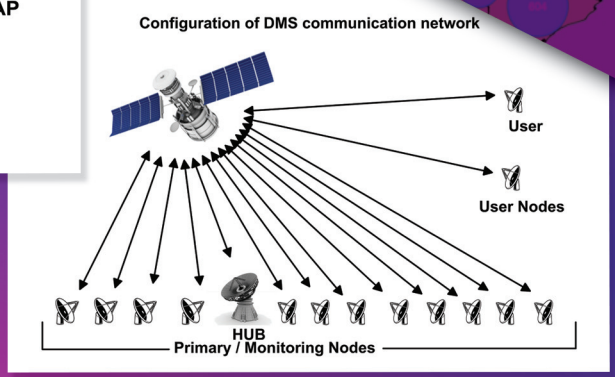
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Training Module on

Communications for Disaster Management





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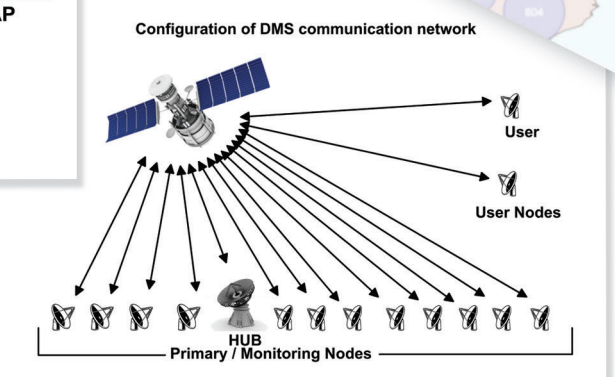
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(Ministry of Home Affairs, Government of India)

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Training Module on

Communications for Disaster Management





National Institute of Disaster Management (NIDM)

(Ministry of Home Affairs, Government of India)

Plot No. 15, Pocket 3, Block B, Sector 29, Rohini, New Delhi 110042

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Resilient India - Disaster free India

Maj Gen Manoj Kumar Bindal
VSM
Executive Director

सत्यमेव जयते

राष्ट्रीय आपदा प्रबंधन संस्थान
(गृह मंत्रालय, भारत सरकार)
National Institute of Disaster Management
Ministry of Home Affairs, Govt. of India
Plot No. 15, Block B, Pocket 3, Sector 29, Rohini, New Delhi 110042

Foreword



Communication during and immediately after a disaster situation is an important component of response and recovery, in that it connects affected people, families, and communities with first responders, support systems, and other family members. Reliable and accessible communication and information systems are also key to a community's resilience.

Under the Disaster Management Act 2005, National Institute of Disaster Management (NIDM) has been assigned nodal responsibilities for human resource development, capacity building, training, research, documentation and policy advocacy in the field of disaster management. NIDM and its professional Faculty Members have made substantial contributions since, the inception of the National Disaster Management Authority in formulating the various Guidelines, structuring and conducting Capacity Building programmes and providing technical support for numerous initiatives.

This training module on "Communications for Disaster Management" is based on the National Disaster Management Guidelines- National Disaster Management Information and Communication System (NDMICS), a publication of National Disaster Management Authority Government of India, which was published in 2012.

I am sure this training module will go a long way in learning about disaster communication network that plays a crucial role in carrying knowledge based information at the right time to the right people for holistically handling disaster management. This training module will also facilitate understanding the role of multiple stakeholders – local governments, non-governmental organizations, academic institutions in disaster communication.

I complement Prof. Surya Parkash, Head GMR Division and other team members for their meticulous work and immense personal contribution who have facilitated the process. I also express my gratitude for the sincere and professional inputs from the external reviewers in assisting the NIDM in the formulation of this training module.

MKBindal

(Manoj Kumar Bindal)

Preface



In recent years, communications networks have emerged as one of the main pillars for disaster management. With the scope and opportunity provided by science and technology, the exploitation of different space technology applications to support the communications services in disasters have played an important role, in the prevention and mitigation of the natural disasters effects on terrestrial communications infrastructures.

This training module is going to benefit readers and other stakeholders in learning about knowledge and skills related to the disaster communication system to a multi-stakeholder target group which are expected to play a role in reducing natural disaster incidences and impacts through various kinds of activities involving social, technical, legal, financial, environmental, administrative and other such issues, aspects and dimensions at different levels/scales. The module is intended to provide a comprehensive knowledge and skills in the field of Information and communication system related to disasters to these participants.

This training module on *"Communications for Disaster Management"* is motivated and intended to promote National Disaster Management Guidelines - National Disaster Management Information and Communication System (NDMICS), a publication of National Disaster Management Authority Government of India, which was published in 2012.

The formulation of the training module on understanding management of disaster communication and cross-cutting issues is an important part of the mandate given to the National Institute of Disaster Management (NIDM) under the Disaster Management Act 2005.

It is believed that the present module will provide an insight to the trainees and readers in the basic understanding about techniques and technologies implemented for communications in the disaster scenarios.

(Dr. Surya Parkash)
Prof. & Head, GMRD, NIDM

Acknowledgement

At the outset, I would like to express sincere thanks to Major General Manoj Kumar Bindal, VSM, Executive Director, National Institute of Disaster Management (NIDM), New Delhi for his kind encouragement, guidance, suggestions and support in the completion of this training module.

I would like to place on record the significant contributions made by different persons in compiling the information and literature apropos of the Training Module on Communications for Disaster Management. I am particularly thankful to National Disaster Management Authority, Government of India; Shri B. Bhattacharjee, Former Member, NDMA and various specialists, experts and stakeholders associated with National Disaster Management Guidelines-National Disaster Management Information and Communication System (NDMICS) based on which this training module is formulated.

I also thank our reviewers, Brig. Ajay Gangwar, Advisor (Ops. & Communication) National Disaster Management Authority; Dr. K H V Durga Rao, Group Head, DMSG, RSA, National Remote Sensing Centre (NRSC), Indian Space Research Organisation and Col. Dheeraj Chandola (Retd.), Senior Consultant (IT & Communication), National Disaster Management Authority for their extensive comments and suggestions, which helped in giving the final shape to the training module.

It gives me immense pleasure in acknowledging the cooperation of my colleagues – Dr. Harjeet Kaur, Shri Anil Kathait and Shri Ritesh Singhal, GMR Division, NIDM and supporting staff at NIDM, without which it would not have been possible in the preparation of this training module.

Sincere thanks are due to the co-author of this document, Dr. Raju Thapa, who made every effort in the preparation and finalization of this training module.

Last but not the least, I would like to thank my wife Reeta and daughter Rasika, without whose consistent moral and logistic support, I would not have been able to give due attention and time to this work.

Finally, I am grateful to the Almighty without whose grace and kindness, I would not have been capable to carry this task successfully.

(Dr. Surya Parkash)
Prof. & Head, GMRD, NIDM

Module at a Glance

Name: Training Module on Communications for Disaster Management

Developed by: National Institute of Disaster Management (NIDM), New Delhi

Technical Support: National Disaster Management Authority (NDMA), State Disaster Management Authority (SDMA), All India Radio (AIR), DoorDarshan (DD), National Informatics Centre (NIC), Public Information Bureau (PIB), Vigyan Prasar, National Academy of Broadcasting and Multimedia (NABM), State Departments of Information and Broadcasting, Community Radios, India Meteorological Department (IMD), National Remote Sensing Centre (NRSC), Central Water Commissions (CWC), Geological Survey of India (GSI), Indian National Centre for Ocean Information Services (INCOIS), Snow and Avalanches Studies Establishment (SASE), etc.

Total Number of sub-modules: 11

Target Audience: SDMAs, DDMAs, All India Radio (AIR), DoorDarshan (DD), National Informatics Centre (NIC), Public Information Bureau (PIB), Vigyan Prasar, National Academy of Broadcasting and Multimedia (NABM), State Departments of Information and Broadcasting, India Meteorological Department (IMD), Academicians, Researchers and Professionals working on disaster management, Disaster Management Centres at State ATIs & SIRDs, NGOs, CBOs, SHGs, Social Volunteers, Public Representatives, Community Radios, HAM radios, NDRF, SDRF, QRTs, RRFs, Paramilitary and Military Establishments, Administration, Local Bodies like Municipality and Panchayats, NSS, NYKS, NCC, Scouts and Guides, Home Guards, Civil Defence and Fire Fighters, Field Agencies like Border Roads, PWD, NHAI, PGCL, NHPC, THDC, NTPC, Stakeholders in Insurance, Finance, Planning, Policy, Development and Legal Sectors

Training programme on the basis of this module requires:

Training Days	:	5 days
Training Hours	:	38-40 Hours
Trainers required	:	Minimum 2
Training Materials	:	As mentioned inside
Total Pages	:	Approx 150

Training Hall with sufficient number of movable chairs and tables

Module prepared by:

Dr. Surya Parkash, Professor and Head, Geo-meteorological Risks Management Division, National Institute of Disaster Management, Ministry of Home Affairs, Government of India

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Who shall use this Module

This module shall be used by a trainer involved in conducting courses on Communications for Disaster Management. The following individuals/ organizations can be the potential users of this module:

- NDMA, SDMAs, DDMAs
- All India Radio (AIR), DoorDarshan (DD), National Informatics Centre (NIC), Public Information Bureau (PIB), Vigyan Prasar, National Academy of Broadcasting and Multimedia (NABM), State Departments of Information and Broadcasting, India Meteorological Department (IMD) etc
- Academicians, Researchers and Professionals working on disaster management
- Disaster Management Centres at State ATIs & SIRDs
- NGOs, CBOs, SHGs, Social Volunteers, Public Representatives, Community Radios, HAM radios etc
- NDRF, SDRF, QRTs, RRFs, Paramilitary and Military Establishments
- Administration, Local Bodies like Municipality and Panchayats
- NSS, NYKS, NCC, Scouts and Guides, Home Guards, Civil Defence and Fire Fighters

- Field Agencies like Border Roads, PWD, NHAI, PGCL, NHPC, THDC, NTPC, Irrigation and Flood Control etc.

