastructure, industries etc. is also required. Flood studies will be carried out to guide the development of appropriate land-use zoning regulations for important urban areas and areas with critical structures and vital installations. These studies will follow a multidisciplinary approach, with the requirements of the end-users (e.g., urban planners, design engineers, and emergency managers), and peer-reviewed before publication.

*The MOWR and the CWC will provide necessary assistance to the state governments in this regard.*

All currently available maps are small-scale maps unsuitable for hazard and risk analyses at the district and local levels. *The MOWR will, in collaboration with nodal scientific agencies and institutions such as the NRSA, SOI, etc., ensure the preparation of large-scale hazard maps of flood prone areas of high vulnerability.* The reliability of flood hazard maps will depend on the accuracy of base maps and the approach followed in their GIS-based integration and subsequent validation. Unplanned urbanisation, neglect of slope maintenance, poor surface and subsurface drainage network in the area, deforestation and poorly planned and substandard constructions greatly increase the damage potential. Flood hazard maps will be the basis for a strategy to be developed to minimise loss of life and property in floods. *The MOWR will, in collaboration with the state governments, CWC, Brahmaputra Board and GFCC, undertake this activity and complete the same by the 31 January 2010.*

An important component of preparedness for floods is the construction of suitable shelters for the flood-affected people during the relief period. *The state governments will design such shelters, keeping in mind the climatic conditions of the affected area and the functional needs of the affected people.* Appropriate locations for constructing shelters in the event of floods will be identified and data collected on the minimum health and hygiene standards that need to be ensured in such shelters. Maintenance of shelters is a major issue. *The MOWR will, in consultation with the CWC, Brahmaputra Board, GFCC, Central Building Research Institute (CBRI) and the state governments, evolve a model design of the shelters for flood prone areas in different regions. The State governments/ SDMAs will ensure use of the shelters through the district and local authorities for purposes such as running schools, anganwadis or*



*other facilities to promote proper maintenance so that these are available in good condition during floods as and when required.*

*The state governments in collaboration with the MOWR and CWC will carry out studies aimed at developing watershed models suitable for using remotely sensed information as inputs, in order to predict flood flow under 'inadequate' or 'no data' situations. Efforts will be intensified to evolve more and more mathematical models and use them to introduce better rationality in decision-making processes.*

*The state governments/SDMAs will undertake mathematical model studies for long reaches complemented by physical model studies for problem reaches for FM works of a permanent nature e.g. embankments, spurs, revetments, etc. involving huge costs and having significant impact on river behaviour. They will also upgrade the facilities in their respective research stations.*

*The MOWR and CWC will, in collaboration with the state governments, and other Institutions such as Central Water and Power Research Station (CWPRS), National Institute of Hydrology (NIH), IITs, universities, and expert organisations/consultancy firms, undertake comprehensive morphological studies on international and inter-state rivers causing erosion and flooding to predict river behavior over short, medium and long periods, identify spots/reaches vulnerable to erosion and evolve eco-friendly and cost-effective measures having no or little impact on river regime to prevent erosion and flooding. It will encourage the state governments to enhance the capability of their institutes and undertake more such studies through them on other rivers within their territories.*

*The MOWR will also sponsor visits in India and abroad for equipping the officials of related organisations and the state governments with the knowledge and skills necessary to undertake such studies.*

## 7.6 Documentation

*The MOWR will facilitate the preparation of films, manuals and other documents targeting various stakeholders to inculcate a culture of flood safety. State governments will make available flood related information in multiple formats, so that different groups of stakeholders can gather the information relevant to them. State governments/SDMAs will set up websites and portals to disseminate all flood related information to stakeholders groups.*

This information will include specific details on flood risk and vulnerability of the areas, flood risk mitigation measures and their effects on safety of the built environment.

The state governments will encourage and assist subject matter specialists from academia and industry to prepare technical documents on the concepts of flood behaviour. Fine-tuning the technical specifications for making new and old buildings and structures flood proof will be a priority area. National and regional libraries and information centres will be encouraged to build significant repositories of technical resources (books, reports, journals, electronic documents, and others) related to FM.






The implementation of these guidelines requires participation of a wide spectrum of professionals. The NIDM and knowledge institutions like the IITs, NITs and other professional bodies will create and maintain a directory of professionals in India, who have experience in flood-related fields, architecture and engineering and who are interested in contributing to the national effort for ensuring flood safety in India and make these available to the SDMAs and ATIs.

*The MOWR will undertake the documentation of the history of flood-related activities in India. A number of documents on floods that have been authored in the past have now become difficult to*

access or are out of print. The MOWR will launch a special initiative to digitise these documents from various sources and save the archives on electronic formats.

The documentation will be used in learning lessons from past experiences and factoring improvements into future planning of preventive, preparatory, mitigative, relief and response measures for FM.

### 7.7 Action Plan for Capacity Building

Activity		Commencement	2008				2009	
			Mar	Jun	Sep	Dec	Mar	Jun
1.	Education in schools and colleges	With immediate effect	M-  eeting <b>Implement</b>					
2.	Technical education	With immediate effect	M-  eeting <b>Implement</b>					
3.	Capacity building of professionals	With immediate effect	M-  eeting <b>Implement</b>					
4.	Flood management research and development	With immediate effect	M-  eeting <b>Implement</b>					
5.	Documentation and dissemination	With immediate effect	M-  eeting <b>Implement</b>					

## 8.1 Introduction

### 8.1.1 Response System

Management and control of the adverse consequences of floods will require coordinated and effective response systems at all levels-national, state, district, local and community. Many of the components of response initiatives will remain the same for different types of disasters. These systems need to be developed considering the multi-hazard scenario of the region to optimally utilise available resources.

### 8.1.2 Institutionalisation

The scale of response for floods and the corresponding role players will be identified and mobilised at the district, state or national levels depending on the magnitude and the severity of the event. Systems will be institutionalised by the DMAs, at various levels, for coordination between the various agencies like central government ministries and departments, state governments, district administration, ULBs, PRIs and other stakeholders for effective post-flood response.

### 8.1.3 Evacuation Plan

Evacuation of human population and livestock is the only prescribed means to save them from the fury of floods. Evacuation of flood affected communities can be one of the most difficult response operations, especially, when it involves large population. Evacuation needs to be carried

out as a precautionary measure based on warning indicators, prior to impact, in order to protect flood-threatened persons from the full effects of the disasters. Evacuation may also be necessary after the area has been flooded in order to move persons from a flood-affected area to safer and better surroundings. For carrying out successful evacuation, the threat perception on the part of DM officials is essential. Continuous dialogue with stakeholders such as, early warning providers, transportation authorities, health-care authorities/personnel, food and essential commodity suppliers, civil societies, NGOs and last but not the least, the communities including the Decision Support System (DSS) and inputs based on Geographical Information System (GIS) platform are essential for carrying out successful evacuation. Responsibilities of each organisation need to be fixed beforehand in the form of SOPs. Other important points that need to be considered for the development of evacuation plan including the action points, are listed below:

- i) Designing department-specific customised action plans to save lives immediately following or before an emergency as per the local scale flood risk profile of the region and to respond to any eventuality/emergency
- ii) Preparing plans of all the organisations involved in the emergency evacuation for all types of emergencies; validating plans; evaluating staff competency; testing the established emergency operational procedures

- iii) Making on-line inventory of emergency relief resources available with the local government, public and corporate institutions for possible accessing during the emergency.
- iv) Evolving coordinated EEP institutional mechanism and triggering actions with joint partnership at the state/district level involving all concerned departments and agencies, armed forces, paramilitary forces, NDRF, SDRF, civil society, CBOs, PRIs, ULBs, Civil Defence (CD), etc.
- v) Building confidence among the populace that their belongings will be protected when they are away from their own houses.

#### 8.1.4 Estimation of the Severity of a Flood

As the local communication infrastructure often fails, the severity of a flood cannot be estimated immediately after its occurrence. The preliminary assessment of the severity of a flood should be based on water level and the estimate of the area flooded as assessed from satellite imageries. Field observation data will be used to modify this assessment once available.

#### 8.1.5 Flood Management Plans

Flood Management Plans (FMPs) prepared by all agencies will incorporate detailed guidelines for prioritised implementation of various activities depending on magnitude and the severity of floods. Response component of DM plans will involve rapid deployment of supplies and logistics, along with the duration of potential deployment. These plans will prescribe appropriate coordination mechanism with other agencies working in the affected areas.

## 8.2 Emergency Search and Rescue

### 8.2.1 Neighbourhood Community

The local community in the affected neighbourhood is always the first responder after a disaster. Experience has shown that over 80 per-cent of search and rescue is carried out by the local community before the intervention of the state machinery and specialised search and rescue teams. Thus trained and equipped teams consisting of local people will be set up in flood prone areas to respond effectively in the event of floods.

### 8.2.2 Search and Rescue Teams

Community level teams will be developed in each district with basic training in search and rescue. Training modules will be developed for trainers of community level search and rescue teams by the NDRF training institutes. On the ground, besides others, the NDRF battalions will also assist the state government/district authorities in training communities. They will be further assisted by the ATIs, CD, Home Guards and NGOs.

*The state governments, through the ATIs, will develop procedures for formally recognising and certifying such trained search and rescue team members; they will also provide suitable indemnity to community level team members for their actions in the course of emergency response following a flood.*

Youth organisations such as the NCC, NSS and NYKS will provide support services to the response teams at the local level under the overall guidance and supervision of the local administration.

## 8.3 Emergency Relief

Trained community level teams will assist in planning and setting up emergency shelters, distributing relief among the affected people, identifying missing people, and addressing the needs of education,

health care, water supply and sanitation, food etc. of the affected community. Members of these teams will be made aware of the specific requirement of the disaster-affected communities. It will be ensured by the concerned authorities that the stockpiling of the essential commodities has been carried out. These teams will also assist the government in identifying the most vulnerable people who may need special assistance following floods.

## 8.4 Incident Command System

*All response activities will be undertaken at the local level through a suitably devised Incident Command System (ICS) coordinated by the local administration through the EOCs. State governments will commission and maintain EOCs at appropriate levels for the coordination of human resources, relief supplies and equipment.*

Standard Operating Procedures (SOPs) for the EOCs will be developed by state governments and integrated within the framework of the ICS, which will take advantage of modern technologies and tools, such as GIS maps, scenarios and simulation models for effectively responding to disasters. GIS maps available from other sources, such as the city planning departments will be compiled considering their potential application after a disaster. The state governments/SDMAs will undertake the training of personnel involved in the ICS. Some of the state governments have already adopted this system.

## 8.5 Community-based Disaster Preparedness and Response Coordination among Various Organisations

### 8.5.1 Institutionalising the Role of Community Based Organisations, Non-governmental Organisations etc. in Incident Command System

A number of organisations, like NGOs, self-

help groups, CBOs, youth organisations such as NCC, NYKS, NSS etc., women's groups, volunteer agencies, CD, Home Guards, etc. normally volunteer their services in the aftermath of any disaster. Village level task forces will also be constituted on voluntary basis for better preparedness of the community. The state governments/SDMAs and DDMA will coordinate the allocation of these human resources for performing various response activities.

*State governments will work with these agencies to understand and plan their roles in the command chain of the ICS, and incorporate them in the DM plans.*

### 8.5.2 Support of Stakeholders

Largescale natural disasters draw overwhelming humanitarian support from different stakeholders. The relief and response activities carried out by such stakeholders must comply with the norms prescribed by the appropriate authorities.

### 8.5.3 Dissemination of Information

Soon after a flood, accurate information will need to be provided on the extent of the damage and other details of the response activities through electronic and print media. *The state governments will utilise different types of media, especially print, radio, television and internet, to disseminate timely and accurate information.*

## 8.6 Involvement of the Corporate Sector

*State governments will facilitate the involvement of the corporate sector in making available their services and resources to the government during immediate aftermath of flood.* The corporate sector, as part of the Corporate Social Responsibility (CSR) effort, can provide, inter alia, the services

of hospitals, power and telecommunication, relief supplies, search and rescue equipment, water pumps and transport and logistics for movement of relief supplies to the extent possible. For instance the Construction Federation of India (CFI) has set up the India Disaster Response Network (IDRN), which can also be associated with the task of emergency response. State governments and district authorities will develop appropriate mechanisms to receive and optimally utilise all such assistance.

## 8.7 Specialised Teams for Response

### 8.7.1 National Disaster Response Force

In terms of the DM Act, 2005, eight battalions of the NDRF are being set up to provide specialised response to any threatening disaster situation or disaster. Out of these seven battalions are already in position. Each of these battalions will have 18 teams with high skill training and latest equipment for water rescue. In order to ensure prompt response to any flood situation, each of these battalions will also have Regional Resource Centres (RRCs) in high vulnerability areas, where boats and other water rescue equipment will be pre-positioned. The NDRF units will maintain close liaison with the state administration and will be available to them proactively, thus avoiding long procedural delays in deployment in the event of any serious threatening disaster situation. *The NDRF battalions will also be provided with communication equipment for establishing last mile connectivity.*

### 8.7.2 Fire and Emergency Services in the Urban Local Bodies

The fire and emergency services in the ULBs of various states are being used as an emergency-cum-fire services force. *The fire and emergency services in the flood prone areas will develop*

*adequate capacity to respond to serious flood situations, in addition to managing fires.*

### 8.7.3 Police Force

The police plays an important role in the aftermath of floods in maintaining law and order, assisting in search and rescue, and in the transportation and certification of casualties. It is equally important that the police forces are properly equipped and trained.

### 8.7.4 Home Guards

The Home Guards serve as an auxiliary arm of the police force and support the district administration in various tasks. They will be trained for carrying out search, rescue and relief operations on occurrence of floods.

### 8.7.5 Civil Defence

The community has a major role to play both as a victim and necessarily as a first responder. Integration of the CD organisation into disaster management can work as a great catalyst for organising community capacity building. CD has been authorised in 225 designated towns in the country out of which 121 have already been activated where volunteers have been recruited and trained. There is a plan to revamp CD, extending its coverage to all the districts in the country and assigning it an important role in DM framework. According to the proposal for revamping, the primary role of CD will be community capacity building and creating public awareness in pre-disaster phase. The proposal envisages converting the town specific setup of CD to a district specific set up. It is proposed to have 18 persons employed on full time basis in each district-specific set up, out of which eight will be the trainers and their duty will be to train volunteers. Till the revamping is finalised, states should start using the existing set up for



training more and more volunteers and spreading awareness on the different aspects of DM. The state governments will also activate the remaining non-activated towns in a phased manner.

The state governments/SDMAs and DDMAAs will coordinate the human resources of the CD set up as well as those of other agencies for performing/responding to various disaster-related activities.

## 8.8 Improving Flood Response

### 8.8.1 State Disaster Response Force

*To augment the capacities of the states, all state governments will constitute, from within their armed police force, adequate strength of personnel for the SDRF with appropriate disaster response capabilities.* In addition, the police, fire and emergency services, Home Guards and CD are being strengthened and upgraded to have adequate capacity to respond effectively to disasters. Deployment of the Indian Armed Forces for post-flood response work will be resorted to only as the last option.

### 8.8.2 National Reserves

*The National Reserves (NRs) will be created by procurement and stockpiling of items commonly required to provide immediate and emergency relief to victims of major natural and man-made disasters.* The NRs will provide essential and life-saving materials to meet the urgent needs of victims or survivors. The stores will be stocked within the campuses of the NDRF battalions and their mobilisation to the relief site will take place from the nearest locations. These mitigation reserves will primarily be utilised to render relief in the aftermath of Level 3 disasters whose magnitude and geographical spread cause destruction beyond the immediate coping capabilities of states.

## 8.9 Emergency Logistics

### 8.9.1 Equipment

Motor launches, country boats, inflatable rubber boats, life jackets, life buoys and other equipments will be required immediately after floods to carry out search and rescue of trapped people. State governments will compile a list of such equipment, identify suppliers thereof and enter into long-term agreement for their quick mobilization and deployment in the event of floods. The IDRN, which is a web-based resource inventory of information on emergency equipment and response personnel available in every district, will also be used for this purpose. *The information on IDRN will be revised and updated frequently. The state governments may avail of CRF for this purpose to the extent of 10 per-cent as provided in the existing rules and guidelines for disbursement.*

### 8.9.2 Relief Camps

The setting up of relief camps for the people whose houses have been damaged by floods and the provision of basic amenities in such camps involves complex logistics of mobilising relief supplies, tents, water supply and sanitation systems, transport and communication systems, and medical supplies. The panchayat buildings in the villages in flood prone areas will be made flood proof as by raising their plinth level at least 0.6 m above the drainage/flood submergence line and making them at least double storeyed or constructing ring bunds around them. Wherever the panchayat building is single storey, a stairway will invariably be provided to the roof so that people can take shelter there temporarily. *The DM plans at the state and district levels will address this issue in detail.*

### 8.9.3 Identification of the Deceased

*In the event of mass casualties, states will*



*develop systems for proper identification of the deceased, recording the details of victims, and making use of DNA fingerprinting.*

## 8.10 Emergency Medical Response

### 8.10.1 Emergency Treatment at Site of Floods

*Prompt and efficient emergency medical response will be provided by Quick Reaction Medical Teams (QRMTs), mobile field hospitals, including floating hospitals for riverine islands and areas inaccessible by roads, Accident Relief Medical Vans (ARMVs) and heli-ambulances.* They will be activated to reach the flood-affected areas immediately, along with dressing material, splints, portable X-ray machines, mobile operation theatres, resuscitation equipment and life-saving drugs, etc. Resuscitation, triage and medical evacuation of victims who require hospitalisation will be done in accordance with SOPs.

### 8.10.2 Medical Facilities and Medical Treatment at Hospital

A well-rehearsed medical preparedness plan is required to provide intensive care to cases rescued from drowning. *An emergency medical plan will be triggered immediately on receiving information about imminent threat of flood. The action will be immediately initiated for crisis expansion of required number of beds.* The medical superintendent should be able to forecast the requirement of enhanced manpower and medical stores after knowing the number of casualties likely to be received at the hospital. Special efforts will be made for the availability of IV fluid, antibiotics vaccines etc. Children, women, elders and other vulnerable casualties will be attended to on priority basis.

### 8.10.3 Mortuary Facilities and disposal of Dead Bodies

*The state will develop contingency plans to have sufficient mortuaries to preserve the dead bodies. After proper identification, dead bodies will be immediately disposed through district authorities, to prevent outbreak of an epidemic and environmental pollution.*

### 8.10.4 Public Health Issues in Aftermath of Floods

*Safe and sufficient drinking water will be ensured.* Protecting existing water sources from contamination, adding chlorine tablet in the water for residual disinfection effect and provision of latrine and proper waste disposal to avoid contamination through flies and other insects are important steps required immediately in the aftermath of a flood. Vector control will be done by spraying of shelters with residual insecticides. Provision of insecticides treated mosquito nets are recommended.











### 8.10.5 Psychosocial Aspects

A large number of victims will suffer from psychosocial effects in the aftermath of a flood. The psychosocial impact of floods will be manifested as psychosocial reaction in the form of post-traumatic stress disorders (PTSD) and other psychosocial ailments in displaced people due to flood. *A team comprising a social worker, a psychologist and a psychiatrist will provide counselling to them.*

### 8.10.6 Documentation of Medical Response

*Documentation of the medical response provided after a flood will be done by a medical administrator.* This documentation will be used as feedback for future improvement of the response strategies.