How to Use this Module

The training design brief will provide users with the objectives of the course, target audience, structure, training methodologies and resource materials etc. The chapters on pre and post training assessment will guide on how to carry out the evaluation and impact assessment of the training course with a set of questionnaires to be used and other necessary instructions. The actual training sessions will start with the sub-modules provided in the contents. However, elaborate instructions and guidelines are given for each session in each sub-module.

Trainer's Guide

The trainer/facilitator/course director may find the following tips useful for smooth conduct of the training.

General

- During the inauguration/introduction session, the trainees should be asked to switch off or keep their mobiles/cell phones in silent mode during sessions and advised to attend only the urgent calls that too by going out of the training hall.
- Participants list with names, addresses, contact numbers, emails, etc. should be circulated for verification from the trainees and for necessary corrections.
- Entire training materials and equipments should be kept ready and checked before the training.
- Clear information about lunch hours and tea breaks should be given to trainees to avert any kind of delays. They should be informed exact time for start of sessions and following day's plans.
- Every possible care should be taken regarding logistic arrangements for the trainees to make them feel comfortable during the entire course of training.

Training Specific

The following points should be taken care of:

- Except the first day, each day shall start with a recapitulation session of about 15 minutes. At the end of each day, summary of the day's proceedings shall be shared with the participants for 10 minutes.
- Group composition shall change for every activity/exercise through different methods.

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ABBREVIATIONS/ACRONYMS USED

ACWC	—	Area Cyclone Warning Center
ADPC	—	Asian Disaster Preparedness Center
ADSI	—	Analog Display Services Interface
AM	—	Amplitude Modulation
AMPS	—	Advanced Mobile Phone System
APCO	—	Association of Public safety Communications Officers
BSC	—	Base Station Controller
BSS	—	Base Station Subsystem
BTS	—	Base Transceiver Station
CCK	—	Complementary Code Keying
CDMA	—	Code Division Multiple Access
CDR	—	Cyclone Detection Radar
CR	—	Cognitive Radio
CSC	—	Common Services Center
CTI	—	Computer and Telephony Integration
CUG	—	Closed User Group
CWC	—	Central Water Commission
CWDS	—	Cyclone Warning Dissemination System
DAC	—	Digital to Analogue Converter
DAE	—	Department of Atomic Energy
DAMA	—	Demand Assigned Multiple Access
DAT	—	Distress Alert Transmitter
DBS	—	Direct Broadcast Satellite
DC	—	District Collector
DEN	—	Dispatch Enhanced Network

DEOC	—	District Emergency Operations Centre
DGNA	—	Dynamic Group Number Assignment
DHQ	—	District Headquarter
DIT	—	Department of Information Technology
DM	—	Disaster Management
DMIS	—	Disaster Management Information System
DMO	—	Direct Mode Operation
DMS	—	Disaster Management Service
DOS	—	Department of Space
DR	—	Disaster Recovery
DRM	—	Disaster Risk Management
DSC	—	Decision Support Centre
DSPT	—	Digital Satellite Phone Terminal
DSS	—	Decision Support System
DTH	—	Direct—To—Home
DWDM	—	Dense Wave Division Multiplexing
EDGE	—	Enhanced Data rates for GSM Evolution
EIC	—	Emergency Information Centre
EOC	—	Emergency Operations Center
ERS	—	Emergency Restoration System
EV—DO	—	EVolution Data Optimised
EVDV	—	EVolution Data Voice
EW	—	Early Warning
FDMA	—	Frequency Division Multiple Access
FIFO	—	First In First Out
FM	—	Frequency Modulation
FMS	—	Facility Management Services

FOIS	—	Freight Operations Information System
FSU	—	Flexible Spectrum Usage
FTP	—	File Transfer Protocol
G2C	—	Government to Center
G2G	—	Government—to—Government
GIS	—	Geographic Information System
GOI	—	Government of India
GoS	—	Grade of Service
GPRS	—	General Packet Radio Service
GPS	—	Global Positioning System
GSM	—	Global System for Mobile
GSN	—	Global Seismographic Network
HAPS	—	High Altitude Platform Station
HEOS	—	Highly Elliptical Orbit Satellite
HF	—	High Frequency
HLR	—	Home Location Register
HSDPA	—	High Speed Downlink Packet Access
HSPA	—	High Speed Packet Access
HTTP	—	Hypertext Transfer Protocol
ICET	—	Intergovernmental Conference on Emergency
ICS	—	Incident Command System
ICT	—	Information & Communication Technology
IDRN	—	Indian Disaster Resource Network
IEEE	—	Institution Electrical and Electronics Engineers
IETF	—	Internet Engineering Task Force
IMD	—	India Meteorological Department
IMS	—	IP Multimedia Subsystem

IMSI	—	International Mobile Subscriber Identity
IMT	—	International Mobile Telecommunications
INCOIS	—	Indian National Centre for Ocean Information Service
IP	—	Internet Protocol
IRS	—	Indian Remote Sensing
ISDN	—	Integrated Services Digital Network
ISRO	—	Indian Space Research Organization
ITU	—	International Telecommunication Union
LEO	—	Low Earth Orbit
LEOS	—	Low Earth Orbit Satellite
LER	—	Label Edge Router
LMC	—	Last Mile Connectivity
LOS	—	Line Of Sight
LSP	—	Label Switched Path
LSR	—	Label Switching Router
LTE	—	Long Term Evolution
MCAP	—	Mobile Communication Access Platform
MEO	—	Medium Earth Orbit
MEOC	—	Mobile Emergency Operations Centre
MEOS	—	Medium Earth Orbit Satellite
MGC	—	Media Gateway Controller
MHA	—	Ministry of Home Affairs
MIMO	—	Multiple Input Multiple Output
MLLN	—	Managed Leased Line Network
MMCP	—	Mini Mobile Communication Pack
MOES	—	Ministry of Earth Sciences
MOU	—	Memorandum of Understanding

MPLS	—	Multi Protocol Label Switching
MPS	—	Mobile Positioning System
MPT	—	Ministry of Post and Telecommunication
MSC	—	Mobile Switching centre
MSP	—	Multi Service Platforms
MSS	—	Mobile Satellite Service
MSTP	—	Multi Service Transport Protocol
MZ	—	Militarized Zone
NADAMS	—	National Agricultural Drought Assessment and Management System
NAT	—	Network Address Translation
NCMC	—	National Crisis Management Committee
NDCN	—	National Disaster Communication Network
NDEM	—	National Database for Emergency Management
NDKN	—	National Disaster Knowledge Network
NDMIS	—	National Disaster Management Information System
NDMICS	—	National Disaster Management Information and Communication System
NDRF	—	National Disaster Response Force
NECP	—	National Emergency Communication Plan
NEOC	—	National Emergency Operations Center
NGN	—	Next Generation Network
NIC	—	National Informatics Centre
NICNET	—	National Informatics Center Network
NIOT	—	National Institute of Ocean Technology
NKN	—	National Knowledge Network
NMS	—	Network Management System
NMT	—	Nordic Mobile Telephone

NRSC	—	National Remote Sensing Centre
OFDM	—	Orthogonal Frequency Division Multiplex
OPGW	—	Optical Ground Wire
OSI	—	Open System Interconnection
PCM	—	Pulse Code Modulation
PDC	—	Personal Digital Cellular
PDO	—	Packet Data Optimised
PM	—	Phase Modulation
PMG	—	Project Management Group
PMR	—	Public Mobile Radio
PMRTS	—	Public Mobile Radio Trunking System
POP	—	Points of Presence
POTS	—	Plain Old Telephone System
PPDR	—	Public Protection and Disaster Relief
PSK	—	Phase Shift Keying
PSTN	—	Public Switched Telephone Network
PTWC	—	Pacific Tsunami Warning Centre
QoS	—	Quality of Service
QPSK	—	Quadrature Phase Shift Keying
RDBMS	—	Relational Database Management System
RFID	—	Radio Frequency Identification
RMC	—	Regional Meteorological Centre
RoW	—	Right of Way
RS & GIS	—	Remote Sensing & Geographic Information System
RTWC	—	Regional Tsunami Warning Centre
S&T	—	Science & Technology
SAC	—	Space Applications Centre

SCA	—	Service Centre Agency
SDA	—	State Designated Agency
SDH	—	Synchronous Digital Hierarchy
SDR	—	Software Defined Radio
SDSS	—	Spatial Decision Support System
SEOC	—	State Emergency Operations Center
SHQ	—	State Headquarter
SIM	—	Subscriber Identity Module
SLA	—	Service Level Agreement
SMS	—	Short Messaging Service
SMTP	—	Simple Mail Transfer Protocol
SRC	—	State Relief Commissioner
STM	—	Synchronous Transport Module
SWAN	—	State Wide Area Network
TACS	—	Total Access Communication System
TCP	—	Transmission Control Protocol
TDM	—	Time Division Multiplexing
TDMA	—	Time Division Multiple Access
TEC	—	Telecommunication Engineering Centre
TMSI	—	Temporary Mobile Subscriber Identity
UDP	—	User Datagram Protocol
UHF	—	Ultra High Frequency
UNDP	—	United Nations Development Program
USOF	—	Universal Service Obligation Fund
V+D	—	Voice Plus Data
VA&RA	—	Vulnerability Analysis & Risk Assessment
VC	—	Video—Conferencing

VHF	—	Very High Frequency
VLR	—	Visitor Location Register
VOIP	—	Voice Over Internet Protocol
VPN	—	Virtual Private Network
VSAT	—	Very Small Aperture Terminal
WCDMA	—	Wideband CDMA
WLAN	—	Wireless Local Area Network
WPC	—	Wireless Planning and Coordination

CONTEXT

Context

Disaster communication is a crucial aspect of Disaster Management and plays an important role in disseminating information to various stakeholders engaged in disaster management. Disaster communication has significant importance in all phases of disaster, particularly in relief operations and rescue operations. Natural Disasters cannot be prevented at the present level of Science & Technology (S&T) and community may have to live with a certain level of risk – the level of risk depending on the level of S&T available for induction in DM and the resources made available by the Government for its actual induction, for holistic management of disaster in a proactive way. There is an urgent need to focus and prioritize actions in preparedness, prevention and mitigation to ensure an effective holistic disaster management. Simultaneously, efforts should also be made towards strengthening the efforts for faster and more efficient response through properly trained personnel equipped with advanced equipment/ instruments and building better recovery during rehabilitation and reconstruction period.

Over the past few decades, the need for disaster management has been recognized globally and there is a drastic move from reactive approach to a proactive approach. Starting with the UN General Assembly meeting on 11th December 1987, same sentiments have been echoed in the world conferences on natural disaster reduction first at Yokohama in 1994 and then at Hyogo, Kobe in 2005. It has now been recognized that disaster prevention, mitigation, preparedness and relief are the four elements along with environmental protection that is closely interrelated with sustainable development.

Mainstreaming disaster management needs to be considered by nations by implementing them in their plan and policies at all administrative levels. In the context of communication system needed for DM work, at the Intergovernmental Conference on Emergency Telecommunications (ICET- 98) at Tampere, Finland, held on 18 June 1998, a legally binding international treaty on employment of Telecommunication Resources was unanimously adopted by 75 countries. For reducing damage to property and environment, human suffering and loss of life caused by disasters, it is very important that effective telecommunication are deployed on timely basis for efficient, immediate and accurate information.

On 29th November, 1999, India signed this Tampere Convention. Utilization and timely deployment of telecommunication assets play an essential role in relief operations, safeguarding life and property, disaster mitigations etc.

The participating parties also raised apprehension regarding possible damage to crucial communication infrastructure due to disaster which could result into disrupts the flow of information. The parties also raised concern utmost significance to setup national level telecommunication infrastructure along with strengthening corporation and coordination among all stakeholders to ease the appropriate utilization of the same.

The diverse geographical distribution of India makes it vulnerable to several disasters. Several disasters in the past such as the Kashmir earthquake (2005), Tsunami (2004), Bhuj Earthquake (2001), Odisha cyclone (1999) etc. have caused a huge loss of life and economy to the country. With the implementation of Disaster Management Act 2005 after unanimously passed in the Parliament on 23rd Dec 2005, a switch from a reactive approach to more holistic and proactive approach was implemented. In general, this move necessitates the development of critical scientific and technological infrastructures, as well as the building of a dependable and dedicated advanced technology-based communication network that would play a critical role.

There is a paradigm shift in information systems related to disaster management with the rapid advancement in communication technologies, space technologies, remote sensing, artificial intelligence, advanced modeling, simulation etc. Astonishing development in information technology has also enhanced capabilities towards visualization and data interpretation.

With the systematic implementation of advanced science and technology, information system prioritizes the development of Information and Communications Technology (ICT) support for the pre-disaster events management while strengthening the establishments of Information and Communications Technology (ICT) for post-disaster scenarios.

Aim of the Course

To provide knowledge and skills related to disaster communication system to a multi-stakeholder target group which are expected to play a role in reducing natural disaster incidences and impacts through various kinds of activities involving social, technical, legal, financial, environmental, administrative and other such issues, aspects and dimensions at different levels/scales.

Target Groups

The target group for this training program would be senior and middle level officers / functionaries from the Central / State / Local Government

departments including Prasar Bharati, All India Radio (AIR), DoorDarshan (DD), Central Water Commissions (CWC), National Informatics Centre (NIC), Public Information Bureau (PIB), Vigyan Prasar, National Academy of Broadcasting and Multimedia (NABM), State Departments of Information and Broadcasting, Community Radios, Indian National Centre for Ocean Information Services (INCOIS), Indira Gandhi National Open University (IGNOU), India Meteorological Department (IMD), Geological Survey of India (GSI), State Disaster Management Authority (SDMA), National Remote Sensing Centre (NRSC), Local Authorities / Bodies (PRIs and ULBs), Social Welfare, State Department of Land Revenue and Disaster Management, Administrative Training Institute (ATIs), Central Water Commissions (CWC), Geological Survey of India (GSI), Indian National Centre for Ocean Information Services (INCOIS), Academic and research institutes, NGOs, CBOs and VOs etc.

The participants are expected to have varied responsibilities, academic backgrounds & experience. They are also required to be equipped with minimal level of knowledge, skills, information and experience related to disaster communication for taking up their tasks effectively in their organizations. They are expected to deal with disaster management during planning and implementation of developmental activities. The programme is intended to provide a comprehensive knowledge and skills in the field of Information and communication system related to disasters to these participants.

Assumptions about Trainees

It is assumed that the age of trainees varies in the relevant sectors. The academic qualifications will also be variable in discipline and level of degrees. They may or may not have experience/exposure to disasters prior to the training.

Why This Training?

Lack of adequate knowledge, skills and information about National Disaster Management Information and communication systems have aggravated the losses and prolonged the recovery process. Informed, skilled and trained human resources can play a significant role in understanding and implementing information and communication in disaster management. The training aims to fill this gap in a proactive mode by imparting skills, knowledge and information related to National Disaster Management Information and communication systems.

Training Needs

An interaction with the various concerned organizations leads to the conclusion that disasters incidences and impacts are rising due to lack of adequate trained human resources with these organizations besides the fact that affected communities are also unaware, uninformed, and unprepared. Different stakeholders as well as the affected communities need to be made aware, informed and prepared to assess the potential/impending disaster risks, minimize the risks and prepared themselves against the remnant risk.

Relevance of Objectives to Training Needs

The objectives of the training programme are formulated to cater to the training needs of different stakeholders for carrying out their tasks more effectively and efficiently in order to reduce disaster risks and manage their impacts on life, economy and environment with better understanding of communications for Disaster Management.

Time Constraint

There will be no time constraints for holding training course. Hence, relevant participants shall be available throughout the year.

Trainers

Senior level officials from Central / State / Local Government departments including Prasar Bharati, National Disaster Management Authority (SDMA), All India Radio (AIR), DoorDarshan (DD), National Informatics Centre (NIC), Public Information Bureau (PIB), Vigyan Prasar, Indian National Centre for Ocean Information Services (INCOIS), National Academy of Broadcasting and Multimedia (NABM), State Departments of Information and Broadcasting, Community Radios, India Meteorological Department (IMD), National Remote Sensing Centre (NRSC), Geological Survey of India (GSI) etc.

Logistics

Boarding and lodging arrangements for 20-25 participants.

Number of Trainees

20 to 40 participants from various departments/agencies.

Venue(s) for Training

NIDM, State ATIs and other relevant training centers.

Language

The language of instruction is English. All the Presentations/Demonstrations/ Drills/Exercises have been prepared in English but can be translated into local languages for understanding by the layman. Interactions can also be in Hindi or any other vernacular languages depending upon the requirement of the State.

Time Frame

Training shall be held for 5 days.

Training Methods

Lectures/Interactive Discussions/Power Point Presentations/Slide Shows/ Brainstorming Discussions/Panel Discussions/Experience Sharing/Participatory Learning/Needs Assessment/Case Studies/Guided Group Exercises (Table Top and Simulation)/Hands on Exercises/Practicals/Skill Transfer/Mock Drills/ Demonstration and Exposure Visit/Guided Field Work.

Media and Equipments

Computers, LCD Projector, Screen, Laser pointer, Overhead Projectors, White board, Flip Charts and Stand, Markers, Mike and Speakers (PA system), Camera, GPS.

Performance Aids

Flip Charts, Lecture Notes/Hand-Outs of Presentations, Questionnaires, Check List, Formats for Data Collection/Templates/Exercises for Case Studies.