### 8.11 Action Plan for Strengthening Flood response

S.No	Activity	Commence-ment	2008			
			M	J	S	D
1	Categorisation of flood disaster	With immediate effect	<b>Meeting</b>  <b>Implement</b>			
2	Response plans for different categories of flood disaster	With immediate effect	<b>Meeting</b>  <b>Implement</b>			
3	ICS	With immediate effect	<b>Meeting</b>  <b>Implement</b>			
4	Institutionalising role of CBOs, NGOs, women's organisations, youth organisations, corporate houses and other stakeholders	With immediate effect	<b>Meeting</b>  <b>Implement</b>			
5	NDRF	With immediate effect	 <b>Implement</b>			
6	SDRFs	With immediate effect	<b>Meetings</b>  <b>Implement</b>			
7	Reorganisation/reorientation of police forces, fire and emergency services, CBOs, Home Guards for flood response	With immediate effect	<b>Administrative measures</b>  <b>Implement</b>			
8	Other emergency response teams	With immediate effect	<b>Meetings</b>  <b>Implement</b>			
9	Emergency equipment and relief logistics	With immediate effect	 <b>Implement</b>			
10	Medical preparedness plan	With immediate effect	<b>Preparation</b>  <b>Implement</b>			

# 9

## Implementation of Guidelines- Preparation of Flood Management Plans

### 9.1 Flood Management Plans

#### 9.1.1 National Disaster Management Plan

*The NEC will prepare and get it approved by the NDMA the national Disaster Management Plan (DMP). This plan will also include FM aspects.*

#### 9.1.2 Plans of Central Ministries/Departments, State Governments and Other Agencies

Implementation of these guidelines on FM will result in formulation of FMPs by the central ministries/departments, the state governments, the district authorities, the rural and urban local bodies and other stakeholders. The salient activities to be covered in the FMPs will include:

- Identification of flood prone areas: village/block/tehsil or taluka/district wise and delineation thereof on maps.
- Preparation of flood vulnerability/flood risk/flood hazard maps.
- Putting in place DSS for FM including preparedness, rescue, relief, rehabilitation and recovery.
- Developing reliable and country-wide FF and W systems in the public domain for all the flood prone areas with sufficient lead time and giving information on prevailing water levels, area inundated, expected water levels and area likely to be inundated

with depth and duration of flooding in a manner easily understood by all.

- Implementation of adequately designed, maintained and sustained structural measures for prevention of flooding and improvement of drainage, leading to feeling of security against floods and overall development in the flood prone areas.
- Operation of reservoirs optimising benefits of flood moderation, irrigation, hydropower, drinking and industrial water supply.
- Enactment and enforcement of laws for regulating developmental activities in flood plains and prevention of encroachments into flood plains and waterways, thereby reducing flood vulnerability/risk.
- Making the existing and new buildings and infrastructure such as roads, railway lines, bridges, canals, etc. capable of withstanding the fury of the floods and not enhancing flood vulnerability/risk.
- Preparation of states and districts FMPs.
- Training of trainers in professional and technical institutions on FM issues.
- Training of professionals like engineers and architects for incorporating measures that can sustain the structures and provide shelter to people during floods in flood prone areas.

- Implementing demonstration projects on flood-proofing in flood prone areas.
  - Launching public awareness campaigns on flood safety and risk reduction and sensitising all stakeholders to flood problems and mitigation in flood prone areas.
  - Undertaking regular inspections of structural works such as embankments, drainage channels, protection works, etc. and implementation of required restoration/strengthening measures prior to and emergency measures during floods in the flood prone areas by the respective agencies/departments.
  - Developing an inventory of the existing built environment.
  - Assessing the flood risk and vulnerability thereof.
  - Developing guidelines for flood-proofing measures and for all existing critical lifeline structures and major public buildings in flood prone areas in a phased manner.
  - Preparation of FMPs plans by schools, hospitals, industries, entertainment houses, major shopping complexes etc. in flood prone areas and carrying out mock drills for enhancing preparedness.
  - Strengthening the EOCs network.
  - Streamlining the mobilisation of communities, NGOs, civil society partners, police force, CD, the corporate sector and other stakeholders on occurrence of floods.
  - Preparing community and village level FMPs.
  - Creating an inventory of resources for effective response to floods in flood prone areas.
  - Strengthening research capability of various academic and research institutions for taking up development of cost effective FM measures.
  - Preparing documentation on lessons from previous floods and their wide dissemination.
  - Preparing an action plan for the upgradation and integration/interlinking of the FM capabilities of the CWC, IMD and the state governments in flood forecasting with clear roadmaps and milestones.
  - Developing appropriate scheme for insurance of lives, crops and private and public properties in flood prone areas by collaborating with insurance companies and financial institutions.
  - Operationalising the NDRF battalions.
  - Operationalising the SDRF battalions in the states.
  - Allotment for land for the Regional Response Centres.
  - Strengthening the medical preparedness for effective response to prevent spread of epidemics especially water-borne diseases after floods.
- The time lines proposed for the implementation of various activities in the guidelines are considered both important and desirable, especially in case of those non-structural measures for which no clearances are required from central or other agencies. Precise schedules for structural measures

will, however, be evolved in the FMPs that will follow at the central ministries/state level duly taking into account the availability of financial, technical and managerial resources. In case of compelling circumstances warranting a change, consultation with NDMA will be undertaken, well in advance, for any adjustment, on a case to case basis.

## 9.2 Flood Management Plans of Central Ministries and Departments

*All central ministries/departments will prepare their FMPs which will cover all aspects of the disaster cycle of every disaster, including floods.*

These plans will clearly indicate the actions to be taken, the allocation of tasks among the various functionaries, the SOPs to be followed, the methodology for carrying out the tasks specified and the timelines for their execution. Mock drills will be carried out to test the efficacy of the implementation of these plans by various agencies falling within the purview of various ministries/departments and other stakeholders at regular intervals.

The FMPs will necessarily address the worst case scenarios and cover various aspects of management of response, risk, situation, information and communication. Since some disasters may transcend geographic boundaries, these plans will also recognise the importance of effective networking and coordination of different levels of response mechanisms.

## 9.3 Flood Management Plans of State Governments

*All state governments/SDMAs will prepare their FMPs in accordance with these guidelines.*

They will also encourage preparation of community preparedness plans to address their own special features and outline the linkages of the various state support systems and the jurisdiction of each of these departments. The GOI has initiated the

GOI-United Nations Development Programme (UNDP) Programme on Disaster Risk Management (DRM) to encourage the development of district, block, taluka and village FMPs, which will be further strengthened. The existing plans will be modified, where required, in order to streamline and optimise the response systems.

*These FM plans will be widely disseminated among various stakeholders for creating greater public awareness.*

These plans must indicate the officer responsible for carrying out specific tasks along with timelines for implementation.

Authorities in charge of educational institutions will prepare their flood preparedness plans and conduct mock drills. Using school buildings as temporary relief camps during disasters disrupts the education of children for long periods. These buildings, if not made flood safe, cannot be used for sheltering people, cattle and their movable properties in a flood. *Alternative arrangements for housing relief camps in flood prone areas will be put in place through various mitigation projects.*

All hospitals in flood prone areas will develop their emergency plans, conduct mock drills and update themselves from time to time with relevant information on DM preparedness. State governments/SDMAs will monitor the preparation and testing of these plans. State governments will ensure that all government offices are able to withstand floods and are fully prepared with DM plans.

*The FMPs will incorporate all the features of the EOCs including their establishment and operations.*

The efforts made by the government of Maharashtra for preparing DM plans at state, district, village and school levels and the government of Madhya Pradesh for preparing a FMP will be shared with other states for useful inputs in this regard.

## 9.4 Flood Management Plans of Nodal Agencies

The MOWR and CWC are the nodal agencies for the monitoring of floods in India through their network of hydro-meteorological and flood forecasting stations. They record the rainfall, river gauge and discharge on all important, inter-state/international rivers. The IMD has established flood meteorological offices and a network of climatological/rain gauge stations in various parts of the country. It gives information and forecast on rainfall in the country to the CWC. The CWC also collects information on floods from various states. Based on this, the CWC, through its regional offices formulates flood forecasts and flood bulletins and transmits the same to various designated functionaries in the GOI and the state governments.

The Bureau of Indian Standards (BIS) is the nodal agency for preparing codes for buildings and other structures related codes. For water resources related structures like dams, flood, embankments, river training works etc., the CWC has been entrusted with the responsibility of preparing various codes for adoption by the BIS. *The BIS will ensure finalisation of all pending revisions within the next two years.*

The MOES has been set up by the GOI bringing together the Earth Commission, the IMD, the Earthquake Risk Evaluation Centre (EREC), and other key institutions to facilitate effective coordination of the various aspects related to the ocean, meteorology, seismology, marine environment, atmosphere and earth sciences, not specifically allotted to any other department or ministry. *As the nodal ministry/agency for FM, the MOWR and CWC, in close collaboration with the MOES will prepare their FMPs based on the*

*guidelines laid down by the NDMA. The various aspects of the FMPs prepared by the other central ministries/departments and state governments and other stakeholder groups will be included in that plan.* The MOWR and CWC will also prepare a comprehensive plan for the upgradation of their capabilities with a clear roadmap and milestones. They will also coordinate with the MOES and IMD for upgradation of their capability for reliable precipitation forecasts and development of close contour maps for flood prone areas.

## 9.5 Implementation of Flood Management Plans



### 9.5.1 Implementation and Monitoring

*The FMPs prepared by the central ministries, departments concerned, state governments, district authorities, rural bodies, urban local bodies and the stakeholders in accordance with these guidelines will be implemented by them in accordance with in-built schedules.* These plans will indicate clearly the structure of the monitoring system and the reports to be generated at various levels together with the agency to which the report is to be sent, its format and the frequency/timing.

### 9.5.2 Financial Arrangements

*The various activities of FMPs will be mainstreamed into the developmental plans of the respective ministries, departments, state governments and they will be responsible for making adequate provisions in their annual plans/budgets. The specific activities can be funded under the centrally sponsored/central sector schemes and the flood mitigation projects as well.*

### 9.6 Action Plan

S.No	Activity	2008	2009	2010
1	FMPs of central ministries and departments	Pre- paration 	Implementation	
2	FMPs of state governments	Pre- paration 	Implementation	



# 10

## Summary of Action Points

### CHAPTER I: Floods - Status & Context

tehsils/districts in a scientific manner in collaboration with the NRSA and Survey of India (SOI).

#### 1. Flash Floods

(para 1.5)

- i) Flash floods forecasting and warning systems using Doppler radars will be installed by the India Meteorological Department (IMD) by September 2009.
- ii) As a preventive measure, the inhabitation of low-lying areas along the rivers, nallas and drains will be regulated by the state governments/State Disaster Management Authorities (SDMAs)/ District Disaster Management Authorities (DDMAs).
- iii) Landslides and blockages in rivers will be monitored by the Central Water Commission (CWC)/National Remote Sensing Agency (NRSA)/state governments/SDMAs with the help of satellite imageries and in case of their occurrence, warning systems will be set up to reduce losses. If possible, appropriate structural measures to eliminate the damage in case of sudden collapse of the blockages will also be taken up.

(para 1.4)

#### 2. Areas Prone to Floods

The Ministry of Water Resources (MOWR) and the state governments/SDMAs/DDMAs concerned will urgently undertake identification of areas prone to floods along with names of villages/talukas or

#### 3. Damages Caused by Floods

There is lack of documentation on floods and flood damage. The state governments will ensure that each and every flood event is properly documented and flood damage assessment is made on a scientific basis with the help of latest technological advancements in the field of remote sensing through satellites etc.

(para 1.6)

#### 4. Drainage Congestion and Water-logging

The MOWR along with the MOA and the state governments will, by the end of March 2008, make a scientific assessment of the area suffering from drainage congestion and water-logging.

(para 1.7)

#### 5. River Erosion

The MOWR along with the state governments will undertake river-wise studies of the problem of erosion and estimate the area liable to erosion by rivers, identify vulnerable spots and plan remedial measures to protect such areas. Latest technological developments for low cost measures, such as reinforced cement concrete (RCC) porcupines, will be considered while planning such measures.

(para 1.8)

## 6. Littoral Drift in River Estuaries

Straight cuts into the sea with a view to make the slope steeper in outfall reaches are sometimes considered as one of the effective measures to overcome the problem. These measures must be taken only after an intensive study on the mathematical and hydraulic models is carried out so as to avoid the risk of increased flooding in case of high tides, cyclonic storms and tsunamis.

(para 1.10)

## 7. Snow-melt / Glacial Lake Outbursts, Formation and Subsequent Bursting of Landslide Dams

While the guidelines for landslides will be issued by the NDMA separately the MOWR/CWC and the state governments will, in collaboration with NRSA, monitor the hilly areas liable to snow avalanches, blockages in rivers due to landslides etc. for such events and in the case of their occurrences, install warning systems for reducing the loss of life and property in the areas likely to be affected. They will also take remedial structural measures, if feasible, for averting the danger.

(para 1.11)

## 8. Cloudbursts

The IMD and CWC in association with state governments will develop forecasting and warning systems in areas prone to floods caused by cloudbursts.

(para 1.13)

## 9. International Dimensions of the Flood Hazard

Negotiations upon issues such as establishment of hydro-meteorological stations

and transmission of their data to India on a real time basis, afforestation, catchment area treatment (CAT) works and construction of reservoirs will be expedited by the MOWR and Ministry of External Affairs (MEA).

(para 1.14)

## 10. Implementation of the Recommendations of the Experts' Committees/Working Groups/Task Forces.

The MOWR and the CWC will, in collaboration with the state governments, closely monitor the implementation of the recommendations of the Experts Committee to review the implementation of the recommendations of the RBA-2003 and the Task Force on Flood Management/Erosion Control-2004.

(para 1.16)

## CHAPTER II: Institutional Framework and Financial Arrangements

### 11. National Institute of Disaster Management

It will network with other knowledge-based institutions and assist in imparting training to trainers, DM officials, etc. It will also be responsible for synthesising research activities and will be geared towards emerging as a centre of excellence' at the national and international levels.

(para 2.2.5)

### 12. Central Water Commission

The MOWR will strengthen and equip appropriately the RM wing of CWC.

(para 2.2.7)

### 13. Ganga Flood Control Commission/ Ganga Flood Control Board

The MOWR will take steps for strengthening the GFCC appropriately.

(para 2.2.8)

### 14. Brahmaputra Board/High Powered Review Board

The MOWR will take immediate action for restructuring/strengthening of the Brahmaputra Board.

(para 2.2.9)

### 15. National Flood Management Institute

The MOWR in close collaboration with the NDMA, will establish a National Flood Management Institute (NFMI) as a centre of excellence with experts in its faculty and having state-of-the-art equipment at an appropriate location, in one of the flood prone states. The institute will be functional by the end of December 2010. Till then the NWA will undertake these activities in addition to its current functions.

(para 2.2.13)

### 16. River Basin Organisations

The MOWR has set up the Brahmaputra Board and GFCC to look after FM in Brahmaputra and the Ganga river basins respectively. The MOWR in consultation with the state governments, will take appropriate action in regard to the establishment of such organisations in other flood prone river basins and in strengthening of the CWC, Brahmaputra Board and GFCC.

(para 2.2.14)

### 17. State Disaster Management Authority

At the state level, the State Disaster

Management Authority (SDMA), headed by the chief minister will be established by the state governments to lay down policies and plans for DM in the state.

(para 2.3.2)

### 18. State Executive Committee

All state governments will appoint experts in FM in the faculty of their administrative training institutes, which will collaborate with the NFMI in organising the training of personnel in the field of FM. Every state government will constitute a State Executive Committee (SEC) to assist the SDMA in the performance of its functions.

(para 2.3.3)

### 19. District Disaster Management Authority

At the cutting edge level, the District Disaster Management Authority (DDMA) headed by the District Magistrate, with the elected representative of the local authority as the co-chairperson, will act as the planning, coordinating and implementing body for DM and take all necessary measures for the purposes of DM in the district in accordance with the guidelines laid down by the NDMA and SDMA.

(para 2.3.6)

### 20. Local Authorities

PRIs and ULBs will ensure capacity building of their officers and employees in DM, carry out relief, rehabilitation and reconstruction activities in the affected areas and will prepare DM plans in consonance with the guidelines of the NDMA, SDMAs and DDMA.

(para 2.3.7)

### 21. State Disaster Response Force

To augment their capacities, all state

governments/SDMAs will organise, from within their armed police force, adequate personnel for the constitution of State Disaster Response Force (SDRF) with appropriate disaster response capabilities. Under the aegis of the NDMA, the states will raise the SDRF

(para 2.3.8)

## 22. Intra-state Multi-sectoral Coordination

The state governments/SDMAs will establish appropriate multi-disciplinary mechanisms, whose clearance of the proposals of various departments with respect to the FM angle will be mandatory, before the works are sanctioned by them and taken up for implementation by the departments concerned. The mechanisms will be empowered to make recommendations for making the works flood safe as well as ensuring that they do not lead to increase in vulnerability of the areas to floods and drainage congestion.

(para 2.3.9)

## 23. Plans of Central Ministries/Departments

The various measures for FM recommended in the guidelines will be funded respectively by the central ministries and departments and state governments concerned by making provisions in their annual and Five-year Plans. Funding will also be available through special mitigation projects to be formulated and implemented by the state governments/SDMAs under the overall guidance and supervision of the NDMA. In addition 10 per cent of Calamity Relief Fund (CRF) can also be utilised for purchase of equipment for flood preparedness, mitigation, rescue and relief.

(para 2.5.1)

## 24. State Plans

The various measures for FM recommended in these guidelines will accordingly be included by the state governments in their state plans.

(para 2.5.2)

## 25. Centrally sponsored/Central Sector Schemes

The MOWR, on the request of the state governments and subject to availability of funds, will include some of the schemes recommended in the guidelines for funding under these schemes.

(para 2.5.3)

## 26. District Planning and Development Council Funds

Certain percentage of funds available to District Planning and Development Council in the flood-prone areas will be allocated for implementation of FM schemes in the district.

(para 2.5.4)

## 27. Calamity Relief Fund

The issues of extending duration in which the state governments are required to complete repair of damaged infrastructure and inclusion of drainage improvement works within the ambit of CRF, will be resolved after the deliberations of the Thirteenth Finance Commission.

(para 2.5.5)

## 28. National Flood Mitigation Project

The NDMA will take action to expedite preparation of DPR and its approval for

implementation by the central ministries and departments and state governments.

(para 2.5.6)

## 29. Flood Insurance

The Ministries of Finance, Agriculture and Water Resources, the state governments and the insurance companies will jointly take up studies for a graded system of insurance premium according to flood risk in flood prone areas of the country. The MOWR, in consultation with the state governments will explore the possibility of introducing schemes where insurance of structures, buildings and crops in flood plains is made compulsory. Consultations on the proposal will be held with all the players and stakeholders and the scheme implemented in a few selected areas on experimental basis. Once successful, the scheme will be implemented on a larger scale. The value of such scheme can not be over stated.