Training Materials

Note Pad, Pen, Folder/Bag, CD, Sketch Pens, and Flip Charts

Measures for Transfer of Learning

Each trainee shall submit an action plan to implement and impart training skills at his/her organization. Trainees will be asked to submit a short term project within one month to demonstrate their level of learning from the course and their efficiency in using the skills.

Assessment, Feedback and Validation Measures

During the course, questionnaires will be distributed to assess the level of learning of the participants. Daily session-wise evaluation will be done through recapitulation of learning of the previous day. Trainer/Facilitator will also evaluate transfer of skills during role plays, exercises and mock drills by the participants. At the end of the course, a feedback evaluation form will be given to the participants to know their perception about the training. External validation shall be done through short term projects and feedback from the head of the sponsoring agency.

Benefits

1. Pool of trained human resources who can cater to the needs for assessing disasters risks and help in managing them or reducing their risks at various levels, viz., local, district, state and national levels.

2. Reliable and credible system for disasters risk management would become available.

3. Networking and co-ordination among various stakeholders will be strong.

Cost of Training (Per Course)

Includes TA/DA for Resource Persons, Training Kit, Stationery Cost, Expenditure on Field Visit, Boarding and Lodging Charges for the Participants, Transportation Charges, Photography, Xeroxing/Binding of Reading Material/Hand Notes, Hospitality Charges for Resource Persons, Communication Charges (Mobile/ Telephone/Postage), Tutor Expenses, Miscellaneous/Contingent Charges and Administrative/Overhead Charges.

Approximate Budget

Rs. 2,000/- per participants per day

Day 1

Topic 1-1: Registration

Enabling Objectives:

- Personal & Organizational Information about trainees
- Expectations from the Course
- Experience of Participant

Contents

- Filling of Registration Form
- Compilation of registration record
- Profile of trainees/organizations

Time and Duration: 09:30-10:00 hrs (30 min.)

Method: Performa for Registration

Facilitator: Training Assistant

Topic 1-2: Inaugural session

Enabling Objectives:

- Mutual Introduction of participants
- Experience Sharing
- Course Introduction
- Significance of Programme

Contents

- Welcome to Participants
- Experience Sharing and Expectations
- Entry Behaviour
- Ground Rules
- Course Introduction
- Inaugural Address

Time and Duration: 10:00-11:30 hrs (90 min.)

Method: Mutual Interaction

Resource Person(s): Course Director and Guest Speaker

Technical session

Topic 1-3: Introduction

Basic of disaster management, requirement of ICT network during various phases of disaster continuum

Enabling Objective:

At the end of this training unit, the participants will be able to:

- Understand the basic of Disaster Management
- Paradigm shift in disaster management in India
- Disaster Management Act, 2005
- Institutional framework in DM act 2005

Time and Duration: 11:45-13:00 hrs (75 min.)

Method: Lecture, Presentation and Discussions with field examples

Topic 1-4: Basic of Disaster management

Enabling objective

- Initiatives on natural disaster risk reduction programme,
- Global initiative of Tampere Convention on Deployment of Telecommunication resources for DM,
- Sustainable Development Goals, Sendai Framework for Disaster Risk Reduction 2015-2030, United Nations Climate Change Conference 2015, Prime Minister 10 Point Agenda etc.

Time and Duration: 14:00 -15:30 hrs (90 min.)

Method: Lecture, Presentation and Discussions with field examples

Topic 1-4: Requirement of ICT Network during various phases of disaster continuum

Enabling objective:

- Natural hazard profile in India and special features of ICT systems
- ICT for Mitigation Phase
- ICT for Preparedness Phase
- ICT for Response Phase
- ICT for Recovery Phase
- GIS platform Inevitable for Holistic DM

Time and Duration: 14:00 -15:30 hrs (90 min.)

Method: Lecture, Presentation and Discussions with field examples

Summary of the Day-1:

Recalling Day-1's deliberations

Time and Duration: 17:15-17:30 hrs (15 min.)

Method: Mutual Interaction

End of Day-1

Day 2 - Learning Event

Session 2-1: Recapitulation of Day-1

Enabling Objectives:

- Recalling the Learning from the Previous Day

Contents:

- Recapitulation by Participants
- Reference to the Reading Material

Method: Oral/Flip Chart

Time and Duration: 09:30-10:00 hrs (30 min.)

Session 2-2: Existing Communications Base and ICT Support-Situation Analysis

Enabling Objectives

- Introduction
- Existing Telecommunication Network of Various Service Providers/ Government Agencies,
- National Emergency Communication Plan (NECP), Ministry of Home Affairs, Govt. of India
- Disaster Management Support (DMS) Network of ISRO
- Police Telecommunication Network (POLNET)
- National Informatics Centre (NICNET) Infrastructure
- State Wide Area Network (SWAN), Status of Implementation of SWAN
- Railway Communication Network
- BSNL Communication Network etc.
- Existing Hazard Forecasting and Warning Network
- Communication Modes Available for Disaster Forecasting and Warning
- Other ICT Based Initiatives (IDRN, NANADISK, NDEM)
- Limitation in Existing Communication and ICT Support
- Limitations of Existing Application Development

Method:

Presentation and Discussion with Field Examples and Sketches

Time and Duration: 10:00-11:15 hrs (75 min.)

Session 2-3: Disaster Management Support (DMS) & National Database for Emergency Management

Enabling Objectives:

- Disaster Management Support (DMS) Network of ISRO
- Case studies: Cyclone AMPHAN, COVID-19 - Geospatial Technology based solution, Floods, Landslides – Karnataka, Forest Fires
- National Database for Emergency Management

Method: Lecture, Presentation and Discussions with a Case Study

Time and Duration: 11:30-13:00 hrs (90 min.)

Session 2-4: GIS-Based National Disaster Management Information System

Enabling Objectives:

- Knowledge-Based Tools for Holistic DM
- Rationale For Establishment of NDMIS
- Development of NDMIS
- GIS-Database
- Participatory Agencies and Nodes in NDMIS
- Active Players of NDMIS: Clients, Data Providers, Data Validators, Information Creator, Security Managers
- Approach to Establishment of NDMIS
- Special Features for Design of NDMIS: Database and its Volume, Data Preparation and Validation, Documentation, Quality, Data Availability, Client Access, Interoperability, Performance and Scalability, Application Services, Security and Protection of Data, Data Protection

Method: Lecture and Discussions

Time and Duration: 14:00-15:30 hrs. (90 min.)

Session 2-5: GIS-Based National Disaster Management Information System

Enabling Objectives: Case studies of GIS-Based National Disaster Management

Method: Lecture, Presentation and Discussions with a Case Study

Time and Duration: 15:45-17:15 hrs (90 min.)

Summary of the Day-2

Recalling Day-2's deliberations

Mutual Interaction

Time and Duration: 17:15-17:30 hrs (15 min.)

End of Day-2

Day 3 - Learning Event

Session 3-1: Recapitulation of Day-2

Enabling Objectives: Recalling the Learning of Previous Day

Contents:

- Recapitulation by Participants
- Reference to the Reading Material

Method: Oral/Flip Chart

Time and Duration: 09:30-10:00 hrs (30 min.)

Session 3-2: Satellite Communications for Disaster Management

Enabling Objectives:

- Introduction
- Case Studies: Chamoli, Uttarakhand Flash Floods, 2021; Haiti Earthquake 2010; Wild Fire Portugal, 2017; Nepal Earthquake 2015; China Earthquake 2008
- ISRO Satellites for Disaster Management Applications

Method: Lecture, Presentation and Brainstorming Discussions

Time and Duration: 10:00-11:30 hrs (90 min.)

Session 3-3: Emergency Operations Centres: Connectivity, Database & Applications Development

Enabling Objectives:

- Introduction
- Flow of Information for EOCs at Different Levels:
  For Command and Control; For Interaction, Coordination & Execution
- Vertical & Horizontal Connectivity of NDCN
- Detailed Design of the Core Network
- Functional Role of NEOC of NDMA
- Stakeholders of NEOC, NDMA

- Applications and Database Required at NEOC
- Applications and Database at the State EOCs
- Applications and Database at the District EOCs

Method: Lecture, Presentation and Discussions with a Case Study

Time and Duration: 11:45-13:00 hrs (75 min.)

Session 3-4: Facilities Provided at EOCs

Enabling Objectives:

- Generic Requirements at EOCs
- Facilities at NEOC and SEOCs
- Facility at Operational Control Room (OPS) at NDMA/MHA
- Facilities at DEOCs
- For Incident Commander at Affected Site: ICT Needs at Incident Command System (ICS); Mini Mobile Communication Pack (MMCP) at the Districts; Headquarters
- At NDRF Headquarters (Base Camp): Facilities at Mobile Emergency Operations Centers (MEOCs)
- At Tactical Headquarters of NDRF Commander: For Companies/Teams/Sub-Teams

Method: Lecture, Presentation and Discussions with a Case Study

Time and Duration: 14:30-16:30 hrs (120 min.)

Session 3-5: Table Top Exercise on Disaster communication, Presentation and Feedback of TTE

Enabling Objectives:

- Conducting TTE
- Facilitation, Observation and Monitoring
- Comments on Technical/Managerial Content Observations on Attitudinal Aspects and Team Spirit

Method:

- Group Exercise (Table-Top)

- Group Presentation

Time and Duration: 16:30-17:15 hrs (45 min.)