(para 2.6)

## CHAPTER III: Flood Prevention, Preparedness and Mitigation

### 30. Embankments/Banks, Flood Walls, Flood Levees

The circumstances, in which embankments/flood walls/flood levees will be constructed for prevention of flooding, can only be decided after carrying out detailed hydrological and morphological studies regarding their favourable and adverse effects. State governments/SDMAs will evolve date lines and priorities for carrying out studies in their States. It is only then that embankments with properly designed and located drainage sluices, spilling sections and anti-erosion measures in combination with other works such as reservoirs, channel improvement works, drainage improvement structures, etc. will be planned and implemented as a short-term and/or long-term solution to the flood

problem. Ongoing embankment projects will also be reviewed with respect to their location and designs.

(para 3.2.1)

### 31. Channel Improvement

Wherever required and subject to techno-economic considerations, the state governments will identify the locations and take up appropriate channel improvement works to increase the velocity and/or the area of flow and reduce the flood level in the river depending upon site-specific conditions.

(para 3.2.3)

### 32. Desilting/Dredging of rivers

The MOWR, CWC and the state governments/SDMAs will study the problem of rise in river beds in a scientific manner with the help of science and technology, academic institutions and corporate sector firms of repute and explore the techno-economic viability of desilting/dredging as a remedial measure to mitigate the effects of rise in the river beds.

(para 3.2.4)

### 33. Drainage Improvement

The state governments/SDMAs will review the adequacy of existing sluices and drainage channels in areas suffering from drainage congestion. If the capacities of existing sluices in embankments and drainage channels are inadequate, they will be improved by increasing the vents and improving outfall conditions. State governments/SDMAs will prohibit the blocking of the natural drainage channels and sluices by an appropriate law and improve their capacity and construct new channels and sluices to ensure flow of excess rainwater in the area.

(para 3.2.5)

#### 34. Diversion of Flood Water

Wherever the capacity of river channels passing through the towns and cities is inadequate and cannot be improved to the required extent, state governments/SDMAs will study the feasibility of implementing the schemes for diverting excess water to existing or new channels by bye-passing them to prevent flooding.

(para 3.2.6)

#### 35. Catchment Area Treatment /Afforestation

The state governments/SDMAs will, take up appropriate watershed management measures including afforestation, check dams, detention basins etc in the catchment of rivers to prevent soil erosion, enhance water conservation and minimise water and sediment runoff.

(para 3.2.7)

#### 36. Anti-erosion Works

The state governments/SDMAs/DDMAs, wherever required and if relocation is not possible on social, technical and economical considerations, will plan and implement appropriate anti-erosion measures such as revetments, slope pitching, permeable and impermeable spurs using conventional materials and/or geo-synthetics for protection of towns, cities, industrial areas, groups of thickly populated villages, railway lines, roads and embankments from erosion by rivers in a time-bound manner. They will also review RR policies for including provision for RR of people who cannot be protected against river erosion on techno-economic considerations. Upon receipt of specific requests from the state governments, the CWC, the GFCC and the Brahmaputra Board will assist them in survey, planning, design and implementation of these measures.

(para 3.2.8)

#### 37. Sea Walls/Coastal Protection Works

Sea walls/coastal protection works will be planned and executed by the respective coastal states/port authorities, keeping in view the complexity of sea behaviour and other environmental aspects.

(para 3.2.9)

#### 38. Alignment, Location, Design and Provision of Waterway i.e. Vents, Culverts, Bridges and Causeways in National Highways, State Highways, District and Other Roads and Railways Embankments

The Ministry of Shipping, Road Transport and Highways (MOSRTH), MOR, MOD, NHAI, BRO, state governments/SDMAs will ensure that national highways, state highways, district and other roads are aligned, located and designed properly with respect to height and width, and provided with adequate waterway in the form of vents, culverts, bridges and causeways so as to make them flood safe and not increase the vulnerability of the area to flooding and drainage congestion.

The safety of existing roads/railway embankments against floods will also be checked by the MOSRTH, MOR, MOD, NHAI, BRO and state governments/SDMAs/DDMAs and if found inadequate, measures by way of increasing height and width and augmenting water way by constructing additional bridges/culverts/causeways or by adding more spans to existing ones, will be taken up.

(para 3.2.10)

#### 39. Inspection, Rehabilitation and Maintenance

The state governments/SDMAs will draw a programme of inspection of all structural measures twice a year, once before the commencement of the monsoon and again after the monsoon has

withdrawn and ensure that restoration/strengthening measures of vulnerable spots are carried out before the commencement of monsoon every year. They will earmark adequate funds for the same in their annual budget and assign responsibility to individual officials for completing the same.

Dams, flood embankments, levees and the works taken up for their protection against erosion etc. will be regularly inspected during floods for identification of vulnerable spots and immediate measures to strengthen them will be implemented. In case of apprehension of any breach or overtopping, people living in the area will be warned of the danger and the civil administration, with the help of NDRF, SDRF and/or the army will take steps for evacuation, rescue and relief.

The NDMA/MHA will take up with the Thirteenth Finance Commission the need for earmarking adequate funds for maintenance of the dams, embankments, levees and town protection works under appropriate heads of account in plan/non-plan budgets.

(para 3.3)

#### 40. Flood Proofing

The state governments/SDMAs will provide adequate number of raised platforms/flood shelters at suitable locations in the flood plains with basic amenities such as drinking water, sanitation, medical treatment, cooking, tents, lantern etc. for the people to take shelter during floods.

The state governments/SDMAs will take steps to make all public utility installations flood safe.

(para 3.5.2)

#### 41. Integrated Water Resources Management

State governments/SDMAs with the cooperation of the CWC and other states will implement the IWRM system for all the river basins and sub-basins.

(para 3.6)

#### 42. Creating Awareness

The state governments/SDMAs will take steps to create awareness to the type of illnesses and other health problems that can result in the aftermath of floods, to all the medical teams and the community at large. Hygienic practices e.g. hand washing with soap and use of the toilet for defecation, use of boiled water or adding chlorine to water and safe food cooking by disease-free persons will be promoted.

(para 3.8.2)

#### 43. Creation of Trained Medical First Responders

The state governments/SDMAs will ensure the creation of trained medical first responders for first aid and resuscitation measures for drowning cases. Medical staff must know how to take out water from the respiratory tract and how to carry out cardiopulmonary resuscitation. A list of trained medical and paramedical staff must also be made available.

(para 3.8.3)

#### 44. Medical Stores

Medical kits will be prepared for the management of flood casualties.

(para 3.8.4)



#### 45. Patient Evacuation Plan

State governments/SDMAs will make available emergency medical equipment and drugs for resuscitation.

(para 3.8.5)

#### 46. Disaster Management Plans

Disaster Management Plans need to be prepared by all hospitals.

(para 3.8.6)

### CHAPTER IV: Flood Forecasting and Warning in India

#### 47. Expansion and Modernisation of Flood Forecasting Services

The CWC, IMD and the state governments will increase the density of the basin-wise network of rain gauge and river gauge stations and establish basin-wise system of FF and early warning. Various FF initiatives as listed below will be taken by the CWC, IMD and the states.

- a) Data collection: Data will be collected using IMD, CWC and Bureau of Indian Standards (BIS) approved automatic sensors for rainfall and river flow measurements. A centralised mechanism for collection, archival and distribution of hydrological data from various river basins will be established on priority basis.
- b) Data transmission: Data will be transmitted using modern automatic telemetry data transmission techniques e.g. satellite, VSAT, Internet/e-mail, mobile phones etc.
- c) Flood forecast and impact assessment models: Computer-based comprehensive

catchment scale hydrological and hydrodynamic models interfaced with flood plain inundation mapping tools will be developed.

- d) Forecast dissemination: Forecast will be disseminated using computer networks and satellite e.g. Internet, e-mail, VSAT, the terrestrial communication network, connectivity of the National Informatics Centre (NIC) etc.
- e) Flood hazard mitigation model: Basin-wise flood hazard mitigation models will be developed.
- f) Damage assessment and quantification models: Damage assessment and quantification models will be developed on priority.
- g) Advisories for flood relief routes: Advisories for facilitating flood relief routes will be formulated and issued.
- h) Value addition: Flood forecasts and warnings will be formulated, preferably, in the local language, in a format which is simple and easily understandable by the administrators and common people as well. CWC will also improve the usefulness of the forecasts and warnings by marking the area likely to be inundated, location of flood shelters etc. on the map of the area.

(para 4.4)

#### 48. Coordination among the Central Water Commission, Indian Meteorological Department and the States

The state governments will, as soon as possible, and not later than March 2008, establish

a mechanism wherein representatives of the CWC, IMD, NRSA and the states interact with each other, exchange data on a real-time basis and formulate the flood forecasts and warnings, which are more reliable and understandable by the forecasters, administrators and the public to minimise loss of lives and property on account of floods. The CWC will also forecast the area likely to be inundated corresponding to the expected river water level.

(para 4.5)

#### 49. Cooperation with Nepal

The system of hydro-meteorological observations and transmission of data will be modernised by installing automatic sensors and satellite-based transmitters. Negotiations in this regard with the government of Nepal will be expeditiously concluded by the MOWR/MEA.

(para 4.6.2)

#### 50. Cooperation with Bhutan

The system will be modernized by the CWC with the installation of automatic sensors for observation of data and satellite-based transmitters for its transmission on a real-time basis.

(para 4.6.3)

#### 51. Cooperation with China

Negotiations with China will be expedited by the MOWR and MEA for extending cooperation with respect to exchange of hydro-meteorological data of rivers common to China and India on more rivers and by increasing the frequency of transmission to an hourly basis. The ongoing effort for reaching an understanding for passing information on blockages in rivers and release of water from the reservoirs constructed on the rivers and their tributaries will

also be expedited and a mechanism for exchange of information put in place at the earliest.

(para 4.6.4)

### CHAPTER V: Dams, Reservoirs and Other Water Storages

#### 52. Natural Detention Basins

The state governments/SDMAs will study the availability of natural depressions, swamps and lakes in the vicinity of the rivers and wherever required and feasible, utilise them for temporary storage of floodwaters.

(para 5.2)

#### 53. Dams and Reservoirs

The state governments/SDMAs/central agencies, wherever feasible, will therefore plan all the new dams and reservoirs with specific flood cushion provisions, prepare their Detailed Project Reports (DPRs) and complete the works in India by the year 2020 and in Nepal and Bhutan by the year 2025.

(para 5.3)

#### 54. Regulation of Reservoirs

Every state government/SDMA will:

- (i) draw up an action plan by June 2008 for completing the review/modification of rule curves and operation manuals within a period of three years.
- (ii) set up expert committees/review committees by September 2008 with the CWC's representative as a member for review of rule curves/operation manuals for each of the major reservoirs.

- (iii) review the operation rules of all the existing reservoirs and modify them by December 2009 making them appropriately consistent with the safety requirements of the structure, flood moderation and other uses.
- (iv) make arrangements of forecast of inflows into the reservoirs incorporating latest technology for collection of real-time data, and analysis and mathematical modelling for formulation of forecast either on their own or through the CWC.
- (v) install automatic water level sensors with satellite-based transmitters at all the reservoirs and share real-time data during the monsoon period among the basin states.
- (vi) once the protocols are worked out and put in place, set up an appropriate mechanism for ensuring strict enforcement, without any deviation of the operational rules so that local compulsions do not cause avoidable loss of life and property elsewhere.

The state governments/SDMAs will be assisted by the CWC and the IMD in implementation of the above measures.

(para 5.4)

### 55. Dam Safety Aspects

Pre-monsoon and post-monsoon inspections of dams will be carried out by experts and subsequent recommendations implemented by the state governments/SDMAs in a fixed time frame to ensure continued service and safety.

(para 5.5)

## CHAPTER VI: Regulation and Enforcement

### 56. Flood Plain Zoning Regulations

The state governments/SDMAs will enact and enforce appropriate laws for implementing flood plain zoning regulations by March 2009.

(para 6.1.5)

### 57. Incentives and Disincentives to States for Enactment and Enforcement of Flood Plain Zoning Regulations

The MOWR will, in consultation with the state government and the CWC evolve a scheme of incentives and disincentives with respect to the central assistance to encourage the states for enactment and enforcement of flood plain zoning regulations.

(para 6.2)

### 58. Encroachments into the Waterways and Natural Drainage Lines

The possibility of removing buildings/structures obstructing existing natural drainage lines will be seriously considered by state governments/SDMAs. In any case, and with immediate effect, unplanned growth will be restricted by state governments/SDMAs so that the construction of structures obstructing natural drainage or resulting in increased flood hazard is not allowed.

(para 6.3)

### 59. Bye-laws for Buildings in Flood Prone Areas

The following provisions will be incorporated by the state governments/SDMAs/Local bodies in the building byelaws for buildings in flood prone areas:

- (a) Plinth levels of all buildings should be 0.6 m above the drainage/flood submersion lines.
- (b) In the areas liable to floods, all the buildings should preferably be double and multiple storeys.

Wherever there are single storey buildings, a stairway will invariably be provided to the roofs so that temporary shelter can be taken there. The roof levels of the single storey buildings and the first-floor level in double-storey buildings will be above 100-year flood levels so that the human beings and movable property can be temporarily sheltered there during periods of danger on account of floods.

(para 6.4)

#### 60. Legal Framework for Making Infrastructure Flood Resilient

An appropriate legal framework will be developed by the state governments/SDMAs so as to make it mandatory for obtaining clearance for the plans for construction of the infrastructure in flood prone areas from states' irrigation/flood control/water resources departments with respect to their safety against floods and effects thereof on the vulnerability of the area to floods and drainage congestion, who will process the cases in a fixed time frame.

(para 6.5)

#### 61. Survey of Flood Prone Areas

The Indian Space Research Organisation (ISRO) has formulated, for the Eleventh Five-year Plan period, a programme for Disaster Management Support (DMS) services wherein "creation of digital, thematic and cartographic data base for hazard zonation and risk assessment and realisation of national data base for emergency management have been identified as one of the programme elements. Under this programme, ISRO and NRSA have planned to cover about 1 lakh sq km

(10 million ha) every year for development of close contour information of ground using the ALTM system thereby envisaging to cover all the priority flood prone areas in a period of five years. Phasing of the area to be surveyed will be done by them in consultation with the CWC so that the most vulnerable areas are covered first.

(para 6.6)

#### 62. Wetlands: Conservation and Restoration

The reclamation of the existing wetlands/natural depressions will be prohibited by state governments/SDMAs and they will formulate an action plan for using them for flood moderation.

(para 6.7)

#### 63. Watershed Management including Catchment Area Treatment and Afforestation

The Ministry of Agriculture (MOA) and Ministry Of Environment and Forests (MOEF) will, in collaboration with the NDMA, MOWR and state governments, implement watershed management including catchment area treatment and afforestation programmes to improve land and water management which will, in turn, result in flood moderation and sediment management in rivers.

(para 6.8)

#### 64. Coordination and Enforcement

The state governments will put in place mechanisms for the enforcement of the acts, laws and rules made by them and identify the officers who will be responsible for their implementation and make them accountable for any lapses/violations.

(para 6.9)

## CHAPTER VII: Capacity Development

### 65. Flood Education

The state governments will strengthen FM education by facilitating the incorporation of the best available technical and non-technical inputs on FM in educational curricula.

The MHA and MOWR in consultation with the Ministry of Human Resource Development (MHRD) and the state governments will promote the efforts of flood education based on the development of high-quality education materials, textbooks and field training.

The MHA and MOWR, in consultation with the MHRD, will encourage the CBSE to introduce modules of FM in classes XI and XII as well. The state governments/SDMAs will encourage their school boards to develop similar content in their school curriculum.

The MHA and MOWR in consultation with the MHRD, All India Council of Technical Education (AICTE), University Grants Commission (UGC), Council of Architecture (COA), Institution of Engineers (IE) and the state governments will develop suitable modules for inclusion in the curricula of architecture and engineering courses in the Indian Institutes of Technology (IITs), National Institutes of Technology (NITs) and other universities, colleges and polytechnics of engineering and architecture to equip the students with the requisite knowledge of flood-proof design and construction techniques.

The MHA will, in consultation with the Ministry of Health and Family Welfare (MOHFW), MOWR and other related agencies, facilitate the introduction of subjects related to the management of diseases caused by disasters including floods in the undergraduate medical curriculum.

The state governments will be encouraged to introduce a five-year quality improvement

programme for teachers and professionals engaged in teaching the subjects related to FM.

(para 7.1)

### 66. Target Groups for Capacity Development

Specially designed public awareness programmes will be developed by the state governments/SDMAs/DDMAs for addressing the needs of physically handicapped and mentally challenged people, women and the elderly. The states Police Force, Civil Defence, Home Guards and SDRFs will also be covered by such efforts. The people will be made aware of the need to keep special kits containing medicines, torch, identity cards, ration card and non-perishable eatables such as dry fruits, roasted chana etc. ready before commencement of monsoons so that, they can carry the same with them, in case, they have to be evacuated. The community will also be trained for preparation and utilisation of improvised flood rescue devices with household articles.

(para 7.2)

### 67. Capacity Development of Professionals

The NIDM will, in consultation with reputed knowledge institutions, develop comprehensive programmes and a national plan for creating a pool of trainers from among trained faculty members of engineering and architecture colleges as also among professionals.

(para 7.3)

### 68. Training

In accordance with these guidelines, the NIDM and NFMI will evolve action plans and national strategy, in collaboration with the ATIs and other technical institutions, to offer a comprehensive curriculum related to flood mitigation management,

preparedness and response in the form of training modules for the various target groups and initiate the design, development and delivery of the same at the earliest by June 2008. The NDRF, SDRF and Civil Defence coordinated by state governments/SDMAs/DDMAs, will impart training to public in flood preparedness, flood mitigation and response.

(para 7.4)

## 69. Research and Development

The state governments will proactively support application-oriented research and developmental activities to address contemporary challenges, generate solutions, and develop new techniques to improve their sustainability in floods.

The MOWR will, with the support of the CWC, NRSA and the state governments arrange for systematic collection of data and incorporate the same in its data bank with an efficient retrieval system.

The MOWR and the CWC will provide necessary assistance to the state governments in respect of studies for quantification of flood risk.

The MOWR will, in collaboration with nodal scientific agencies and institutions such as the NRSA, SOI, etc. ensure the preparation of large-scale hazard maps of flood prone areas of high vulnerability

The MOWR will, in collaboration with the state governments, CWC, Brahmaputra Board and GFCC, undertake the activity of preparation of flood hazard maps and complete the same by the 31 January 2010.

The state governments will design such shelters, keeping in mind the climatic conditions of the affected area and the functional needs of the affected people.

The MOWR will, in consultation with the CWC, Brahmaputra Board, GFCC, Central Building Research Institute (CBRI) and the state governments, evolve a model design of the shelters for flood prone areas in different regions. The State governments/SDMAs will ensure use of the shelters through the district and local authorities for purposes such as running schools, anganwadi or other facilities to promote proper maintenance so that these are available in good condition during floods as and when required.

The state governments in collaboration with the MOWR and CWC, will carry out studies aimed at developing watershed models suitable for using remotely sensed information as inputs, in order to predict flood flow under 'inadequate' or 'no data' situations. Efforts will be intensified to evolve more and more mathematical models and use them to introduce better rationality in decision-making processes.

The state governments/SDMAs will undertake mathematical model studies for long reaches complemented by physical model studies for problem reaches for FM works of a permanent nature e.g. embankments, spurs, revetments, etc. involving huge costs and having significant impact on river behaviour. They will also upgrade the facilities in their respective research stations.

The MOWR and CWC will, in collaboration with the state governments, and other Institutions such as Central Water and Power Research Station (CWPRS), National Institute of Hydrology (NIH), IITs, universities, and expert organisations/consultancy firms, undertake comprehensive morphological studies on international and inter-state rivers causing erosion and flooding to predict river behavior over short, medium and long periods, identify spots/reaches vulnerable to erosion and evolve eco-friendly and cost-effective measures having no or little impact on river regime to prevent erosion and



flooding. It will encourage the state governments to enhance the capability of their institutes and undertake more such studies through them on other rivers within their territories.

The MOWR will also sponsor visits in India and abroad for equipping the officials of related organisations and the state governments with the knowledge and skills necessary to undertake such studies.

(para 7.5)

## 70. Documentation

The MOWR will undertake the documentation of the history of flood-related activities in India. A number of documents on floods that have been authored in the past have now become difficult to access or are out of print. The MOWR will launch a special initiative to digitise these documents from various sources and save the archives on electronic formats.

The documentation will be used in learning lessons from past experiences and factoring improvements into future planning of preventive, preparatory, mitigative, relief and response measures for FM.

(para 7.6)

## CHAPTER VIII: Flood Response

### 71. Search and Rescue Teams

The state governments, through the ATIs, will develop procedures for formally recognising and certifying such trained search and rescue team members; they will also provide suitable indemnity to community level team members for their actions in the course of emergency response following a flood.

(para 8.2.2)

### 72. Incident Command System

All response activities will be undertaken at the local level through a suitably devised Incident Command System (ICS) coordinated by the local administration through the EOCs. State governments will commission and maintain EOCs at appropriate levels for the coordination of human resources, relief supplies and equipment.

(para 8.4)

### 73. Institutionalising the Role of Community Based Organisations, Non-governmental Organisations etc. in Incident Command System

A number of organizations, like NGOs, self-help groups, CBOs, youth organizations such as NCC, NYKS, NSS etc., women's groups, volunteer agencies, Civil Defence, Home Guards, etc. normally volunteer their services in the aftermath of any disaster. Village level task forces will also be constituted, on voluntary basis, for better preparedness of the community. The state governments/SDMAs and DDMAAs will coordinate the allocation of these human resources for performing various response activities. State governments will work with these agencies to understand and plan their roles in the command chain of the ICS, and incorporate them in the DM plans.

(para 8.5.1)

### 74. Dissemination of Information

The state governments will utilise different types of media, especially print, radio, television and Internet, to disseminate timely and accurate information.

(para 8.5.3)



**75. Involvement of the Corporate Sector**

State governments will facilitate the involvement of the corporate sector in making available their services and resources to the government during immediate aftermath of flood.

(para 8.6)

**76. National Disaster Response Force (NDRF)**

The NDRF battalions will also be provided with communication equipment for establishing last mile connectivity.

(para 8.7.1)

**77. Fire and Emergency Services in the Urban Local Bodies**

The fire and emergency services in the flood prone areas will develop adequate capacity to respond to serious flood situations, in addition to managing fires.

(para 8.7.2)

**78. State Disaster Response Force**

To augment the capacities of the states, all state governments will constitute, from within their armed police force, adequate strength of personnel for the SDRF with appropriate disaster response capabilities.

(para 8.8.1)

**79. National Reserves**

The National Reserves (NRs) will be created by procurement and stockpiling of items commonly required to provide immediate and emergency relief to victims of major natural and man-made disasters.

(para 8.8.2)

**80. Equipment**

The information on IDRN will be revised and updated frequently. The state governments may avail of CRF for this purpose to the extent of 10 per cent as provided in the existing rules and guidelines for disbursement.

(para 8.9.1)

**81. Relief Camps**

The DM plans at the state and district levels will address this issue in detail.

(para 8.9.2)

**82. Identification of the Deceased**

In the event of mass casualties, states will develop systems for proper identification of the deceased, recording the details of victims, and making the use of DNA fingerprinting.

(para 8.9.3)

**83. Emergency Treatment at Site of Floods**

Prompt and efficient emergency medical response will be provided by Quick Reaction Medical Teams (QRMTs), mobile field hospitals, including floating hospitals for riverine islands and areas inaccessible by roads, Accident Relief Medical Vans (ARMVs) and heli-ambulances

(para 8.10.1)

**84. Medical Facilities and Medical Treatment at Hospital**

An emergency medical plan will be triggered immediately on receiving information about imminent threat of flood. The action will be

immediately initiated for crisis expansion of required number of beds.

(para 8.10.2)

#### 85. Mortuary Facilities and Disposal of Dead Bodies

The state will develop contingency plans to have sufficient mortuaries to preserve the dead bodies. After proper identification, dead bodies will be immediately disposed through district authorities, to prevent outbreak of an epidemic and environmental pollution.

(para 8.10.3)

#### 86. Public Health Issues in Aftermath of Floods

Safe and sufficient drinking water will be ensured. Vector control will be done by spraying of shelters with residual insecticides.

(para 8.10.4)

#### 87. Psychosocial Aspects

A team comprising a social worker, a psychologist and a psychiatrist will provide counselling to victims.

(para 8.10.5)

#### 88. Documentation of Medical Response

Documentation of the medical response provided after a flood will be done by a medical administrator.

(para 8.10.6)

## CHAPTER IX: Implementation of Guidelines- Preparation of Flood Management Plans

### 89. National Disaster Management Plan

The NEC will prepare the National Disaster Management Plan (DMP) and get it approved by the NDMA. This plan will also include FM aspects.

(para 9.1.1)

### 90. Flood Management Plans of Central Ministries and Departments Plans

All central ministries/departments will prepare their FMPs which will cover all aspects of the disaster cycle of every disaster, including floods.

(para 9.2)

### 91. Flood Management Plans of State Governments

All state governments/SDMAs will prepare their FMPs in accordance with these guidelines.

These FM plans will be widely disseminated among various stakeholders for creating greater public awareness.

Alternative arrangements for housing relief camps in flood prone areas will be put in place through various mitigation projects.

The FMPs will incorporate all the features of the EOCs including their establishment and operations.

(para 9.3)

## 92. Flood Management Plans of Nodal Agencies

The BIS will ensure finalisation of all pending revisions within the next two years.

As the nodal ministry/agency for FM, the MOWR and CWC, in close collaboration with the MOES, will prepare their FMPs based on the guidelines laid down by the NDMA. The various aspects of the FMPs prepared by the other central ministries/departments and state governments and other stakeholder groups will be included in that plan.

(para 9.4)

## 93. Implementation and Monitoring

The FMPs prepared by the central ministries,

departments concerned, state governments, district authorities, rural bodies, urban local bodies and the stakeholders in accordance with these guidelines will be implemented by them as per in-built schedules.

(para 9.5.1)

## 94. Financial Arrangements

The various activities of FMPs will be mainstreamed into the developmental plans of the respective ministries, departments, state governments and they will be responsible for making adequate provisions in their annual plans/budgets. The specific activities can be funded under the centrally sponsored/central sector schemes and the flood mitigation projects as well.

(para 9.5.2)

## AREA LIABLE TO FLOODS



## Annex-I/II

## State-wise Break-up of Flood Prone Areas

(Area in lakh hectares)

Sl. No.	Name of States/UTs	Area prone to floods as assessed by RBA	Flood prone area as reported by States to the 11th Plan Working Group
<b>STATES</b>			
1	Andhra Pradesh	13.90	34.80
2	Arunachal Pradesh		0.82
3	Assam	31.50	38.20
4	Bihar	42.60	68.80
5	Chattisgarh	-	-
6	Delhi (NCT)	0.50	0.70
7	Goa	-	-
8	Gujarat	13.90	20.50
9	Haryana	23.50	23.50
10	Himachal Pradesh	2.30	2.31
11	Jammu & Kashmir	0.80	5.14
12	Jharkhand	-	-
13	Karnataka	0.20	9.00
14	Kerala	8.70	14.70
15	Madhya Pradesh	2.60	3.37
16	Maharashtra	2.30	3.30
17	Manipur	0.80	0.80
18	Meghalaya	0.20	0.95
19	Mizoram	-	0.54
20	Nagaland	-	0.09
21	Orissa	14.00	33.40
22	Punjab	37.00	40.50
23	Rajasthan	32.60	32.60
24	Sikkim	-	0.20
25	Tamil Nadu	4.50	4.50
26	Tripura	3.30	3.30
27	Uttar Pradesh	73.36	73.40
28	Uttarakhand	-	-
29	West Bengal	26.50	37.66
<b>UTs</b>			
30	Andaman & Nicobar Islands	-	-
31	Chandigarh	-	-
32	Dadra & Nagar Haveli	-	-
33	Daman & Diu	-	-
34	Lakshadweep	-	-

35	Pondicherry	0.10	0.50
	<b>Total</b>	<b>335.16</b>	<b>453.58</b>

**Notes:-**

1. Figures assessed by the RBA for the states of Bihar, Madhya Pradesh and Uttar Pradesh are before their bifurcation and as such also include flood prone areas of Jharkhand, Chattisgarh and Uttarakhand respectively.
2. RBA, taking into consideration that some of the area reported to be protected by the states is also affected by the floods, estimated area prone to floods as 400 lakh hectares. It did not give state- wise break up of 400 lakh hectares.
3. In respect of the states, which did not report flood prone area to the Working Group (WG) of the Eleventh Plan, the figures as reported to RBA or the Working Group of Tenth Plan have been taken.

## Annex-I/III

## Statement Showing Damage Due to Floods/Heavy Rains

Sl. No	Year	Area Affected (lakh hectares)	Population (crore)	Crops damaged		Houses damaged		Cattle (thousands)	Human Lives	Public utilities (Rs. crores)	Total damages (Rs. crores)
				Area (lakh hectares)	Value (Rs. crores)	(thousands)	Value (Rs. crores)				
1	2	3	4	5	6	7	8	9	10	11	12
1	1953	22.9	2.428	9.3	42.08	264.92	7.42	47.03	37	2.90	52.40
2	1954	74.9	1.292	26.1	40.52	199.98	6.56	22.55	279	10.15	57.23
3	1955	94.4	2.527	53.1	77.80	1666.79	20.94	72.01	865	3.98	102.73
4	1956	92.4	1.457	11.1	44.44	725.78	8.05	16.11	462	1.14	53.68
5	1957	48.6	0.676	4.5	14.12	318.15	4.98	7.43	352	4.27	23.37
6	1958	62.6	1.098	14.0	38.28	382.25	3.90	18.44	389	1.79	43.97
7	1959	57.7	1.452	15.4	56.76	648.82	9.42	72.69	619	20.02	86.20
8	1960	75.3	0.835	22.7	42.55	609.88	14.31	13.91	510	6.31	63.17
9	1961	65.6	0.926	19.7	24.04	533.47	0.89	15.92	1374	6.44	31.37
10	1962	61.2	1.546	33.9	83.18	513.79	10.66	37.63	348	1.05	94.89
11	1963	34.9	1.093	20.5	30.17	420.55	3.70	4.57	432	2.74	36.61
12	1964	49.0	1.378	24.9	56.87	255.56	4.59	4.96	690	5.15	66.61
13	1965	14.6	0.361	2.7	5.87	112.96	0.20	7.29	79	1.07	7.14
14	1966	47.4	1.440	21.6	80.15	217.27	2.54	9.07	180	5.74	88.43
15	1967	71.2	2.046	32.7	133.31	568.00	14.26	5.83	355	7.86	155.43
16	1968	71.5	2.117	26.2	144.61	682.70	41.11	130.31	3497	25.37	211.10
17	1969	62.0	3.322	29.1	281.90	1268.66	54.42	270.33	1408	68.11	404.44
18	1970	84.6	3.183	49.1	162.78	1434.03	48.61	19.20	1076	76.44	287.88
19	1971	132.5	5.974	62.4	423.13	2428.03	80.24	12.87	994	129.11	632.48
20	1972	41.0	2.669	24.5	98.56	897.30	12.46	58.23	544	47.17	158.19
21	1973	117.9	6.408	37.3	428.03	869.80	52.48	261.02	1349	88.49	569.00
22	1974	67.0	2.945	33.3	411.64	746.71	72.43	16.85	387	84.94	569.02
23	1975	61.7	3.136	38.5	271.49	803.71	34.10	17.35	686	166.05	471.66
24	1976	119.1	5.046	60.4	595.03	1745.50	92.16	80.06	1373	201.50	888.69
25	1977	114.6	4.943	68.4	720.61	1661.63	152.29	556.33	11316	328.95	1201.89
26	1978	175.0	7.045	99.6	911.09	3507.54	167.57	239.17	3396	376.10	1454.76
27	1979	39.9	1.952	21.7	169.97	1328.71	210.61	618.25	3637	233.63	614.20
28	1980	114.6	5.412	55.5	366.37	2533.14	170.85	59.17	1913	303.28	840.50
29	1981	61.2	3.249	32.7	524.56	912.56	159.63	82.25	1376	512.31	1196.50
30	1982	88.7	5.601	50.0	589.40	2397.37	383.87	246.75	1573	671.61	1644.88
31	1983	90.2	6.103	32.9	1285.85	2393.72	332.33	153.10	2378	873.43	2491.67
32	1984	107.1	5.455	51.9	906.09	1763.60	181.31	141.31	1661	818.16	1905.56
33	1985	83.8	5.959	46.5	1425.37	2449.88	583.86	43.01	1804	2050.04	4059.27
34	1986	88.1	5.550	45.8	1231.58	2049.28	534.41	60.45	1200	1982.54	3748.56
35	1987	88.9	4.834	49.4	1154.64	2919.38	464.49	128.64	1835	950.59	2569.72



NATIONAL DISASTER MANAGEMENT GUIDELINES - MANAGEMENT OF FLOODS

Sl. No	Year	Area Affected (lakh hectares)	Population (crores)	Crops damaged		Houses damaged		Cattle (thousands)	Human Lives	Public utilities (Rs. crores)	Total damages (Rs. crores)
				Area (lakh hectares)	Value (Rs. crores)	(thousands)	Value (Rs. crores)				
1	2	3	4	5	6	7	8	9	10	11	12
36	1988	162.9	5.955	101.5	2510.90	2276.53	741.60	151.00	4252	1377.80	4630.30
37	1989	80.6	3.415	30.1	956.74	782.34	149.82	75.18	1718	1298.77	2405.33
38	1990	93.0	4.026	31.8	695.61	1019.93	213.73	134.15	1855	455.27	1708.92
39	1991	63.6	3.389	27.0	579.02	1134.41	180.42	41.09	1187	728.89	1488.33
40	1992	26.5	1.926	17.5	1027.58	687.49	306.28	78.67	1533	2010.67	3344.53
41	1993	114.4	3.041	32.1	1308.63	1926.05	528.32	211.19	2864	1445.53	3282.49
42	1994	48.1	2.755	39.6	888.62	914.64	165.21	52.32	2078	740.76	1794.59
43	1995	52.5	3.593	32.5	1714.79	2001.90	1307.89	62.44	1814	679.63	3702.39
44	1996	80.5	4.473	38.3	1124.49	726.80	176.59	73.21	1803	861.39	3005.74
45	1997	45.7	2.966	22.6	692.74	505.13	152.50	27.75	1402	1985.93	2831.18
46	1998	108.5	4.744	75.0	2594.17	1932.87	1108.78	107.10	2889	5157.77	8860.72
47	1999	77.7	2.799	17.5	1850.87	1613.26	1299.06	91.29	745	462.830	3612.76
48	2000	53.8	4.501	35.8	4246.62	2628.86	680.94	123.25	2606	3936.98	8864.54
49	2001	61.8	2.646	39.6	688.48	716.19	816.47	32.70	1444	5604.46	7109.42
50	2002	70.9	2.632	21.9	913.09	762.49	599.37	21.53	1001	1062.08	2574.54
51	2003 *	65.0	3.447	34.3	1424.83	846.92	802.93	16.43	1864	2206.60	4434.35
52	2004*	80.3	3.422	26.9	615.07	1492.81	852.66	63.87	1275	1868.87	3336.59
53	2005*	33.8	2.968	22.4	958.27	349.62	316.95	113.23	1503	1546.94	2822.16
	TOTAL	4001.7	174.156	1873.8	37663.35	64549.66	14341.17	5026.49	84207	43499.60	96691.71
	AVG	75.5	3.286	35.3	710.62	1217.92	270.58	94.83	1588	820.75	1805.18
	MAX (YEAR)	175.0 (1978)	7.045 (1978)	101.5 (1988)	4246.62 (2000)	3507.54 (1978)	1307.89 (1995)	618.2 (1979)	11316 (1977)	5604.46 (2001)	8864.54 (2000)

## Annex-I/IV

## Estimate of Area Suffering from Drainage Congestion/Water-logging

(in lakh hectares)

State	Irrigation Commission (1972)	National Commission on Agriculture (1976)	Ministry of Agriculture (1984-85)	Latest figures as reported by States
Andhra Pradesh	NR	3.39	3.39	3.39
Assam	NR	NR	4.50	4.50
Bihar	NR	1.17	7.07	9.41
Gujarat	NR	4.84	4.84	4.84
Haryana	6.5	6.20	6.20	6.20
Jammu and Kashmir	NR	0.10	0.10	0.10
Karnataka	0.07	0.10	0.10	0.10
Kerala	NR	0.61	0.61	0.61
Madhya Pradesh	0.57	0.57	0.57	0.57
Maharashtra	0.28	1.11	1.11	1.11
Orissa	NR	0.60	0.60	2.17
Punjab	10.9	10.90	10.90	10.90
Rajasthan	3.48	3.48	3.48	3.48
Tamil Nadu	NR	0.18	0.18	0.18
Uttar Pradesh	8.10	8.10	19.80	19.80
West Bengal	18.5	18.50	21.80	21.80
Delhi	NR	0.01	0.01	0.01
<b>Total</b>	<b>48.40</b>	<b>59.86</b>	<b>85.26</b>	<b>89.17</b>

**NR: Not Reported**

## Brief Particulars of Important Committees/Working Groups/Task Forces on Flood Management Appointed by the Government of India

### 1 The Policy Statement – 1954 and Supplementary Statement-1956

Following the unprecedented floods of 1954, the Union Minister for Planning, Irrigation and Power, placed before Parliament, on 3 September 1954, two statements namely, 'Floods in India - Problems and Remedies' and 'The Floods in the country'. The objective, set unequivocally in the policy statements, was to rid the country of the menace of floods by containing and managing floods. In the supplementary statement placed before the Parliament on the 27 July 1956, the optimistic note changed a little, stating 'We shall, however, be able to curb and confine the floods, more and more and do all that is possible to save ourselves from the harm and the devastation that they bring'. Another statement on the flood situation and flood control programme pointed out that absolute immunity from flood damage was not physically possible even in the distant future.

### 2 The High Level Committee on Floods – 1957 and Policy Statement of 1958

The High Level Committee on floods submitted its report in December 1957, and this was considered by the Central Flood Control Board in its seventh meeting held in May 1958. Some of the important recommendations were:

- (i) Absolute or permanent immunity from flood damage is not physically attainable by known methods of flood control. Flood plain zoning, flood forecasting and warning, and like measures should, therefore, be given due importance, particularly as these do not require large capital investment.
- (ii) Flood control schemes should fit in with other water-related plans to the extent feasible.
- (iii) Future multi-purpose projects should consider flood control aspects simultaneously.
- (iv) Effects of embankments on river regimes need to be considered before approving such proposals.
- (v) In general, embankments are satisfactory means of flood protection when properly designed, executed and maintained, but a suitable combination of this method with other methods such as storage dams, detention basins, etc. is usually more efficient and should be adopted as resources permit.
- (vi) Priorities for soil conservation work relating to flood control should be as under:
  - (a) Catchment areas of multi-purpose dams.