Summary of Day-3 Activities and Learning

Instructions for Field Visit on the following day

17:15-17:30 hrs (15 min.)

End of Day-3

Day 4 - Learning Event

Session 4-1: Recapitulation of Day-3

Enabling Objectives: Recalling the learning from the previous day

Contents:

- Recapitulation by Participants
- Reference to the Reading Material & Discussions

Method: Oral/Flip Chart

Time and Duration: 09:30-10:00 hrs (30 min.)

Session 4-2: Field Exposure

Enabling Objectives: Understanding disaster communication

Method: Exposure Visit/Guided Field Work/Simulation Exercise/Mock drill

Time and Duration: 10:00-15:30 hrs (330 min.)

Session 4-3: Presentation and Feedback of Field Visit and Simulation Exercise

Enabling Objectives:

- Comments on Technical/Managerial Content

- Observations on Attitudinal Aspects and Team Spirit

Method: Flip Charts, Power Point Group Presentation

Time and Duration: 16:30-17:15 hrs

Summary of Day-4 Activities and Learning

Following Day Plan: 17:15-17:30 hrs (15 min.)

End of Day-4

Day 5 - Learning Event

Session 5-1: Recapitulation of Day-4

Enabling Objectives:

- Recalling the Learning of the Previous Day

Contents:

- Recapitulation by Participants
- Reference to the Reading Material, Field Discussions and Presentations

Method: Oral / Flip Chart

Time and Duration: 9:30-10:00 hrs (30 min.)

Session 5-2: Technology, Emerging Trends and R&D Requirements

Enabling Objectives:

- Introduction
- Multiplexing and Modulation Techniques for Increased Traffic
- Carrying Capacity
- Convergence of Voice, Video and Data Services
- Telecommunication Network Technologies
- DTH (Direct-To-Home)

- Optical Fiber Communication (OFC) Networks
- Signal Transmission and Mobile Communication Technologies for Cellular Service
- Community radio/ Amateur Radio
- Social Media

Method: presentation/Video/Slide Show

Time and Duration: 10:00-11:30 hrs (90 min.)

Session 5-3: Last Mile Connectivity

Enabling Objectives:

- Introduction
- Suggested Actions at State/UT level
- Providing Need Based Communication Support
- Planning and Execution of The Network (by Implementing Agency)

Method: presentation/Video/Slide Show

Time and Duration: 11:30-13:00 hrs (90 min.)

Session 5-4: Common Alert Protocol

- Introduction
- Indian scenario
- Case studies
- Use of CAP Platform in Shri Amarnath Yatra, 2018 & 2019
- CAP Platform used in Early Warning for Cyclone Fani, 2019
- IDEWP- Implementation impediments

Method: presentation/Video/Slide Show

Time and Duration: 14:00-13:30 hrs (90 min.)

Session 5-5: Quiz with respect to course

Enabling Objectives:

- Knowledge Check

Contents: Knowledge Check

Method: Slide Show, Question-Answers

Time and Duration: 15:30-16:30 hrs (60 min.)

Session 5-6: Evaluation, feedback, certification and valediction

Contents:

- Feedback from Participant
- Post-training Assignment

Method: Follow-up Strategy

Time and Duration: 16:45-17:30 hrs (45 min.)

End of the Course

Executive Summary

Communication has played an essential role in Disaster Management (DM) from its inception in delivering information to all stakeholders engaged in the disaster management, notably in rescue operations and relief activities.

At the current level of science and technology (S&T), it is impossible to stop occurrence of natural disasters, resulting communities to live certain level of risk. Depending on resources for its actual induction provided by the government and current status of Science & Technology (S&T), the level of risk may vary from one place to another.

In the pre-disaster scenario of the DM continuum, prioritization of preparedness, prevention and mitigation activities are pre-requisite for an effective holistic disaster management. Holistic disaster management approaches are also enhanced with advancement in science and technology; improved infrastructure; rapid, efficient and fast response; improved coordination and corporation with frequent mock drills and well trained personal; better rehabilitation and reconstruction period etc. As a result of this insight, the disaster management has shifted from a reactive and response-centric strategy to a proactive and comprehensive approach.

Telecommunication resources must be deployed and used promptly to save lives, mitigate disasters, and aid relief efforts. On 29th November 1999, India signed this Tampere Convention. The participating parties raised concern regarding possible damage to crucial communication infrastructure due to disaster and also underlined the need to set up national level telecommunication infrastructure along with strengthening corporation and coordination among all stakeholders to ease the appropriate utilization of the same.

Sub-Module 1: Introduction to Disaster Communication System

Owing to the peculiar geo-climatic prevailing conditions throughout the Indian land area as well as its geophysical nature, India has been subjected to various types of catastrophic natural disasters such as landslides, cyclones, droughts, floods, tsunamis, earthquakes, and other natural disasters on a regular basis, leading in massive casualties, property, and environmental damage, and is therefore regarded as among the most disaster-prone countries in the world.

In the pre-disaster scenario of the disaster management continuum, comprehensive disaster management asks for emphasizing disaster preparedness, prevention and mitigation activities. For reducing damage to property and environment, human suffering and loss of life caused by disasters it is very important that effective telecommunication are deployed on a timely basis for efficient, immediate and accurate information and enhanced construction during the rehabilitation and reconstruction duration.

Sub-Module 2: Requirement of ICT Network during various phases of Disaster Continuum

To minimize the amount of acceptable risk in society, a knowledge-based information system for the Disaster Management (DM) cycle must give balanced support to each stage of these activities. This chapter analyses the need for an information communication and technology (ICT) network at different phases of the disaster recovery process.

The needs unique to each stage of disaster management, as well as the consequences for the communication systems and components involved are explored further below.

ICT for Mitigation Phase

ICT for Preparedness Phase

ICT for Response Phase

ICT for Recovery Phase

GIS platform Inevitable for Holistic DM

Sub-Module 3: Existing Communications Base and ICT Support – Situation Analysis

The sub-module largely includes the basic information of various service providers' existing communications infrastructure, as well as danger forecasting and warning systems, as well as certain constraints in the current infrastructure concerning the disaster management need. Large bandwidth pipes are already accessible across the nation, thanks to the fast development of optical fiber-based communications infrastructure by various service providers (both commercial and PSUs). During a disaster scenario, various network connections

can be utilized to establish the essential communications network, both horizontal and vertical. Some of the efficient networks available for supporting various e-Governance initiatives are discussed in the module such as State Wide Area Network (SWAN), National Information Center Network (NICNET), Network of Indian Space Research organization (ISRO), Disaster Management Support (DMS), Police Telecommunication Network (POLNET) etc.

Sub-Module 4: Disaster Management Support (DMS) & National Database for Emergency Management

India is prone to many natural disasters like floods, landslides, cyclones, forest fires, earthquakes, drought, etc. Satellites provide synoptic observations of natural disasters at regular intervals that helps in better planning and management of disasters. In order to better understand the risks due to such disasters, it is necessary to integrate satellite and field based observations and to work towards risk reduction principles. Satellite communication and navigation systems also play an important role in disaster management with improved technological options.

Disaster Management Support (DMS) Programme, comprehensively addresses various aspects of natural disasters in the country, using space based inputs. ISRO disseminates relevant information in interactive geo-spatial domain through various geoportals like Bhuvan, National Database for Emergency Management and MOSDAC for the administrators to better understand the impact and for improved decision support.

ISRO provides the satellite based near real time information support to Central Ministries / Departments and State Ministries / Departments, prior during and after major natural disasters. In addition, ISRO also provides capacity building in use of Space technology inputs in Disaster Management Support.

Towards supporting country's efforts in efficient management of natural disasters, ISRO has evolved a comprehensive space-based Disaster Management Support (DMS) Programme and institutionalised the same in association with concerned ministries / agencies. The DMS programme addresses disasters such as flood, cyclone, drought, forest fire, landslide and earthquake. Earth observation satellites together with meteorological and communication satellites and aerial survey system form the base for providing timely support and services for disaster management.

To support the total cycle of disaster/emergency management for the country, in near real time, the database creation is addressed through National Database for Emergency Management (NDEM), a GIS based repository of data. NDEM is envisaged to have core data, hazard-specific data, and dynamic data in spatial form as well as textual form. The database enables the development of decision support system in the form of customised user interfaces with necessary security mechanisms.

Sub-Module 5: GIS-Based National Disaster Management Information System

It is convenient to remotely monitor vital information on the location, transformation, and regression of the disaster with the passage of time utilising information on remote sensing. Such information helps to formulate effective action plans for post-disaster situations of response activities. Such information can also be useful for immediate and efficient responding to disasters and can be implemented by various stakeholders such as disaster response personnel, Incident commanders etc. Remote sensing and Geographic information system may help with better response planning regarding suitable routes for evacuation, essential lifelines locations such as medical facilities, shelters, evacuation points, relief items, airports etc.