- (b) Himalayas with their foothills.
  - (c) Indo-Gangetic plain
  - (d) Deccan plateau.
- vii) Works relating to watershed management be prioritised. Work commenced in a catchment should not be left incomplete to take up work in other catchments.
- (viii) The following order of priority in general is recommended:
- (a) Emergent schemes.
  - (b) Continuing schemes.
  - (c) Schemes for the protection of important urban and industrial communities.
  - (d) Schemes which would help in augmenting flood protection in the country.
  - (e) Schemes, which combine other beneficial utilisation of waters.

Another policy statement tabled in Parliament in 1958 also emphasises that while substantial diminution of flood-related distress is possible, immunity against flood is impracticable.

### **3 The Ministers' Committee on Flood Control - 1964**

A Ministers' Committee on Flood Control was constituted in February 1964 to review the National Flood Control Policy outlined in 1954. The Committee mainly recommended more attention to non-physical measures like flood warning and forecasting, flood plain zoning, flood insurance; studying possibility of multi-purpose storage dams for flood prevention and sediment detention in regard to major flood producing catchments; administrative measures for restricting occupancy of flood zones and emphasis on flood zones and frequency studies.

### **4 The Working Groups on Flood Control for the Five-year Plans**

The Working Groups on flood management, comprising experts and administrators, review the progress and performance of flood management measures undertaken and suggest appropriate strategies to formulate proposals including mobilization of resources for each five year plan and recommend measures, required for effective flood management programme in the country.

### **5 The Rashtriya Barh Ayog – 1980**

The R.B.A. submitted its comprehensive report in March 1980. This contained a total of 207 recommendations covering the entire gamut of the flood problem in the country. Some of the important recommendations were:

- Data collection for providing information on their long-term performance and their impact on various socio-economic factors.
- Legislation and enforcement by states to prevent unauthorised riverbed cultivation and encroachments into drains, etc.
- Separate reporting of flood damage for (i) Unprotected areas (ii) Protected areas and (iii) Areas situated between the embankments.
- Legislation for management of flood plains.
- A comprehensive dynamic and flexible approach to the problem of floods as a part of a comprehensive approach for the utilisation of land and water resources.
- Priority for measures to modify the susceptibility of life and property to flood damage.
- Priorities for the completion of continuing schemes.
- Provision of adequate funds for maintenance.
- States to enact legislation amending Section 17 (II) of Land Acquisition Act, to make the existing provisions for emergent situations, as applicable for flood control works.
- Intensifying studies on sedimentation of reservoirs.
- Forming a National Council for mitigating the effect of the disaster.

A review of implementation status of these recommendations made by the CWC during 1987 and subsequently during 2003 indicated that there is much to be achieved.

## **6 The Pritam Singh Committee Report - 1980**

To examine the problem of erosion in West Bengal on both banks of the river Ganga upstream and downstream of the Farakka Barrage, the government of West Bengal set up a committee in August 1978 under the Chairmanship of Shri Pritam Singh, Member (Floods), CWC. The Committee comprised the Chairman, GFCC; Director, CWPRS; General Manager, Farakka Barrage Project; Chief Engineer, government of Bihar and Chief Engineer government of West Bengal.

The committee identified the priority reaches downstream of Farakka Barrage for taking anti-erosion measures.

## **7 The National Water Policy - 1987**

Important recommendations made in the National Water Policy of 1987 on flood control and management were:

- Basin-wise master plan for FM in each flood prone basin.
- Sound watershed management and catchment area treatment.
- Providing adequate flood-cushion in water storage projects wherever feasible
- Emphasis to be made on measures like flood forecasting and flood plain zoning to minimise flood damage.

## **8 The Report of the Committee on Flood Management in the North-Eastern States - 1988 (Naresh Chandra Committee)**

During the year 1987, when the failure of the monsoons resulted in an unprecedented drought in most parts of the country, Assam and the neighbouring states had the misfortune of experiencing large-scale flooding of the Brahmaputra valley. A committee was set up under the Chairmanship of the Secretary, Water Resources to look into this problem in some detail and to review the efficacy of the current measures being taken and recommend further measures.

The Committee suggested that the recommendations of the RBA should be implemented by the state governments. Anti-erosion works are costly and can be justified only when protection is provided to vital installations. The main cause of erosion in tributaries is impinging of high velocity. To overcome this problem, bank revetments, preferably made with boulders, should be used. For drainage improvement the adequacy of existing sluices and drainage channels should be checked in a timely manner.

## **9 The Report of the Committee on Flood Management in the States of Bihar, West Bengal, Uttar Pradesh and Orissa - 1988**

After the severe floods of 1987 in Bihar, West Bengal, Uttar Pradesh, etc., the GOI set up a committee under the chairmanship of Secretary, Water Resources to review the efficacy of the current measures and recommend measures for urgent implementation. Some specific recommendations of the Committee include

- Properly designed, satisfactorily executed and adequately maintained embankments should continue as a cost-effective and quick measure.
- Early completion of partly completed projects.
- Construction of raised platforms on government or acquired land and handing over to local bodies/panchayats.
- Ensuring adequate waterways to ease out drainage congestion.
- Operation of existing reservoirs, keeping flood moderation in mind even if no flood cushion is provided.

- Provision of flood benefit/reserve storage in new/future reservoir projects to the extent possible.
- Implementation of flood plain zoning.
- Settling cost sharing among beneficiaries of anti-erosion works executed.
- Setting up of Tal Development Authority and arranging special funding for developmental schemes suitable to Tal/Chaur areas.
- Allocation of more funds for early completion of unfinished schemes in the Sundarbans of West Bengal.
- Evaluation of completed project by states with the assistance of GFCC/CWC.

#### **10 The Recommendations of the Regional Task Forces - 1996**

During the monsoon of 1996, a large number of states including Rajasthan and Haryana, which were generally not flood prone, experienced floods of severe intensity causing extensive damage to life and property. Certain coastal areas experienced chronic problems of coastal erosion. It was, therefore, considered essential to examine the problem of floods and flood management in the country afresh. Consequent upon this, GOI had constituted five Regional Task Forces namely,

- (i) Eastern Region Task Force
  - (ii) Northeastern Region Task Force
  - (iii) Northern Region Task Force
  - (iv) Northwestern Region Task Force
  - (v) Southern Region Task Force
  - (vi) The main thrust areas identified for actions by these task forces were
- Implementation of main recommendations of the RBA.
  - Preparing a catalogue of embankments existing in various river systems.
  - 10 per-cent of annual out lay of flood control sector to be earmarked for maintenance of flood control structures.
  - Studies on some major reservoirs and review of operation/rule curves.

Other important measures recommended in general are the tackling of encroachment of people into flood plains of the river downstream of the dam and inside embankments, taking up flood plain zoning measure especially the preparation of flood risk maps and scientifically analysing the happenings of severe



rainfall occurrences, very high flood stages and prolonged heavy drainage congestion in specific years, within a reasonable time of occurrence of such events by state governments, etc.

### **11 The Experts' Committee for Bank Erosion Problem of River Ganga-Padma in the Districts of Malda and Murshidabad in West Bengal - 1996 (G.R. Keskar Committee)**

Considering the gravity of the problem of the bank erosion of the river Ganga in the districts of Malda and Murshidabad in West Bengal, the Planning Commission constituted an Experts' Committee under the Chairmanship of Shri. G.R. Keskar, Member (RM), CWC in September 1996.

Various measures recommended by the Committee are as under:

#### **(i) Short-term Measures Recommended for Immediate Execution**

##### *Left Bank upstream of Farakka Barrage in Malda District*

This includes construction of two long spurs at the 29th and 28th km upstream of Farakka Barrage near Manickchak, closing of the gap in left marginal embankment, repair/restoration of existing protection works in the district of Malda and maintenance of Bhutni Diara Embankment

##### *Right Bank downstream of Farakka Barrage in Murshidabad district*

Repair/restoration of existing works, construction of spurs near Bindugram downstream of Farakka Barrage, afflux bundh with revetment along with nominal launching apron in Fazilpur reach etc.

#### **(ii) Long-term Measures**

Monitoring of performance of two long spurs upstream of Farakka, restricting flow through Barrage normal to its axis as possible by gate regulation, extensive river survey before and after floods every year for morphological study and creation of data bank for regular analysis, etc.

### **12 The National Commission for Integrated Water Resources Development Plan - 1999**

The National Commission for integrated water resources development plan in its report (September 1999) made inter alia, the following recommendations regarding FM.

- Since there are no solution for complete protection against floods, the country has to shift its strategy towards efficient management of flood plains, flood proofing, flood forecasting, disaster preparedness and response planning, flood fighting and flood insurance.
- Embankments provide reasonable protection against floods. However the performance of embankments has to be evaluated and suitable changes be made in design, construction and maintenance for better results.

The network of flood forecasting and warning is to be extended to remaining flood prone areas.

### **13 The Expert Group for Flood Management in Uttar Pradesh and Bihar – 1999 (G.N. Murthy Committee)**

An Expert Group was set up under the Chairmanship of Shri G.N. Murthy, the then Chairman, GFCC, Patna to examine and suggest an action plan of an identified and specific FM scheme with inter-se priority for implementation. The Group emphasised the need for building a realistic data bank on hydrology, topography, geology, morphology, hydraulics, damages etc. The priority schemes consisted of schemes on closure of gaps in the embankment/extension of existing embankments, embankment schemes, anti-erosion works, drainage schemes in Bihar and Uttar Pradesh. As a long-term solution, construction of storage reservoirs and watershed management was recommended.

### **14 The Working Group on Flood Control Programme for the Tenth Five- year Plan – 2001(R. Rangachari Working Group)**

A Working Group on Flood Control Programme was set up by Planning Commission, GOI in November, 2000 under the Chairmanship of Shri R. Rangachari, whose terms of reference included the review of the performance of the sector during the Ninth Plan period and making suggestions on the appropriate strategy for the Tenth Plan period, etc.

The report submitted in August 2001 had made a review of the flood management works adopted so far and gave suggestions on the future strategy for flood management. It dealt upon many policy issues and examined the international dimension of the flood management. It had made a review of the implementation of the RBA recommendations, too.

### **15 Report of the Committee on Silting of Rivers in India – 2002 (Dr. B.K. Mittal Committee)**

To study and report on the problem of silting in Indian rivers and related aspects including feasibility of desilting, the Ministry of Water Resources constituted a committee in October 2001 under the Chairmanship of Dr. B.K. Mittal, former Chairman, CWC. Its main recommendations were

- Catchments afforestation, right practice of land use, catchment area treatment, and others.
- In the river itself construction of suitable hydraulic structures that may trap silt.
- Embankment along the aggrading river should be constructed, only after proper studies are made on its behaviour especially due to sedimentation load and resultant morphological changes.
- Desilting in general technically not feasible due to non-sustainability, non-availability of vast land for disposal of dredged material.
- Dredging has insignificant effect on flood magnitude.
- Selective dredging may be undertaken after a thorough study of each case for desilting of tidal rivers or confluence points and to maintain minimum depth of water for navigation.

## **16 The Expert Committee to Review the Implementation of the Recommendations Of Rashtriya Barh Ayog – 2003 (R. Rangachari Committee)**

An Experts Committee under the Chairmanship of Shri R Rangachari was set up by the Ministry of Water Resources, GOI in October 2001 to review the implementation of recommendation of Rashtriya Barh Ayog.

The Committee summed up its views as follows:

- Flood damage assessment, from year to year, is not done realistically or on scientific basis as per RBA recommendations, due to collateral reasons, which are surmised but not expressed. This needs corrective steps.
- Lack of representative, scientific and credible post-project performance evaluations of past flood management works is a serious handicap.
- Unabated and unplanned intrusion into the flood plains and riverbeds, sometimes with the approval or acquiescence of government has now reached alarming dimensions. If this is not managed, flood losses will continue to mount.
- RBA has made a number of recommendations on the future approach and the planning and implementation thereof. Most of these have not been implemented or at the best partially implemented. They will have to be kept in view as part of future approach.
- The international dimensions of FM as an integral part of Water resource development and management must be proactively addressed.
- A number of other issues of importance like adequate funds, legislation, research and people's involvement at all important stages, etc., are very important to effectively manage floods. However, the inter-state issues in multi-state river basins is a very important matter waiting to be effectively addressed.

## **17 The Committee for Identification of Critical Anti-erosion Schemes of Ganga Basin States for Inclusion in CSS to be Implemented during Tenth Plan – 2003 (C. B.Vashistha Committee)**

Keeping in view the seriousness of river erosion and its associated problems, the Ministry of Water Resources, GOI constituted a Committee to identify the schemes for inclusion in the Centrally Sponsored Scheme "Critical Anti-erosion works in Ganga Basin states for Tenth Plan" under the leadership of Shri C.B. Vashistha, Chairman, GFCC.

The Committee visited the critical anti-erosion sites of river Ganga in Uttar Pradesh, Bihar and West Bengal for assessment of the problem and gave its recommendations, which have largely been implemented.

### **18 Report of the Technical Group on Flood and Erosion Problems of North Bengal – July 2004 (M.K. Sharma)**

Rivers like Teesta, Jaldhaka, Torsa, Raidak and Mahananda draining the north Bengal along with their several tributaries cause a serious flood erosion problem in the region. To study the flood and erosion problem of the region and suggest suitable measures, the Ministry of Water Resources constituted a technical group comprising representatives from concerned central and state organisations under the Chairmanship of Shri M.K. Sharma, Member (RM), CWC.

- Design flood estimation may be done in accordance with the sub zonal report of the CWC.
- River training/activation of channel may be attempted on selected reaches where feasible.
- Maintenance of embankments during the pre-monsoon and the monsoon period may be undertaken in accordance with these guidelines given in the embankment manual.
- Considering the magnitude and severity of flood and erosion problems in the north Bengal region it is suggested that a comprehensive plan for flood management for the north Bengal may be prepared.
- Materials such as bamboo, branches of trees, river shingle and boulders which are locally available at comparatively lower cost can be utilised for inducing siltation thus diverting the river flows and preventing bank erosion.
- Implementation of prioritised schemes (listed in the reports) to be taken up during Tenth Plan.

### **19 National Water Policy - 2002**

- Basin-wise master plan for flood control and management.
- Provision of adequate flood cushion in reservoir projects.
- Flood control to be given overriding consideration in reservoir regulation policy.
- More emphasis on non-structural measures.
- Strict regulation of settlements and economic activities in flood plains.
- Flood forecasting activities to be modernised and expanded.

### **20 The Task Force on Flood Management/Erosion Control - 2004**

A Task Force was set up by the Ministry of Water Resources (MOWR) (vide order No. 24/3/2004-ER/2812-48 dated 11 August, 2004) to look into the problem of recurring floods in Assam and neighbouring states as well as in Bihar, West Bengal and eastern Uttar Pradesh under the chairmanship of Chairman, Central Water Commission (CWC) and Secretary ex-officio to the GOI. The terms of reference of the task force were

- (i) To examine the causes of the problem of recurring floods and erosion in Assam and other neighbouring states as well as in Bihar, West Bengal and eastern Uttar Pradesh.
- (ii) To review the measures undertaken so far to combat floods and erosion.
- (iii) To suggest short-term and long-term measures for management of floods and erosion control.
- (iv) To examine related international dimensions and suggest future course of action.
- (v) To suggest institutional arrangements for tackling the problem.
- (vi) To suggest sources of funding for the future action plan.
- (vii) To examine any other related matter/issues.

The task force submitted its report to the MOWR on 31 December 2004. The broad recommendations were:

- i) The role of the central government in the flood control sector be expanded. It has recommended that the flood control schemes should be funded through the centrally sponsored scheme in the ratio of 90 per-cent central and 10 per-cent state from the present 75:25. The task force has recommended that the corpus for centrally sponsored scheme also needs to be increased substantially to accommodate all critical flood management and critical anti-erosion works.
- ii) Schemes worth Rs. 316.14 crore be taken before the coming flood season as an immediate measure. The schemes worth Rs. 2030.15 crore have been recommended under short term-I category to be executed during the remaining two years of the Tenth Five Year Plan, i.e., during the 2005-06 and 2006-07 and Rs. 2635.81 crore under short term-II category to be completed in the Tenth Plan.
- iii) The total investment for plan/flood management may be increased from the existing half per-cent of the total plan outlay to at least one per-cent.
- iv) Funds in the state sector be earmarked as additional central assistance for maintenance of embankments.
- v) Eligibility criteria of schemes for central funding be reduced to Rs. 1 crore from the existing limit of Rs. 3 crore per scheme.
- vi) A revolving fund of Rs. 50 crore, which may be available annually to the Ministry of Water Resources to take up emergent flood management schemes, be created. The normal requirement of 'in principle' approval of the Planning Commission is recommended to be waived in this particular case. The schemes under this fund could be implemented by the states/Boards after inspection by the CWC/Brahmaputra Board. The task force has further recommended that to mobilise

resources for this revolving fund, a flood cess of say one per-cent to two per-cent could be levied on new infrastructure like roads, buildings, power plants etc. in the flood prone states.

- vii) The central government may consider funding the flood control component of the reservoir projects.
- viii) Under the institutional arrangements, an authority in the North-east region with all the statutory powers be set up. In the meantime the Brahmaputra Board be strengthened and restructured.
- ix) The Sikkim and North Bengal River Management Board be established for planning and integrated implementation of measures for flood management in Sikkim and North Bengal.
- x) The Ganga Flood Control Commission be strengthened by addition of the post of Member (Works) and appropriate field formation for investigation and execution of critical flood management works be created.
- xi) The jurisdiction of Farakka Barrage Organisation, be extended.
- xii) In order to have policy formulation and coordination among various agencies, Flood Management Organisation of the Central Water Commission be strengthened by restoring the post of Member (Floods) abolished earlier and redeployment of posts of Chief Engineer, two Directors and other lower level functionaries.
- xiii) The Brahmaputra Board and the proposed Sikkim and North Bengal River Management Board be entrusted the techno-economical examination of the schemes upto Rs. 15 Cr. for submission to the Planning Commission for investment clearance.
- xiv) The reservoir projects in the north-east as well as in Nepal and Bhutan be expedited under the category of long-term measures for flood management.

*Annex-I/VI*

## Important Recommendations of the RBA as Identified by the Expert Committee and Status of Their Implementation

### Evaluation of Performance

#### 1. Recommendation SI.No.4

**For the purpose of evaluation of the performance of the existing and future flood control works, data has to be collected in an effective manner so as to provide quantitative and dependable information on their long term performance and their impact on various socioeconomic factors**

The state governments of Andhra Pradesh, Assam, Bihar, Orissa, Punjab, Uttar Pradesh accept the recommendation to take up such studies. The Central Water commission, Ganga Flood Control Commission, Brahmaputra Board and Assam have got the performance evaluation studies for some schemes done, generally through Water and Power Consulting Services Ltd. (WAPCOS) or other agencies. These reports were then forwarded to concerned state governments for necessary action. Seven schemes have also been evaluated by the government of Assam.

### Flood Plain Use

#### 2. Recommendation SI.No.14

**The states should undertake legislation to prevent unauthorised riverbed cultivation and encroachments into drains etc. and where such laws already exist, the enforcement agencies should be strengthened.**

The cultivation of crops like watermelons, however, be allowed with caution.

The practice of cultivation in the abandoned beds of dhars which discharge into main rivers should be stopped.

Andhra Pradesh has informed that action has been taken under River Conservation Act. Bihar has Bihar Irrigation Act 1997 against encroachment. Punjab uses the Canal & Drainage Act for this purpose. Uttar Pradesh uses the Zamindari Abolition Act. Similarly, Orissa and Himachal Pradesh are proposing to take action.

#### 3. Recommendation SI.No.15

**Where suitable legislation with a penal clause for unauthorised crossings over drains has not been enacted, the same should be done and enforced.**

Andhra Pradesh, Punjab, Uttar Pradesh, Rajasthan and Bihar report that action is being taken under the existing acts to enforce this measure. Orissa is taking action in the matter. Himachal Pradesh is considering the enactment.



#### 4. Recommendation SI.No.49

**Flood plain management measures should be undertaken by the states where necessary legislation exists. Suitable legislation should be enacted in other states.**

Manipur state enacted the legislation in 1978. However, the act is not being enforced till now. The state government of Rajasthan passed the legislation in 1990. Details of enforcement are not available. The state governments of Andhra Pradesh, Assam, Bihar, Himachal Pradesh, Orissa, Punjab, West Bengal and Tripura are still considering this legislation. State government of Madhya Pradesh intimated that they have no serious flood problem and are not considering any legislation. Uttar Pradesh and Haryana consider the legislation necessary but are taking administrative measures. The NCT of Delhi reports that the existing Delhi Development Act 1957 has adequate provisions, which has been ignored so far.

#### 5. Recommendation SI.No.51

**Develop a special flood prone area programme similar to the drought prone area programme or tribal area development of 'DIARA' land along with appropriate research and development support.**

Hardly any progress in the matter has been reported by anyone.

#### Flood Damage Assessment

#### 6. Recommendation SI.No.21

**Wherever possible, contour maps along with gauge data should be used by the flood control departments to derive estimate of area flooded.**

Surveys for preparing contour maps to a scale of 1:15,000 with 25 cm to 50 cm contour intervals were taken up under central funding and until March 1992 (when it was terminated), an area of about 54,000 sq km had been surveyed by the Survey of India. Survey maps of flood prone areas of various reaches of the Jhelum, Sutlej, Ganga tributaries of the Brahmaputra have been furnished to the state governments of Assam, Bihar, Haryana Punjab, Jammu and Kashmir, Uttar Pradesh, West Bengal, etc. for preparing flood risk maps, There has been, however, poor response/reluctance of the concerned state governments in the follow-up action.

#### 7. Recommendation SI.No.22

**Remote sensing techniques operated through artificial satellite(s) may be used in selected areas to provide a sample check on the extent of area and cropped area affected by floods**

Andhra Pradesh, Punjab, Orissa, Uttar Pradesh, Himachal Pradesh are utilising this technique. The NRSA is now in a position to play a more important role in this regard. Rajasthan and Arunachal Pradesh are exploring the use of this technology.

**8. Recommendation SI.No.28**

**Flood damage may be reported separately for the following three categories of areas:**

- i) Unprotected areas**
- ii) Protected areas**
- iii) Areas situated between the embankments and the river**

None of the states, who have responded to the questionnaire, are following this procedure.

**9. Recommendation SI.No.29**

**The extent of area affected by drainage congestion should be compiled separately for protected and unprotected areas**

No state that has responded, is currently following this procedure.

**10. Recommendation SI.No.30**

**Damage data should be compiled basin and sub-basinwise also**

No state that has responded, is currently following this procedure.

**11. Recommendation SI.No.33**

**At the national level, damage data should be compiled by the CWC with an economics unit added to it. It should publish data at the national level.**

The CWC is compiling the national damage data primarily on the basis of information received from the respective state revenue authorities and reconfirming the same subsequently before finalisation. While finalizing the data, figures are cross-checked from the NDM division of MOA (now MHA).

**12. Recommendation SI.No.36**

**The CWC should aid and encourage research in the methodology of flood damage assessment.**

The CWC is following this guideline

**Future Approach****13. Recommendation SI.No.81**

**The comprehensive approach to the problem of floods must form part of the overall**

**comprehensive approach for the best possible utilisation of our land and water resources for optimum production on a sustained long term basis.**

**The approach to the Flood problem should remain dynamic and flexible, so as to accommodate future improvements in policy if called for, taking into account the state of our economy, our social conditions, and the availability of resources.**

The CWC/GFC/Brahmaputra Board have accepted and are following it in the master plans evolved through their agencies.

**14. Recommendation SI.No.82**

**Various alternative measures, physical or otherwise, should be considered for FM and the optimum combination of the measures available in a given situation, selected.**

**15. Recommendation SI.No.83**

**There is a need for storage in various forms, which would even out the flow and also conserve water for use during the dry period**

**16. Recommendation SI.No.84**

**Afforestation and soil conservation measures are recommended as a useful complement to other measures and should be taken up in the watersheds of rivers with heavy silt charge.**

**17. Recommendation SI.No.85**

**Reservoirs, to the extent technically and economically feasible, must be considered as an important component in any package of measures for FM.**

**18. Recommendation SI.No.86**

**Where conditions permit, the use of natural detention basins for flood moderation may be availed of. However, if reclamation of the detention basin has been carried out, the storage may be made use of only during abnormal floods.**

**19. Recommendation SI.No.88**

**While considering the use of embankments, the associated problems and side-effects should be kept in view, and minimised to the fullest extent possible.**

**20. Recommendation SI.No.92**

**Measures attempting to modify the susceptibility of life and property to flood damage should be adopted to a much more increasing degree than heretofore**

The recommendations at serial no. 14-20 have been accepted by the states of Assam, Andhra Pradesh, Arunachal Pradesh, Chhatisgarh, Orissa, Punjab, Uttar Pradesh, Rajasthan, Himachal Pradesh and Bihar. The NRM Division, MOA, GOI, is implementing catchment area treatment including a soil and water conservation programme under River Valley Project and Flood Prone River Programme in 45 catchments. The CWC is providing flood forecasting services through 179 stations, Andhra Pradesh, Assam, Orissa, Uttar Pradesh and Bihar are maintaining warning and relief/rescue systems.

## **Planning and Implementation**

### **21 Recommendation SI.No.96**

**Need and feasibility of providing flood space in reservoirs should continue to be examined and implemented.**

Andhra Pradesh, Bihar, Punjab, Orissa, and Uttar Pradesh agree.

### **22. Recommendation SI.No.112**

**Negotiations should be expedited between Nepal and India with regard to the construction of storage and development of water resources.**

Uttar Pradesh and Bihar agree.

### **23. Recommendation SI.No.113**

**Unless adequate maintenance of completed works is assured, it will add to the damage potential through their deterioration and it would be unwise to undertake new construction at the cost of maintenance of already existing works.**

Most states that have responded have reported inadequate funds for maintenance being made available to them.

### **24. Recommendation SI.No.116**

**Completion of continuing schemes should receive priority in allocation of funds, to the extent necessary.**

The recommendation has been accepted by the states of Andhra Pradesh Assam, Arunachal Pradesh, Bihar, Himachal Pradesh, Madhya Pradesh, Orissa, Punjab and Uttar Pradesh. Reportedly, fund constraints jeopardise the main objective of the schemes.

### **25. Recommendation SI.No.117**

**Attempts should be made to obtain public participation.**

Rajasthan, Himachal Pradesh, Bihar, Andhra Pradesh, Punjab, Orissa and Uttar Pradesh state that they are implementing this.

## **Financing**

### **26. Recommendation SI.No.122**

**Flood control sector be given preference while making allocations from funds meant for special problems in major flood prone states**

Most states that have responded have reported that only meagere funds are allocated to flood control.

## **Maintenance**

### **27. Recommendation SI.No.132**

**Adequate funds for maintenance should be assured; amounts for maintenance suggested for various types of works may be taken as a guide. These should be reviewed by the state officers on the basis of actual needs and norms accordingly fixed. These norms should be reviewed periodically.**

Many states have reported that only insufficient funds are being made available for maintenance.

### **28. Recommendation SI.No.137**

**Arrangements should be made for connecting by telecommunication links, all points of important flood and drainage works to the headquarters of superior engineering officers and the control room of state headquarters.**

The states of Andhra Pradesh, Orissa, Bihar, Madhya Pradesh, Uttar Pradesh, and Rajasthan simply agree. Himachal Pradesh agree but report its inability to follow due to fund constraint.

## **Organisation**

### **29. Recommendation SI.No.143**

**River basin authorities should be set up for preparing plans by basins/sub-basins of inter-state rivers.**

### **30. Recommendation SI.No.149**

**River basin authorities should be constituted as statutory authorities.**

Central agencies like the GFCC, Brahmaputra Board and CWC agree. But the government has no response.

## Legislation

### 31. Recommendation SI.No.152

**The central government should assume the powers conferred on it by the constitution under Entry 56 of the union list and enact suitable legislation for the regulation and development of inter-state rivers.**

### 32. Recommendation SI.No.154

**The central government should prepare a model bill dealing with all aspects of flood control to serve as a guide for the state governments.**

Central agencies like the GFCC, Brahmaputra Board and CWC agree. The state government have not responded in the matter.

## Research, Education and Training

### 33. Recommendation SI.No.167

**More emphasis should be laid on research, education and training as relevant to water resources development, river science and control of floods**

The recommendation is being implemented by the states of Andhra Pradesh, Bihar, Punjab, Orissa, Himachal Pradesh, Rajasthan and Uttar Pradesh.

### 34. Recommendation SI.No.176

**The existing research organisations should intensify their research investigation to obtain scientific information on river morphology and river response to various hydraulic structures and encroachments.**

The state governments of Andhra Pradesh, Bihar and the Brahmaputra Board are implementing this recommendation.

## Cyclones and Sea Erosion

### 35. Recommendation SI.No.190

**The recommendations contained in the project report prepared by the IMD for better forecasting and warning are endorsed.**

The IMD introduced a 24-hours watch for cyclones and their warning which has been upgraded from Stage 2 to stage 4 in 1999. A satellite-based cyclone warning dissemination system has also been installed and is being operated.

**36. Recommendation SI.No.191**

**Only restricted urbanisation should be permitted in areas vulnerable to sea surges resulting from cyclones**

The state government of Andhra Pradesh stated that the recommendation is being followed.

**37. Recommendation SI.No.192**

**Disaster prevention policies should be encouraged.**

**38. Recommendation SI.No.193**

**The general range of land use regulation recommended for flood prone areas may be applied for cyclone-hit areas too.**

**39. Recommendation SI.No.194**

**Casuarina and other plantations, wherever feasible, should be grown as wind breakers for a width of about 2 km along the seacoast.**

There has been no response from the state governments on recommendations at SI. No. 37-39.

**40. Recommendation SI.No.195.**

**Shelter buildings, especially designed for cyclone conditions should be constructed in the coastal areas.**

Andhra Pradesh and Orissa have reported that they are following these recommendations.



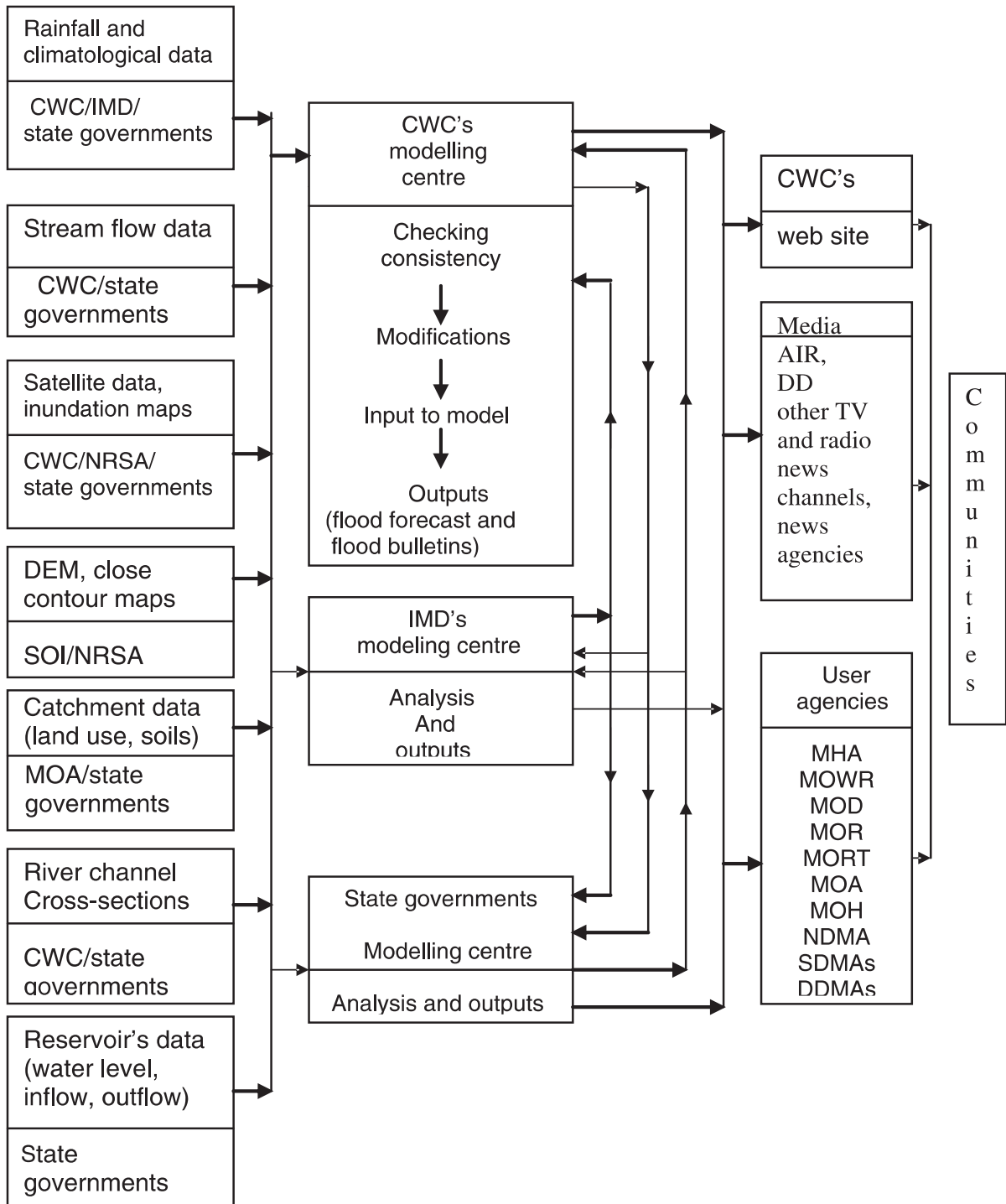
## Annex-I/VII

## State-wise Details of Achievements on Structural Measures

S.No.	Name of States /UTs	Area benefited	Length of embankments	Length of drainage channel	Village raised/protected	Town/ village protection works	Raised platforms
		lakh hectares	Kms	Kms			
1	2	3	4	5	6	7	8
1	Andhra Pradesh	13.11	2230.000	13569.000	23	72	NR
2	Arunachal Pradesh	0.55	6.324	4.447	17	0	0
3	Assam	16.42	4464.180	850.690	0	694	NR
4	Bihar	29.49	3430.000	365.000	0	47	58
5	Chattisgarh	0.00	0.000	0.000	0	0	0
6	Delhi	0.78	83.000	453.000	0	0	0
7	Goa	0.03	23.190	32.770	0	2	0
8	Gujarat	4.83	104.120	271.000	30	805	NR
9	Haryana	20.00	1144.000	4385.000	98	448	0
10	Himachal Pradesh	0.12	58.000	11.000	0	0	0
11	Jammu and Kashmir	2.17	230.000	14.000	5	12	0
12	Jharkhand	0.01	14.000	0.000	5	2	0
13	Karnataka	0.05	73.515	10.000	0	30	0
14	Kerala	3.46	205.744	31.100	6	4	0
15	Madhya Pradesh	0.04	26.000	0.000	0	37	0
16	Maharashtra	0.01	44.500	110.000	0	0	0
17	Manipur	1.32	577.000	166.000	1	38	0
18	Meghalaya	0.01	112.000	0.000	2	8	0
19	Mizoram	0.00	0.000	0.000	0	0	0
20	Nagaland	6.32	10.519	0.000	0	8	0
21	Orissa	6.30	6541.000	131.000	14	29	NR
22	Punjab	31.90	1370.000	6622.000	0	3	0
23	Rajasthan	0.82	145.000	197.000	0	25	0
24	Sikkim	0.17	101.810	64.860	0	18	0
25	Tamil Nadu	1.22	87.000	19.000	4	46	0
26	Tripura	0.33	141.740	95.230	0	11	NR
27	Uttar Pradesh	17.03	2097.000	3995.000	4511	65	NR
28	Uttarakhand	0.02	9.000	0.000	0	6	NR
29	West Bengal	25.68	10539.000	7392.760	00	48	NR
Union Territories							
30	A and N Islands	0.00	0.000	0.000	0	0	0
31	Chandigarh	0.00	0.000	0.000	0	0	0
32	Dadra and Nagar Haveli	0.00	0.000	0.000	0	0	0
33	Daman and Diu	0.00		0.000	0	0	0
34	Lakshadweep	0.00	0.000	0.000	0	0	0
35	Pondicherry	0.04	61.000	20.000	0	0	0
	<b>Total</b>	<b>182.22</b>	<b>33928.642</b>	<b>38809.857</b>	<b>4716</b>	<b>2458</b>	<b>58</b>

NR : Not reported

Flowchart for Flood Forecasting and Early Warning



## Annex-V/I

## Case Study for Effectiveness of Hirakud Dam in Flood Moderation

**Hirakud Dam**

The Hirakud dam was conceived to provide one of a series of three storage reservoirs on the Mahanadi river, primarily for flood control of the Mahanadi delta. The scheme was, however, prepared as multipurpose project with emphasis on flood control with other benefits added to improve revenues and economic returns. It is a fact that the flood control function had over a period of time received secondary status below hydropower and irrigation.

The Hirakud reservoir has a total storage capacity of 66 lakh acre feet (8.14 BCM) upto the full reservoir level of 630 ft. The live storage capacity between the minimum water level (DSL) of 590 ft and the full reservoir level is 347.2 lakh acre feet (5.82 BCM). It was originally envisaged that during the monsoon months June to September, the reservoir level be kept at 590 ft, so as to make available the capacity above this level for flood absorption purposes. As the monsoon draws to an end, the reservoir was to be filled in to reach the FRL of 630 ft by first October every year, to meet the lean season needs of irrigation, power, etc. The reservoir has no earmarked flood storage as such. The available capacity during the monsoon season is utilised for flood moderation.

In actual operation, over the years since it was commissioned in 1957, many changes have taken place, primarily governed by the requirements of irrigation and power generation. In the early years of operation, it was noted that the irrigation and power interests would be assured with early filling of the reservoir than originally planned. Such changes occurred again and again, as summarised in the Table below.