Sub-Module 6: Satellite Communications for Disaster Management

When there is damage to the communication infrastructure of any area, the role of satellite communication comes into play and satellite technology has an undeniable crucial role during disasters especially in re-establishing communication links. In any disaster situation satellite transmissions using small aperture earth stations, such as fixed VSATs, vehicle-mounted earth stations (VMES) and transportable earth stations are the most viable solutions to provide emergency telecommunication services for relief operations. Such communication links are very crucial for both disaster victims and those involved in emergency response efforts. Satellite communications are highly survivable (physical survivability and robustness), independent of terrestrial infrastructure, able to provide load sharing and surge capacity solutions for larger sites, best for redundancy etc. There are several benefits associated with use of using satellite communications such as ubiquitous coverage, instant infrastructure, independent of terrestrial infrastructure, temporary network solutions, rapid provisioning of services etc. Satellite communications such

as VSATs, mobile-satellite terminals, ancillary equipment etc can carryout a variety of functions such as voice and data communication, position information transmission, crucial image transmission, field reporting, data collection etc.

Sub-Module 7: Establishment of National Disaster Communication Network

The Emergency Operating Centres at the national, state, and district levels, are described in this sub-module. NDRF's Mobile Emergency Operations Center (MEOC) is also discussed in this module. Emergency Operating Centres (EOCs) are the primary command and control facilities in charge of ensuring that disaster management functions are carried out successfully at all stages of a natural catastrophe. After receiving initial information about the advent of a significant natural catastrophe, it operates at full capacity around the clock (24x7). This sub-module also covers connectivity (across EOCs), applications, and database needs at EOCs.

Satellite and terrestrial networks establish connectivity between EOCs and other stakeholders. Pre-disaster, during-disaster, and post-disaster situations are covered by the applications necessary at EOCs.

Sub-Module 8: Facilities Provided at Eocs

The arrangements established at different levels of Emergency Operations Centers (EOCs) to allow effective communication during disasters are discussed in this chapter. The communication establishment planned for all levels of Emergency Operation Centers, as well as NDRF Battalions' stations, includes a Static Communication Access Platform (SCAP), while NDRF and District Headquarters will have a Mobile Communication Access Platform (MCAP). At the national, state, and district levels, EOCs will have both terrestrial and satellite connection (for failsafe reserves).

Static Communication Access Platform (SCAP) has information and Technology (IT) hardware and satellite communication, whereas Mobile Communication Access Platform (MCAP) will have the necessary information and Technology gear as well as wireless connectivity (based on satellite and VHF system). The communication needs of NDRF team members and local authorities will be fulfilled via planned Mobile Emergency Operation Centre (MEOC), which will utilize satellite connectivity and a VHF system. The connectivity will be

ensured by establishing two way communications to exchange data, video and voice from site of disaster to other EOCs, NDMA Headquarters, MHA, and NDRF headquarters.

Infrastructure development is not a one-time event; rather, it is a continual and growing process.The exploitation of new technologies with cutting-edge next-generation communications network and a variety of software applications on the horizon is critical for DM Continuum management.

Sub-Module 9: Technology, Emerging Trends and R&D Requirements

Stakeholders participating in disaster management at various levels have a general understanding of the various technical platforms available and how to use them for successful disaster management assistance. In this framework, the goal of this chapter is to discuss the emerging technological background in broad terms.

The outline of basic telecommunication concepts such as switching, multiplexing, and others, which are regularly employed in modern telecommunication networks, is presented in this sub-module. Other network technologies including mobile networks, satellite networks, and so on are also discussed in this sub-module. Because fast technology advancements are on the horizon, the following section includes a quick sketch of potential situations.

Finally, a section on research and development follows, because no chapter on telecommunications and information and communication technology (ICT) is complete without mentioning research and development efforts, because innovation brings a slew of new features that are critical for improving DM with increasing efficiency and shorter response times during various stages of natural disasters.

Sub-Module 10: Common Alerting Protocol (CAP)

Common Alerting Protocol (CAP) is widely used for exchanging public warnings and emergencies between alerting technologies. CAP facilities simultaneous dissemination of warning messages over many warning systems to many applications such as Cell Broadcast, Google Public Alerts etc. This technique simplifies the task and enhances the effectiveness of warning dissemination to

responsible officials. CAP has several characteristics such as flexible targeting specific geographic areas, message in multilingual and multi-audience, phased and delayed effective times and expirations, enhanced message update and cancellation features, template support for framing complete and effective warning messages, digital encryption and signature capability, facility for digital images, audio, and video etc.

Sub-Module 11: Last Mile Connectivity

In the event of a calamity, last-mile connection is the first casualty. The major goal of the disaster communication network is to provide last-mile connection in the incident area as quickly as feasible. The communication design should be done in stages, starting with voice communication when you arrive at the site and gradually progressing to video and data communication over time. This sub-module goes into the communication support that will be offered for establishing graded communication at the catastrophe site in great detail.

Sub-Module 1

Introduction on Disaster Communication System

1.1 Introduction

Owing to the peculiar geo-climatic conditions that prevail in the Indian land mass and its geophysical nature, India has been exposed to a number of catastrophic natural disasters such as landslides, cyclones, tsunamis, floods, earthquakes, droughts on a regular basis, resulting in mass casualties, property, and environmental damage, and is thus regarded as one of the most disaster-prone countries. Due to expanding population, unplanned urbanisation, structural development in high-risk zones, environmental degradation, climate change, and other factors, susceptibility to natural and man-made catastrophes has increased during the previous four to five decades (NDMA 2012).

Communications has played an essential role in Disaster Management (DM) from its inception, in delivering information to all stakeholders and, in particular, in rescue and emergency relief activities for disaster victims.

Rapid modernisation and advancement in information and communication technology (ICT) has allowed for not only the prediction of some disasters, but also the provision of means for rapid and effective rescue and relief operations, reducing the fatalities caused by some of the worst disasters. For example, compared to the more than 10,000 people who died in Andhra Pradesh during a cyclone in 1979, effective communication tactics reduced the loss to less than 1000 people after a storm of equal strength in May 1990 in the same state. A storm killed more than 300,000 people in neighbouring Bangladesh in the early 1970s (NDMA 2012). A previous hurricane of equal severity, however, claimed the lives of 3,000 people after the government installed an elaborate early warning system.

The nodal agency, India Meteorological Department (IMD), transmits early warning (EW) for cyclone bulletins in local languages using a network of analogue and digital receivers located in the field across India. Similarly, the Central Water Commission (CWC) provides flood forecasting and EW services to virtually

all of India's main flood-prone inter-state river basins. After the Indian Ocean tsunami of December 2004, the Asian Disaster Preparedness Center (ADPC) has collaborated with the International Telecommunication Union (ITU) to assess the current state of emergency communications in Asia-Pacific countries and make recommendations on national emergency telecommunication and early warning system setups. To improve early warning systems, ADPC launched the Tsunami Alert Rapid Notification System Program as part of the Indian Ocean Early-Warning Systems Programme, with a focus on robust ICT systems to distribute information and warnings from the national to the community level (NDMA 2012).

In recent times focus is more on dissemination of reliable and timely knowledge-based information to all the stakeholders engaged in various phases of disaster management rather than reactive approach to deal with disaster management issues. In holistic approach of disaster management, priority are given to pre-event scenarios of prevention, mitigation, and recovery which is necessary for a country's efforts to be sustainable development.

1.2 Paradigm Shift in DM

1.2.1 Initiatives on Natural Disaster Risk Reduction Programme

Natural disasters cause massive loss of life and property annually, delaying economic and social progress by years, if not decades. Around 7500 natural disasters devastated the planet, killing over 2 million people and generating over 1.2 trillion dollars in economic losses between 1980 and 2005 (NDMA 2012). Natural disaster-related economic losses in the recent decade were the highest on record, totaling $3 trillion, more than a trillion more than the preceding decade. Floods, tsunamis, earthquakes, and tropical cyclones were among the disasters that struck the Asia-Pacific area between 2010 and 2019, accounting for 44 percent of all disasters. The substantial spike in economic loss was attributed to more extreme weather events, larger populations in disaster areas, and greater supply chain disruption in a globalised economy (Reuters 2021).

In the pre-disaster scenario of the disaster management continuum, holistic disaster management calls for prioritising disaster prevention, mitigation, and preparedness activities, while bolstering initiatives for a better and more accurate responding via highly trained personnel, highly developed tools, and improved building during the reconstruction and rehabilitation period.

As a result, the holistic DM cycle has been concentrated on four overlapping phases in the context of natural disasters: mitigation, readiness, response, and recovery (NDMA 2012). Disaster management continuum is shown in Fig.t 1.