## Summary of Hirakud Reservoir Filling Schedules

Authority/Year	Recommend Reservoir Level in feet as on						
	1 July	1 Aug	21 Aug	1 Sept	11 Sept	21 Sept	1 Oct
1953 Project Report (revised)	590	590	590	590		620 (15/9)	630
1959 reservoir operation manual*	590	590	590	590			630
1962 Evaluation							
Committee Report	592	590	590	600	615	625	630
1970 Hirakud Coord. Committee Report	600	600	600	610	615	625	630
1976 Experts Committee Report	600	600	605	617	623	627	630
1989 and 1992 Expert Committee report	595	590	610 to 622	619 to 627	624 to 629	629.5 to 630	630

\*General average years

Source: CWC/Orissa government records

Notes: Dead storage level 590 ft and full reservoir level 630 ft.

It is thus clear that there is constant endeavour to give greater importance to hydropower and irrigation and consequently to fill up the reservoir very early, relegating the FM aspect to low priority. This is contrary to the original project concept. What is even worse, it is found that in actual operation, 'the reservoir is being kept substantially higher than the latest recommended filling schedule' and this curtailment in flood control storage was used mostly for power generation purposes. This poses a real threat to flood moderation aspect as also to the safety of the flood embankments in the delta. Silting in the reservoir will aggravate the problem.

The effect of the Hirakud dam in moderating the floods at the delta head, as per the records and analysis of the government of Orissa, is summarised in the Table given below.

### Role of Hirakud Dam in Reduction of Flood Peak at Mahanadi Delta Head

Year	Peak flow dates	Peak flow at Delta Head with and without Hirakud Dam			
		Actual with Hirakud Dam In position		Hypothetical without Hirakud dam in place	
		Lakh cusec	1000 cumec	Lakh cusec	1000 cumec
1	2	3	4	5	6
1961	4-13 July	12.85	36.39	15.15	42.90
	14-26 July	11.52	32.82	12.65	35.82
	1-11 Sept	11.68	33.07	15.17	44.49
	14-17 Sept	13.05	36.95	13.80	39.08
1964	16-19 Aug	8.95	25.34	13.40	37.95
	22-26 Aug	9.05	25.67	13.90	39.36
1967	2-5 Aug	8.94	25.32	14.21	40.24
1973	2-7 July	8.32	23.56	11.50	32.56
1976	11-18 Aug	9.14	25.88	9.50	37.10
1978	26 Aug-3 Sept	9.93	28.12	12.53	35.48
1980	19-30 Sept	12.70	35.96	14.20	40.21
1982	30 Aug-6 Sept	15.84	44.85	20.90	59.18
1983	4-13 Sept	9.02	25.54	10.50	29.73
1985	1-14 Aug	9.30	26.34	11.10	31.43
1986	25-30 June	8.70	24.64	13.10	37.10
1991	20 July-4 Aug	7.25	20.53	10.90	30.87
	12 July-21 Aug	12.71	35.99	16.90	47.86
1992	8 July-2 Aug	11.34	32.11	14.00	39.64
	16-30 Aug	11.26	31.89	15.10	42.76
1994	8-19 July	10.24	29.00	13.20	37.38
	6-11 Aug	10.81	30.61	12.15	31.76
1995	25 July	9.11	25.80	12.16	34.43

Source: 1. Orissa government records taken from the report of the Working Group on Flood Control for the Tenth Plan

2. Article by R Rangachari presented at the Ninth National Water Convention, November 2001 at Bangalore, titled 'Role of Storage Dams in the Management of Floods'

Summing up, every flood that passed through the dam has been moderated.

As the uncontrolled catchment, downstream of Hirakud dam is sizeable, Hirakud reservoir alone cannot be depended upon to keep flood peaks in the delta region below safe levels. This underlines the need for further storages and improvements and strengthening the flood control embankments in the delta region.

The effectiveness of the Hirakud dam in FM can be enhanced by many ways. These include real-time inflow and flood forecasts, effective communication links of the dam agency with upstream and downstream regions, revision of the reservoir regulation manual, independent monitoring and annual reviews of the actual operations.

## Model Bill For Flood Plain Zoning

### A bill

to provide for the zoning of flood plains of rivers in the state of -----Be it enacted by the legislature of the State of -----in the Twenty-----year of the Republic of India as follows:

#### CHAPTER 1

#### PRELIMINARY

##### Short title, Extent and

1.(1) This Act may be called the Flood Plain commencement

(2) It extends to the whole State of-----

(3) This section shall come into force at once and the remaining provisions of this Act shall come into force on such date as the state government may, by notification in the Official Gazette, appoint:

Provided that different dates may be appointed for different provisions of this Act and for different areas or different rivers.

##### Definition

2.(1) In this Act, unless the context otherwise requires-

(a) 'flood plain includes water channel, flood channel and that area of nearby low land susceptible to flood inundation.

(b) 'flood plain zoning' means retracting any human activity in the flood plains of a river where the plains are created by overflow of water from the channels of rivers and Streams;

(c) 'flood zone' means the area which is required to carry the flow of the maximum probable floods;

(d) 'Flood Zoning Authority' in relation to a river, means the authority appointed by the State Govt. under Section 3;

(e) 'land' includes interest in lands, benefits arising out of lands and things attached to the earth or permanently fastened to anything attached to the earth;

(f) 'occupier' in respect of any land, means any person who has an interest in the land and cultivates the land himself or by his servants or by hired labour and includes a tenant;

- (g) 'Owner' in relation to any land includes any person having interest in such land;
  - (h) 'prescribed' means prescribed by rules made by the State Govt. under this Act;
  - (i) 'river' includes its tributaries;
- 'water channel' means the channel in which the flows of a river are generally confined.

## CHAPTER II

### FLOOD ZONING AUTHORITY AND ITS POWERS

#### Declaration of flood plain zoning

- 3.(1) Where the state government considers it necessary or expedient so to do, it may, by notification in the official Gazette and in the Gazette of every District in which any part of a river flows, declare that flood plain zoning shall be made in the manner hereinafter specified.
- (2) The state government may direct that a survey be made of a river for the purpose of determining the limits within which the provisions of the Act are to be applied and that proper charts and registers be prepared specifying all boundaries and landmarks and any other necessary matter for the purposes of ascertaining such limits.
- (3) The state government may by notification in the Official Gazette, appoint the Collector of the District or such other authority as that government considers necessary, as the Flood Zoning authority for the purposes of making a survey of the area as required under sub-section (2) and may specify in such notification, the duties to be discharged by such authority.

#### Powers and functions of the Flood Zoning Authority

4. The Flood Zoning authority shall exercise the powers and discharge the duties in accordance with the provisions of this Act and the terms and conditions specified in the notification under sub-section (3) of section 3.

## CHAPTER III

### SURVEYS AND DELINEATION OF FLOOD PLAIN AREA

#### Survey

- 5.(1) The flood Zoning Authority shall carry out surveys of flood plains of the rivers and determine the nature and the extend of flood plains of the rivers.
- (2) The Flood Zoning authority shall, on the basis of the survey carried out under sub-section (1), establish flood plain zones and delineate



the areas which are subject to flooding including classification of land with reference to relative risk of flood plain use intended to safeguard the health, safety and property of the general public.

(3) The Flood Zoning Authority shall prepare charts and registers indicating the areas delineated under sub-section (2).

**Power to take up survey**

6.(a) to enter upon and survey and take levels of any land within its or his jurisdiction;

(b) to mark such levels, boundaries and lines by placing marks or boundary stones;

(c) to measure the land;

(d) to do all other acts necessary for the purposes of ascertaining the limits referred to in sub-section (2) of section 3;

(e) where otherwise the survey cannot be completed and the levels taken, to cut down and clear away any part of standing crop, fence or hudge;

Provided that no Flood Zoning Authority or any other officer shall enter into any building or open any enclosed court or garden attached to a dwelling house (unless with the consent of the occupier thereof) without previously giving such occupier atleast seven days notice in writing of its or his intention to do so.

**Payment of damages**

7.(1) The Flood Zoning Authority or any other officer generally or specially authorised by it in this behalf, who has entered upon any land under section 5 shall, before leaving, tender compensation to the owner or occupier of such land for any damage which may have been caused and in case of dispute as to the sufficiency of the amount so tendered, the Flood Zoning Authority or such officer shall refer the matter to the -----for his decision.

(2) The decision of the officer under sub-section (1) shall be final and no suit shall lie in a civil court to have it set aside or modified,

**CHAPTER IV**

**NOTIFICATION OF LIMITS OF FLOOD PLAINS**

**Declaration of intention of State Govt. to demarcate flood plain areas**

8. The State Govt. may, on the basis of a report from the Flood Zoning Authority or otherwise, by notification in the Official Gazette, declare its intention to demarcate the Flood Plain areas and either prohibit or restrict the use of land therein.

**Public Notices**

9. (1) The Flood Zoning Authority shall, on the issue of notification under section 8, cause public notice of the substance of such notification to be given at convenient places in the area.
- (2) The Flood Zoning Authority shall also give notices individually to the owners of the lands situated in the area.
- (3) The Flood Zoning Authority shall exhibit records, charts, maps, registers and such other documents showing the river channel, flood channel and the flood plain area, specifying the nature and extent to which the use of limits of the area is either prohibited or restricted, the office for inspection by the general public at the timings specified therein.

**Objections**

- 10.(1) Any person who desires to raise any objection to the limits and either the prohibitions or restrictions specified in the public notice referred to in section 9, may within a period of sixty days from the date of publication of the notification in the official gazette, forward to the Flood Zoning Authority a statement in writing setting forth his objections.
- (2) After the expiry of period aforesaid, the Flood Zoning Authority shall issue a notice in the manner prescribed and consider the objections after giving the party concerned a reasonable opportunity of being heard in the matter.

The Flood Zoning Authority shall forward to the State Govt. its or his proposals together with the records referred to in sub-section (3) of section 9.

**Decision of the State Government**

- 11.(1) The State Govt. shall, after considering the report of the Flood Zoning limits of the areas as it considers necessary.
- (2) The decision of the state government shall be final.
- (3) The state government shall, by notification in the official Gazette, declare that the provisions of this Act shall apply to the said river with boundaries and limits as specified.
- (4) The areas delineated and approved by the state government shall be deemed to be the flood plain and the limits shall, where necessary, be marked either by boundary stones or other suitable marks.
- (5) The Flood Zoning Authority shall maintain the charts and registers of such areas so delineated and such charts and registers shall form part of the permanent records of the office.

- (6) The charts and registers maintained under sub-section(5) shall be furnished to the Collector of the District in which any part of the river is situated and shall be open for inspection by the general public at such times as may be prescribed.

## CHAPTER V

### PROHIBITION OR RESTRICTION OF THE USE OF THE FLOOD PLAINS

#### **Powers to prohibit obstruction, etc. in**

- 12.(1) Where the State Govt. is satisfied that it is necessary to do so in the interest of public health, safety, or property in the interest of reducing the flood plain area inconvenience to the general public or that it is necessary to prohibit or restrict the activities in the flood plain, that government may, by notification in the Official Gazette, specify the area where such prohibition or restriction is to be enforced and the nature and extent of such prohibition or restriction.

Provided that no notification under this sub-section shall be issued after the expiry of six months from the date of publication of notification under section-8.

- (2) Upon the publication of a notification under sub-section (1) notwithstanding anything contained in any law, custom, agreement or instrument for the time being in force, the prohibition or restriction specified in such notification shall prevail.

- (3) No person shall undertake any activity within the prohibited area or restricted area except with the previous permission of the Flood Zoning Authority. Provided that where a person makes an application to the Flood Zoning Authority for permission under this sub-section to undertake any activity and the Flood Zoning Authority does not, within a period of ninety days from the date of receipt of such application, communicate to the person that permission applied for has been refused, it shall be presumed that the Flood Zoning Authority has granted such permission.

#### **Penalty**

13. If any person commences or carries on or attempts to carry on any activity in the area specified in the notification under sub-section (1) of section 12 contrary to the terms and conditions specified in such notification, he shall be punishable.
- (a) With fine which may extend to five hundred rupees or in default, of payment of fine, to simple imprisonment for a term which may extend to two months; and
- (b) With further fine which may extend to one hundred rupees for each day after the conviction under clause (a).

**Power to Compound**

14.(1) Subject to such conditions as may be prescribed, any officer authorised by the State Govt. by a general or special order in this behalf may, either before or after the institution of proceedings under this Act accept from the person who has committed or is reasonably suspected of having committed an offence, a sum of money not exceeding-----rupees.

(2) On the payment of such sum of money, such person shall be discharged and no further proceedings shall be taken against him in respect of such offence.

**Appeal**

15.(1) Any person aggrieved by any decision of the Flood Zoning Authority may refer an appeal to the prescribed authority within a period of ninety days from the date on which such decision was communicated to him;

Provided that the prescribed authority may entertain the appeal after the expiry of the said period of ninety days if it is satisfied that the appellant was prevented by sufficient cause from filing the appeal in time.

(2) The prescribed authority may after giving a reasonable opportunity to the appellant of being heard in the matter, make such orders as it deems fit and the decision thereof shall be final

**Revision**

16.(1) Where no appeal has been preferred under section 15, the State Govt. may, for the purpose of examining the legality, propriety or correctness of any inquiry or proceedings of the Flood Zoning Authority, call for the records of any inquiry or proceedings of the Flood Zoning Authority and make such order in the case as it thinks fit;

Provided that no such records shall be called after the expiry of six months from the date of such order.

(2) No order of the Flood Zoning Authority shall be varied by the State Govt. so as to prejudicially affect any person without giving such person a reasonable opportunity of being heard in the matter.

**CHAPTER VI****COMPENSATION****Payment of compensation**

17.(1) Where any permission to undertake any activity in the flood plain has been refused to any person or whereas a result of prohibition or restriction imposed on any person under this Act, such person suffers any damage, he shall be entitled to the payment of

compensation not exceeding the difference between the value of the land as determined under section 23 of the Land Acquisition Act, 1894 and the value which it would have, had the permission for carrying on any(Central Act 1 of 1894) activity had been granted or the prohibition or restriction had not been imposed.

- (2) In determining the amount of compensation under sub-section(1), any restriction to which the land is subjected to under any other law for the time being in force in regard to the right of the person claiming compensation to carry on any activity on the land or otherwise to the use of the land shall be taken into consideration.

**Determining the compensation and apportionment by consent**

- 18.(1) The person to whom the compensation under section 17 is to be paid and the apportionment of such amount among the persons interested therein shall be determined by agreement between the Flood Zoning Authority and the person or persons claiming interest therein.

- (2) In default of any such agreement, the Flood Zoning Authority shall, after holding such enquiry as it considers necessary, make an award determining:-

- (a) the amount of compensation to be paid under section 17 and  
(b) the apportionment, if any of such compensation among persons known or believed to be interested therein;

Provided that where the amount of compensation exceeds Ten thousand rupees, no award shall be made without the previous approval of the State Govt. or such other officer as the State Govt. may authorise in his behalf.

**Compensation not admissible**

- 19.(1) No compensation shall be awarded.

- (a) if any in so far as the land is subject substantially similar restriction in force under some other law in force on the date on which the restrictions were imposed by or under this Act; or  
(b) if compensation in respect of the same restrictions imposed by or under this Act or substantially similar restrictions in force under some other law has already been paid in respect of the land to the claimant or any predecessor in interest of the claim; or  
(c) for removal of any encroachment.

(2) If any person has unauthorisedly undertaken any activity, then any increase in the value of land from such activity shall not be taken into account in estimating the value of land.

**Application against award** 20.(1) Any person aggrieved by the Award of the Flood Zoning Authority under sub section(2) of section 18 may by an application in writing, apply to the State Govt. or such other officer as the State Govt. may authorise in this behalf.

(2) Any application under sub-section(1) shall be made in such form and in such manner as may be prescribed and shall be made within forty five days from the date of communication of the award.

(3) The application under this section shall be disposed of in such manner as may be prescribed.

**Procedure & Powers of authorities in deciding** 21.(1) An application under section shall be deemed to be proceedings within the meaning of section 141 of the code of Civil Procedure, applications 1908 and in the trial thereof, the authorities empowered to decide reference may exercise on the powers of civil court.(Central Act 5 of 1908).

(2) The scope of inquiry shall be restricted to the consideration of the matter referred to the State Govt. or such other officer as the State Govt. may authorise in this behalf.

**Decision enforceable** 22. The decision under section 21 shall be enforceable as a decree of as decree of civil court civil court

**Payment under award** 23. On the determination of the compensation under sub-section (1) of section 18, or on the making of an award under sub-application is made under section 20 against such award after decision of the authority, the compensation shall be paid by flood Zoning Authority and the provisions of section 31 to 35(both inclusive) of the land Acquisition Act, 1894, shall apply to such payment (Central Act 1 of 1894).

## CHAPTER-VII

### POWER TO REMOVE OBSTRUCTIONS AFTER PROHIBITION

**Power to remove obstructions** 24.(1) The Flood Zoning Authority may, in accordance with the provisions of this Act, within such time as may be specified by it direct any owner or occupier of land to do any act or remove any unauthorised obstruction within such time as may be specified by it and such owner or occupier shall do such act or remove the obstruction.

(2) If the owner or occupier fails to comply with the order of the Flood

Zoning Authority within time specified under sub-Section (1), the Flood Zoning Authority may cause the act to be performed or cause the obstruction to be removed.

(3) All expenses incurred by the Flood Zoning Authority under this section shall be recovered from such owner or occupier as arrears of land revenue.

## CHAPTER VIII

## MISCELLANEOUS

- Preventing Flood Zoning.** 25. Any person who prevents the Flood Zoning Authority in discharging Authority from doing an act any act imposed on such Authority by or under this Act, shall be deemed to be offence to have committed an offence under section 186 of the Penal Code.(Central Act 45 of 1860).
- Flood Zoning Authority** 26. The Flood Zoning Authority and other officers and employees and other officers to be authorised under this Act shall be deemed to be public servants within public servants the meaning of section 21 of the Indian Penal Code (Central Act 45 of 1860).
- Protection of action taken** 27.(1) No suit, prosecution or other legal proceeding shall lie against in good faith the State Govt. or any authority or person exercising any power or performing any duty under this Act for anything which is in good faith done or intended to be done in pursuance of this Act or order made hereunder.
- (2) No suit or other legal proceeding shall lie against the State Govt. for any damage caused or likely to be caused for anything which is in good faith done or intended to be done in pursuance of this Act or any rule or order made there under.
- Recovery of fine** 28. All fines imposed under this Act shall be recovered in the manner provided in the Code of Criminal Procedure, 1898.(Central Act 5 of 1890).
- Power of Court** 29. A civil court shall have jurisdiction to settle, decide deal with any question which is by or under this Act required to be settled., decided or dealt with by the Flood Zoning Authority or such other officer authorised by the State Govt. in this behalf.
- Power to make rules** 30 (1) The State Govt. may, by notification in the Official Gazette, make rules to carry out the purposes of this Act.

- (2) In particular and without prejudice to the generally of the foregoing provisions, such rules may provide for.
  - (a) The manner in which charts and records shall be maintained.
  - (b) The form and manner in which application under section 20 shall be made and the manner in which such application shall be disposed of;
  - (c) Any other matter which has to be, or may be, prescribed.
- (3) Every rule made under this Act shall be laid, as soon as may be after it is made, before each House of the State Legislature while it is in session for a total period of fourteen days which may be comprised in one session or two or successive sessions and if before the expiry of the session immediately following the session or the successive sessions aforesaid both Houses agree that the rule should not be made, the rule shall, thereafter, have effect only in such modified form or be of no effect, as the case may be, so, however, that any such modification or annulment shall be without prejudice to the validity of anything previously done under that rule.



## Core Group on Management of Floods

---

1. Dr. Mohan Kanda, Member, NDMA - Chairman
2. Secretary, Ministry of Water Resources.
3. Chairman, Central Water Commission.
4. Director, National Institute of Hydrology, Roorkee.30
5. Director, IIT, Chennai.
6. Dr. U.C.Mohanti, Professor, IIT, Delhi.
7. Dr. Nayan Sarma, Professor, IIT, Roorkee.
8. Joint Secretary, Ministry of Home Affairs (dealing with Floods).
9. Secretary/Commissioner (Disaster Management/Relief), government of Assam.
10. Secretary/Commissioner (Disaster Management/Relief), government of Bihar
11. Secretary/Commissioner (Disaster Management/Relief), government of Orissa
12. Secretary/Commissioner (Disaster Management/Relief), government of West Bengal.
13. Dr. Kamta Prasad, Chairman, Institute for Resource Management and Economic Development, New Delhi.
14. Dr.K.J.Ramesh, Scientist F, DOST
15. Member (RM), CWC - Convener

## Extended Group on Management of Floods

---

1. Dr. Mohan Kanda, Member, NDMA - Chairman
2. Secretary, Ministry of Water Resources
3. Chairman, Central Water Commission
4. Chairman Brahmaputra Board, Guwahati
5. Chairman, Ganga Flood Control Commission, Patna
6. Executive Director, National Institute of Disaster Management, New Delhi
7. Secretary/Commissioner (Disaster Management/Relief), Govt. of Assam
8. Secretary/Commissioner (Disaster Management/Relief), Govt. of Bihar
9. Secretary/Commissioner (Disaster Management/Relief), Govt. of Uttar Pradesh
10. Secretary/Commissioner (Disaster Management/Relief), Govt. of West Bengal
11. Secretary/Commissioner (Disaster Management/Relief), Govt. of Andhra Pradesh
12. Secretary/Commissioner (Disaster Management/Relief), Govt. of Orissa
13. Secretary/Commissioner (Disaster Management/Relief), Govt. of Haryana
14. Secretary/Commissioner (Disaster Management/Relief), Govt. of Uttarakhand
15. Secretary Water Resources/Pl. Secretary (Irrigation), Govt. of Assam
16. Secretary Water Resources/Pl. Secretary (Irrigation), Govt. of Bihar
17. Secretary Water Resources/Pl. Secretary (Irrigation), Govt. of Uttar Pradesh
18. Secretary Water Resources/Pl. Secretary (Irrigation), Govt. of West Bengal
19. Secretary Water Resources/Pl. Secretary (Irrigation), Govt. of Andhra Pradesh
20. Secretary Water Resources/Pl. Secretary (Irrigation), Govt. of Orissa
21. Secretary Water Resources/Pl. Secretary (Irrigation), Govt. of Haryana
22. Secretary Water Resources/Pl. Secretary (Irrigation), Govt. of Uttarakhand
23. Director General, India Meteorological Department, New Delhi
24. Director General, Indian Council of Agricultural Research (ICAR), New Delhi
25. Joint Secretary, Ministry of Home Affairs
26. Dr. Kamta Prasad, Chairman, Institute for Resource Management and Economic Development, New Delhi
27. Director, National Remote Sensing Agency, Hyderabad
28. Director, National Institute of Hydrology, Roorkee

29. Dr. S. Mohan Prof. and Head, Department of Civil Engineer IIT, Chennai
30. Dr. U.C. Mohanty, Professor, IIT Delhi
31. Dr. Nayan Sharma, Professor, IIT Roorkee
32. Dr. K. J. Ramesh, Scientist F, Department of Science and Technology, Mehrauli Road, New Delhi-110016
33. Prof. Kalyan Rudra, 213, Dum Dum Park, Flat No. 2/1, Kolkata
34. Chief Engineer CWC, New Delhi
35. S.K. Agrawal, Specialist (Floods), NDMA

## List of Persons Who Made Contributions to Preparation of Guidelines on Flood Management

---

- 1 Mr. A. K. Sinha, Director, CWC
- 2 Mr. A. K. Panday, Additional Chief Secretary (Development), Rajasthan
- 3 Mr. A. Ramalingam, I.A.S., Joint Commissioner (I.R.), Revenue Administration, Disaster Management and Mitigation Department, Chennai
- 4 Mr. A. C. Mohanty, Secretary (DM), Maharashtra
- 5 Mr. A. K. Choudhary, Chief Secretary, Bihar
- 6 Mr. A. K. Ganju, Chief Engineer, CWC
- 7 Mr. A. K. Gogoi, Additional Director General, ICAR
- 8 Mr. A. K. Gupta, Dy. Director, CWC
- 9 Mr. A. K. Jain, Additional Secretary, Irrigation and Command Area Development, Andhra Pradesh
- 10 Mr. A. K. Sinha, Commissioner cum Secretary (Water Resource), Bihar
- 11 Mr. A. P. Kandigal, Assistant Engineer, CWC, Mizoram
- 12 Mr. Ajay Kumar, Executive Engineer, CWC, Mizoram
- 13 Mr. Ajit Kumar Tripathy, Chief Secretary, Orissa
- 14 Mr. Ambuj Sharma, I.A.S., Secretary, Revenue Department, Chennai
- 15 Mr. Amit Kiran Deb, Chief Secretary, West Bengal
- 16 Mr. Anand Prakash, Engineer in Chief, Irrigation Department, Uttar Pradesh
- 17 Mr. Ajay Kumar, Dy. Director, CWC
- 18 Ms. Anjali Bhawra, IAS, Secretary Revenue, Punjab
- 19 Mr. Anup Shrivastava, Special Secretary, Revenue and Disaster Management Department, Chhattisgarh
- 20 Mr. Arvindo, Secretary (Water Resource), Orissa
- 21 Mr. Ashok Gupta, Deputy Commissioner Relief, Madhya Pradesh
- 22 Mr. Ashok Kumar, IAS (P), Andaman & Nicobar
- 23 Mr. Atanu Purkayastha, Secretary, Relief, West Bengal
- 24 Mr. Aurobindo Behra, Principal Secretary (Water Resource), Assam
- 25 Mr. B. Murali Kumar, Director (DM-1), MHA
- 26 Mr. B. B. P Singh, Chief Engineer, Planning and Monitoring, Water Resources Department, Bihar
- 27 Mr. B. N. Prusty, Assistant Engineer, Central Water Commission, NMSD-I, Raipur, Chhattisgarh

- 28 Mr. B. P. Singh, former Chief Engineer (Floods), CWC
- 29 Mr. B. R. Loe, Dy. Director General Meteorology, IMD
- 30 Mr. Bhupati Prasad Pandey, Secretary (Relief and Rehabilitation), Maharashtra
- 31 Mr. C.N. Seetharam, Secretary, DM, Karnataka
- 32 Mr. C. Targay, Chief Secretary, Andaman and Nicobar Administration
- 33 Mr. Chandrashekhar Mutha, Deputy Secretary, Disaster Management and Cooperation Department
- 34 Ms. Christine Wanglat, Deputy Director (DM), Arunachal Pradesh
- 35 Dr. D. K. Shankaran, Chief Secretary, Maharashtra
- 36 Mr. D. Pal, Joint Secretary, Disaster Management, West Bengal
- 37 Mr. Deepak Trivedi, Relief Commissioner, Uttar Pradesh
- 38 Mr. Dinesh Chandra Sharma, Chief Engineer, Irrigation, Uttarakhand
- 39 Mr. Dominie Lalhmangaiha, Consultant (DRM), GOI-UNDP, Mizoram
- 40 Mr. (Dr.) S. Mohan, Head, Department of Civil Engineering, IIT Chennai
- 41 Mr. G. Behera, Group Director, Water Resources and Oceanography and Project Director, Decision Support Centre, DMSP, NRSA, Hyderabad
- 42 Mr. G. Sudhakar Rao, Karnataka
- 43 Mr. G. B. Patel, Chief Engineer, Gujarat
- 44 Mr. G. D. Priyadarshini, Andhra Pradesh
- 45 Mr. G. D. Singhal, Chief Engineer, Irrigation Department, Uttar Pradesh
- 46 Mr. G. S. Purba, Chief Engineer, (FM), CWC
- 47 Ms. Gauri Chattarjee, Secretary, MOWR
- 48 Mr. Gorakh Thakur, Senior Joint Commissioner, MOWR
- 49 Mr. H. N. Sharma, Irrigation Department, Uttar Pradesh.
- 50 Mr. Islam, Chief Engineer (Water Resource), Assam.
- 51 Mr. J. Hari Narayan, Chief Secretary, Andhra Pradesh
- 52 Mr. J. Panda, Special. Relief Commissioner, Managing Director, Orissa State Disaster Mitigation Authority
- 53 Mr. J. P. Agrawal, Additional Secretary, Water Resources Department, Orissa
- 54 Mr. K. Basu Kumar, Joint Secretary (Revenue) Andaman & Nicobar
- 55 Mr. K. C. Das, Secretary (Water Resource), Assam.

- 56 Mr. K. D. Sharma, Director, National Institute of Hydrology
- 57 Mr. K. J. Ramesh, Advisor, Department of Science and Technology
- 58 Mr. K. Kohli, IAS, Director (RR&DM), Arunachal Pradesh
- 59 Mr. K. K. Hazarika, Secretary, Revenue, Assam
- 60 Mr. K. M. Reddy, Andhra Pradesh, SDMS
- 61 Mr. K. Radhakrishnan, Director, National Remote Sensing Agency
- 62 Mr. K. S. Singh, Secretary (Revenue/Disaster Management) Andaman & Nicobar
- 63 Mr. Kalyan Rudra, Kolkata
- 64 Mr. Kamal Lochan Mishra, Deputy General Manager, OSDMA, Orissa
- 65 Mr. Kamata Prasad, Institute for Resource Management and Economic Development
- 66 Mr. Kewal Sharma, Dev. Commissioner, Arunachal Pradesh
- 67 Mr. L. K. Tripathy, Chief Secretary, Tamil Nadu
- 68 Ms. Latha Krishna Rao, Secretary Revenue and Disaster Management, Karnataka
- 69 Mr. M. Dharamraj, Director, Tamil Nadu, Pondicherry and Andaman and Nicobar Islands GDC, Survey of India, Chennai
- 70 Mr. M. Ramesh Kumar, Principal Secretary, Relief and Rehabilitation Department, Maharashtra
- 71 Dr. M. Satya Kumar, Karnataka
- 72 Mr. M. A. Abraham, Deputy Secretary, Revenue (K) Department, Kerala
- 73 Mr. M. F. Farooqui, Special Commissioner, (Revenue and Disaster Management), Tamil Nadu
- 74 Mr. M. K. Mishra, SIO, NIC, Chhattisgarh
- 75 Mr. M. K. Shrivastava, Relief Commissioner and Secretary (DM), Bihar
- 76 Mr. M. L. Sahu, Director, Revenue and DM Dept. Chhattisgarh
- 77 Mr. M. P. Singh, Director, CWC
- 78 Mr. M. S. Verma, Deputy Commissioner (Ganga), MOWR
- 79 Mr. M. Viswanath, Deputy Chief Engineer, Irrigation Department, Andhra Pradesh
- 80 Ms. Madhu Arora, Director (SU-I), Department of Telecommunications
- 81 Mr. Malsawma Lawnthang, Under Secretary, Disaster Management and Rehabilitation Department, Mizoram
- 82 Dr. Mangala Rai, Director General, Indian Council of Agricultural Research (ICAR)
- 83 Mr. Mani, Joint Relief Commissioner, Tamil Nadu
- 84 Mr. Mohd. Haleem, Chief Engineer, Irrigation. Department, Haryana

- 85 Mr. Mohinder Singh, Principal Secretary (Irrigation), Uttar Pradesh
- 86 Mr. N. Ravishankar, Principal Secretary (Irrigation), Uttarakhand
- 87 Mr. N. C. Sen, Joint Secretary, Revenue Department, Tripura
- 88 Mr. N. J. Singh, Director (FMP), CWC
- 89 Mr. N. K. Aswal, Relief Commissioner and Secretary, Revenue and Disaster Management Department, Chhattisgarh
- 90 Mr. N. K. Chanchlani, Assistant Meteorologist, Meteorological centre Lalpur, Raipur, Chhattisgarh
- 91 Mr. N. S. Napalchayal, Principal Secretary (DM), Uttarakhand
- 92 Mr. N. Y. Apte, Director, IMD
- 93 Mr. Narendra Kumar, Chief Engineer, Irrigation, Department, Uttar Pradesh
- 94 Prof. Nayan Sharma, Professor, IIT, Roorkee
- 95 Mr. Nikunja K.Sundaray, Special Relief Commissioner and Secretary (Disaster Management), Orissa
- 96 Mr. O. P. Singh, Director, IMD
- 97 Mr. O. P. Khanda, Chief Engineer, CWC,
- 98 Mr. O. Ravi, Joint Secretary (DM-I), MHA
- 99 Mr. P. Raman, Engineer-in –Chief (WRO) and Chief Engineer (General), Public Works Department, Chennai
- 100 Dr. Pavan Kumar Singh, Senior Research Officer, NDMA
- 101 Mr. P. C. Lalthlamuana, Director, Disaster Management and Rehabilitation, Mizoram
- 102 Mr. P. C. Sarma, Chief Secretary, Assam
- 103 Mr. P. G. Dhar Chakrabarty, Executive Director, National Institute of Disaster Management
- 104 Mr. P. K. Basu, Relief Commissioner, Bihar
- 105 Mr. P. K. Datta, Under Secretary, Revenue Department, Tripura
- 106 Mr. P. K. Jha, Resident Engineer, Water Resources Department, Bihar
- 107 Mr. P. S. Roy, Dy. Director, NRSA
- 108 Mr. P. S. Sudhakar Babu, Indian Red Cross Society
- 109 Mr. Padmanav Behera, Assistant Financial Adviser, Special Relief, Orissa
- 110 Ms. Promila Issar, Principal Secretary, (Disaster Management), Haryana
- 111 Ms. Preeti Sudan, Principal. Secretary, (Revenue), Andhra Pradesh
- 112 Mr. R. Jeyaseelan, former Chairman, CWC

- 113 Mr. R. Thangamani, Executive Engineer, CWC, Hydrology Division, Chennai
- 114 Mr. R. C. Bhatia, Director General, Indian Meteorological Department (IMD)
- 115 Mr. R. D. Singh, Scientist F, NIH, Roorkee
- 116 Mr. R. N. P.Singh, Member (RM), Central Water Commission
- 117 Mr. R. N. Prashar, Principal Secretary, Irrigation Department and Financial Commissioner, Haryana
- 118 Mr. R. N. Sarangi, Joint Advisor (Water Resources), Planning Commission
- 119 Mr. R. V. Sharma, Deputy Director General of Metrology, Regional Metrological Centre, Chennai
- 120 Mr. Rajesh Kishor, Commissioner of Relief, Gujarat
- 121 Mr. Rakesh, Dy. Commissioner, Gurgaon, Haryana
- 122 Mr. S. B. Sarmah, Secretary (Irrigation), Assam
- 123 Prof. (Dr.) S.C Mohanty, Director & OSD, Relief and Rehabilitation Department, Maharashtra
- 124 Mr. S. C. Das, Secretary, Water Resources Department, Assam
- 125 Mr. S. D. Diwan, Assistant Executive Engineer, Central Water Commission, UMSD, Chhattisgarh
- 126 Mr. S. K. Benarjee, Additional Director General, IMD
- 127 Mr. S. K. Agrawal, former Member (RM), CWC and Specialist (Floods) NDMA
- 128 Mr. S. K. Biswas, Chief Engineer, Irrigation and Waterways Department, West Bengal
- 129 Mr. S. K. Choudhary, Commissioner (Brahmaputra and Barak), MOWR
- 130 Mr. S. K. Das, Chairman, CWC
- 131 Mr. S. M. Hazarika, AEE, Brahmaputra Board
- 132 Mr. S. P.Tucker, Principal. Secretary.(Irrigation), Andhra Pradesh
- 133 Mr. S. P. Dutt, Secretary (Irrigation), West Bengal
- 134 Mr. S. P. Kakran, Commissioner (Ganga), MOWR
- 135 Mr. S. P.Mandagire, Chief Engineer, Maharashtra
- 136 Mr. S. R. Ramanan, Director, Area Cyclone Warning Centre, Regional Metrological Centre, Chennai
- 137 Mr. Sanjay Kumar, Scientist C, NIH
- 138 Mr. Satendra, Special. Secretary, DM, Bihar
- 139 Mr. Satish Chandra, Secretary (Project), Andhra Pradesh
- 140 Dr. Satya Kumar, IMD
- 141 Mr. Satya Prakash, Principal Secretary, Home Department, Madhya Pradesh



- 142 Mr. Shambhunath, Chief Secretary, Uttar Pradesh
- 143 Mr. Sitaram Gupta, OSD-I, Rajasthan
- 144 Mr. Som Naidu, Additional District Magistrate, Andaman & Nicobar
- 145 Mr. Sridhar Behera, EIC, Water Resources Department, Orissa
- 146 Mr. Sudhir Mankad, Chief Secretary, Gujarat
- 147 Mr. Sunder Ray, Managing Director, OSDMA, Orissa
- 148 Ms. Sutirtha Bhattacharya, Secretary (Irrigation), Andhra Pradesh
- 149 Ms. Surinder Kaur, Director, IMD
- 150 Mr. T. Sreekanth, Sub Divisional Magistrate, Andaman & Nicobar
- 151 Mr. T. G. Antony Balan, Chairman, Brahmaputra Board.
- 152 Prof. (Dr.) U.C. Mohanty, IIT, Delhi
- 153 Mr. Umesh Sinha, Secretary, Revenue, Relief Commissioner, Uttar Pradesh
- 154 Mr. V. Bhanumurthy, NRSA
- 155 Mr. V. D. Roy, Dy. Director, CWC
- 156 Mr. V. Jaishankar, Secretary, Water Resources Department, Bihar
- 157 Mr. V. K. Pipersenia, Pr. Secretary, (Revenue and Disaster Management), Assam
- 158 Mr. V. K. Sharma, Principal Secretary (Revenue), Uttar Pradesh
- 159 Mr. V. R. Sastri, Chairman, Ganga Flood Control Commission
- 160 Mr. V. V. Ramana Sarma, SE, CWC, Karnataka
- 161 Mr. Vishva Mohan Upadhyaya, Secretary, Revenue Department, Madhya Pradesh
- 162 Prof. Vinay Sehgal, NIDM

## Contact Us

---

For more information on these guidelines for Management of Floods

Please Contact:

Dr. Mohan Kanda, IAS (Retd.)

Member,

National Disaster Management Authority,

Centaur Hotel, (Near IGI Airport)

Tel: (011) 25655010

Fax: (011) 25654813

Email: [kandamohan@yahoo.co.in](mailto:kandamohan@yahoo.co.in)

Web: [www.ndma.gov.in](http://www.ndma.gov.in)

Shri S.K.Agrawal,

Specialist (Floods)

National Disaster Management Authority,

Centaur Hotel, (Near IGI Airport)

Tel: (011) 25655479

Email: [ska-ndma@rediffmail.com](mailto:ska-ndma@rediffmail.com)