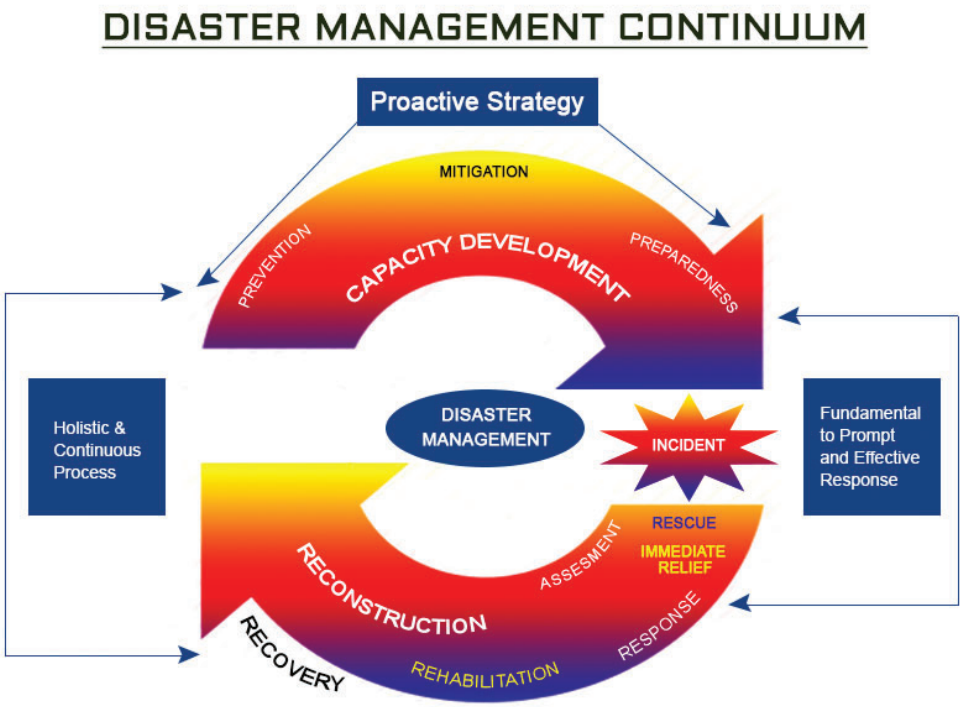


Fig. 1 Disaster management continuum

(Source: NDMA 2012)

1.2.2 Paradigm Shift in Global Approach to DM

Given the massive effects of natural disasters, which have led to a large amount of fatalities and significant property damage, infrastructural facilities, and the environment globally, mainly in developing nations, the United Nations General Assembly decided to declare the 1990s as the International Decade for Natural Disaster Reduction through International Cooperation for Saving Lives on the 11th of December, 1987.

Subsequently, on December 22, 1989, the United Nations General Assembly declared the International Decade for Natural Disaster Reduction, which would begin on January 1, 1990, and established the required "International Framework of Action" for this Decade. The goal of the Worldwide Decade for Natural Disaster Reduction was to decrease the loss of life, property damage, and disruption of social and economic environments caused by natural catastrophes by coordinated international effort, particularly in poor nations. The international conference on Natural Disaster Reduction in the city of Yokohama, Japan (23rd – 27th May, 1994) confirmed many inter-alia in order to review the status of disaster reduction midway through the decade and to work out the strategy and plan of action for a safer world.

1.2.3 Paradigm Shift in DM in India

Considering, the fact the nation's hazard profile and its impact on the national economy at periodic intervals in general, and the impact of the last few major disasters in specific, such as Uttarakhand floods 2013, Kashmir earthquake 2005, Indian Ocean earthquake and tsunami 2004, Bhuj Earthquake 2001, Orissa Super cyclone 1999, leading to the loss of approximately Rs 34,400 crores in property and 40,200 lives, India decided to change from a reactive approach to a holistic approach to disaster management by incorporating technology and innovation through all facets of the disaster management continuum, with the introduction of Disaster Management Act 2005 on December 23, 2005, which was unanimously passed by the Parliament. In general, this strategy asks for the development and implementation of effective technological and scientific infrastructures, as well as the construction of dependable and dedicated disaster communication systems based on modern technology (NDMA 2012).

In India, the Disaster Management Act 2005 explicitly defines the organisational structure and functional duties for disaster management. The National Disaster Management Authority (NDMA), an apex organisation led by the Prime Minister as Chairperson, was established under the Disaster Management Act of 2005. In essence, the National Disaster Mitigation Act (NDMA) focuses on disaster prevention, preparedness, mitigation, rehabilitation, rebuilding, and recovery, as well as developing suitable policies and standards for effective and coordinated national disaster response and assistance. It is also responsible for coordinating the enforcement and execution of its policies and programmes as the country's top policy-making body for disaster management. The Disaster Management Act of 2005 has therefore formed specific institutional organisations inside

the current administrative framework, with statutory disaster management responsibilities at all levels of government, i.e., national, state, and district (NDMA 2012). A diagrammatical representation of the National Disaster Management Structure is given at Fig. 2.

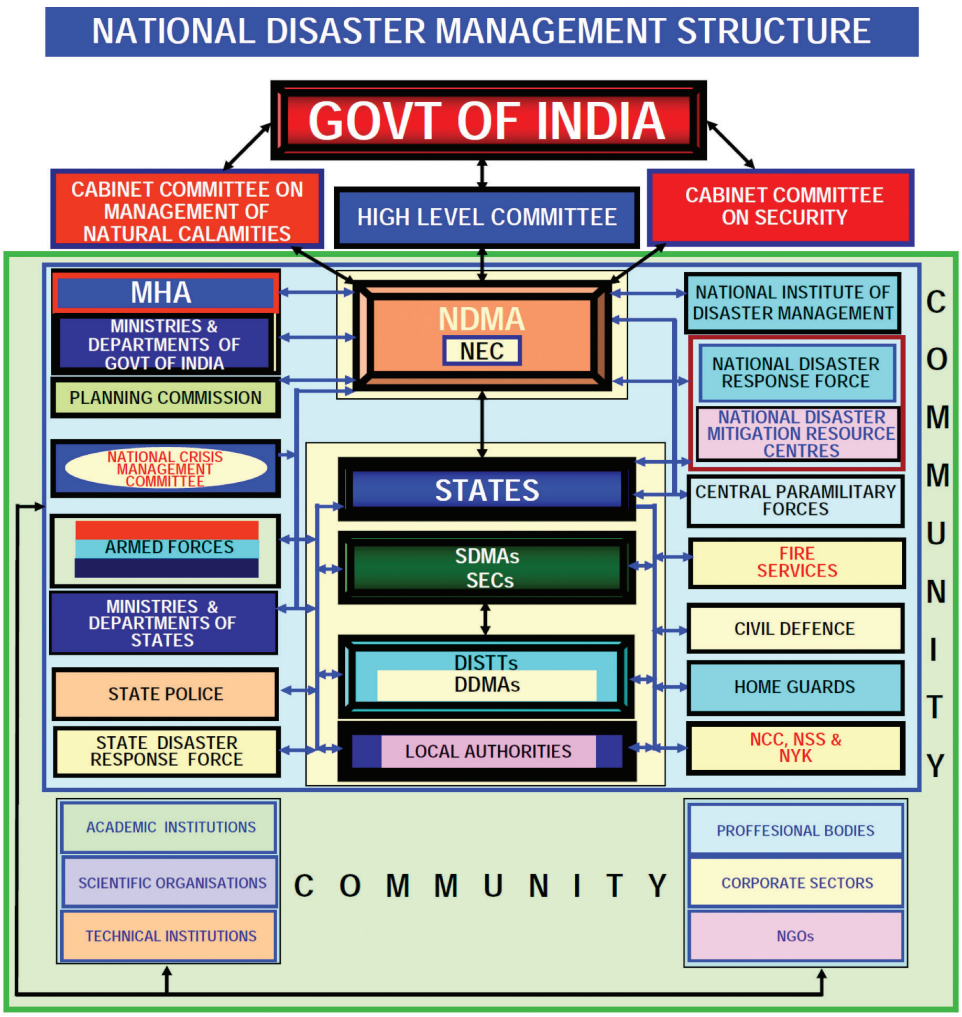


Fig. 2 This diagram reflects interactive linkages for synergised management of disasters and not a hierarchical structure.

(Source: NDMA 2012)

For efficient coordination and administration, all components of the disaster management Institutional framework must have desired Information and Communications Technology (ICT) connectivity and assistance. The list of early warning and forecasting agencies requiring due connectivity is given at Fig. 3.

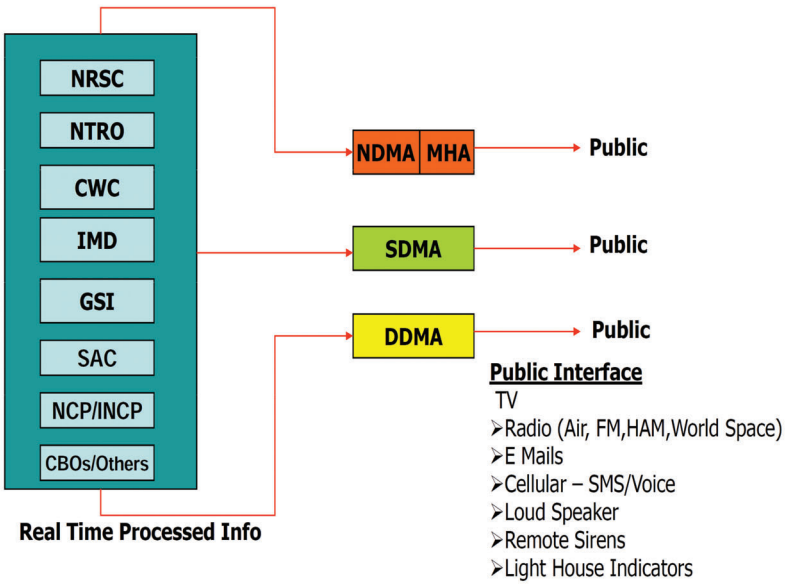


Fig. 3 List of Early Warning & Forecasting Agencies Requiring Due Connectivity.

(Source: NDMA 2012)

1.3 Natural Hazard Profile in India and Special Features of ICT Systems

Well, almost 58.6% of the Indian total area is vulnerable to earthquakes of various magnitudes; about 12% of the Indian land mass, covering over 50 million hectares, is vulnerable to floods and subsequent land erosion; about 8% of the total area is vulnerable to cyclones; and 68 percent of the area is vulnerable to drought. Approximately 5700 km of India's lengthy coastline, which stretches for 7516 km, is vulnerable to cyclones and tsunamis (NDMA

2012). With expanding population, unplanned urbanisation, development in high-risk zones, environmental degradation, climate change, and other factors, susceptibility to natural and man-made disasters has increased during the previous four to five decades.

1.3.1 ICT for Flood Management: Special Features

Due to large flows in the Ganga-Brahmaputra-Meghna river system, India is frequently flooded. The main causes of floods are widespread heavy rainfall in the catchment areas and inadequate capacity of the river channel to contain the flood flow within the banks of the river. In the tidal reach areas, widespread inundation occurs where high floods in the river synchronises with the high tidal levels from the sea. Due to siltation, the Brahmaputra River presents unique issues in Assam, necessitating priority dredging of the riverbed to reduce the impact of floods and soil erosion. On a GIS platform, satellite images of flood-affected regions will allow the Decision Support System to direct flood mitigation efforts (NDMA 2012).

Inter-state cooperation can be utilised to prevent disasters by installing an automated Alarm System with suitable level/discharge sensors. The solutions are effective and timely information systems, as well as contingency plans for coping with such calamities. The current manual water level marking system will be replaced with an automatic danger level overflow alarm system using intelligent sensors that will send information to the State Emergency Operations Center (SEOC)/ District Emergency Operations Center (DEOC) in real time, allowing for quick evacuation and saving lives and property (NDMA 2012).

Flooding in cities and towns is a new dimension in the flood scenario. This is a growing problem because of more frequent and severe rains, unprepared management and indiscriminate encroachment of rivers, insufficient drainage, and a lack of infrastructure upkeep. Satellite data from the National Remote Sensing Center (NRSC) may be used to map and monitor flood-inundated regions, assess flood damage, zone flood hazards, and conduct historical flood surveys of river design and protective measures. Flood hazard map of India is given in Figure 4.

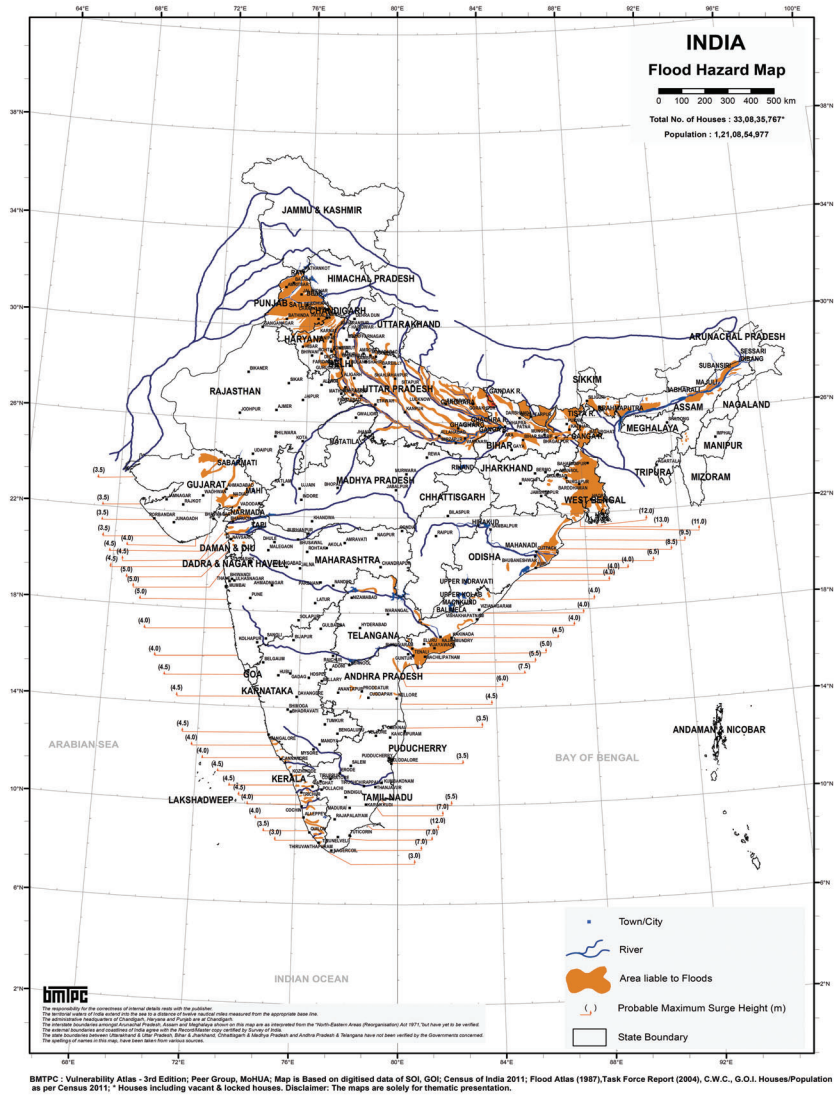


Fig. 4 Flood hazard map of India

(Source: NDMP 2019)

1.3.2 ICT for Cyclones Management: Special Features

India is particularly sensitive to cyclones and related dangers such as storm tides, high velocity winds, and heavy rains because to its long coastline of about 7500 kilometres of flood coastal terrain, high population density,

geographical position, and topological aspect of its coastal zone. To go from the early warning to the last mile, network equipment must be able to operate in a variety of topographical situations in each of the country's cyclone-prone States/UTs. The community has enough time to reply to the advice received from the district/sub-district level and take necessary action if warnings are received on time. A cyclone that strikes the Indian coast usually lasts 3 to 4 days from the time it originates to the time it reaches land. The time it takes to identify a cyclone and provide a warning is varied and relies on the distance between the site of development and the shore (NDMA 2012). Wind and Cyclonic hazard map of India is given at Figure 5.

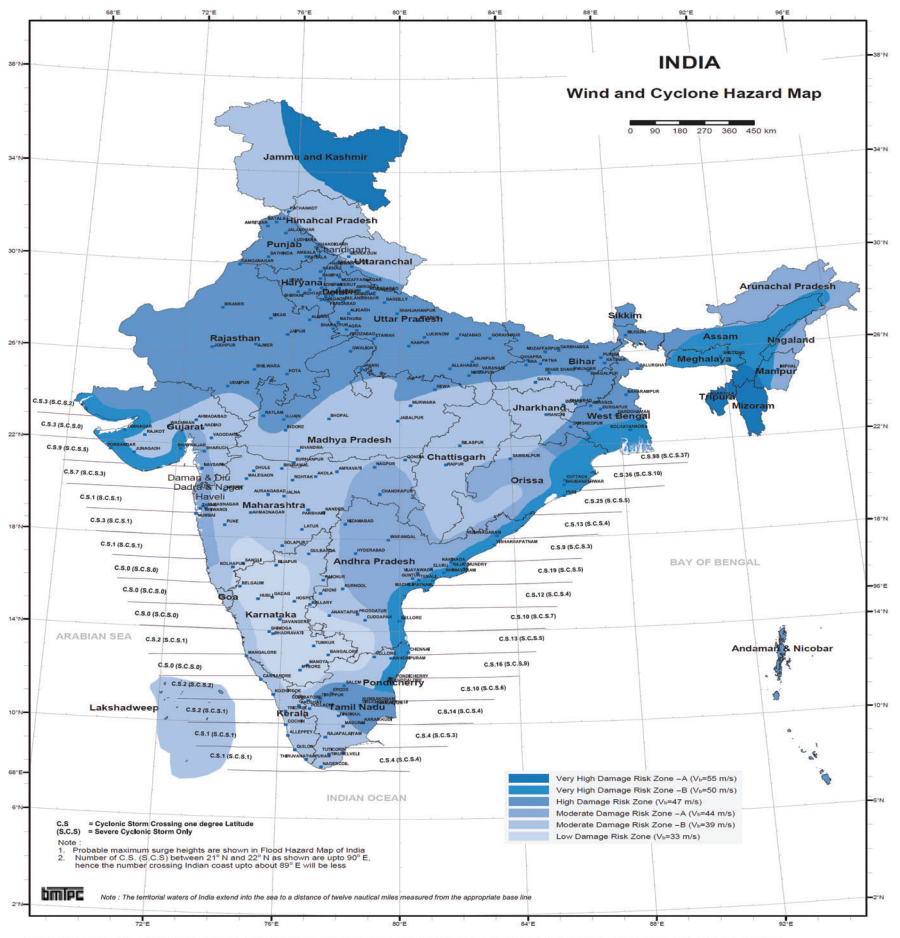


Fig. 5 Wind and Cyclonic hazard map of India

(Source: NDMP 2019)

1.3.3 ICT for Earthquake Management: Special Features

Because of the large geographical distribution as well as challenging terrain such as that of Jammu & Kashmir, Himachal Pradesh, and others, the damage potential of earthquakes spanning roughly 59 percent of India's landmass has a significant influence on ICT infrastructure. As a result, these background concerns must be considered when preparing for earthquake-related ICT assistance for the activities engaged in the entire catastrophe continuum (NDMA 2012). Earthquake related seismic zone map of India is given at Fig. 6.

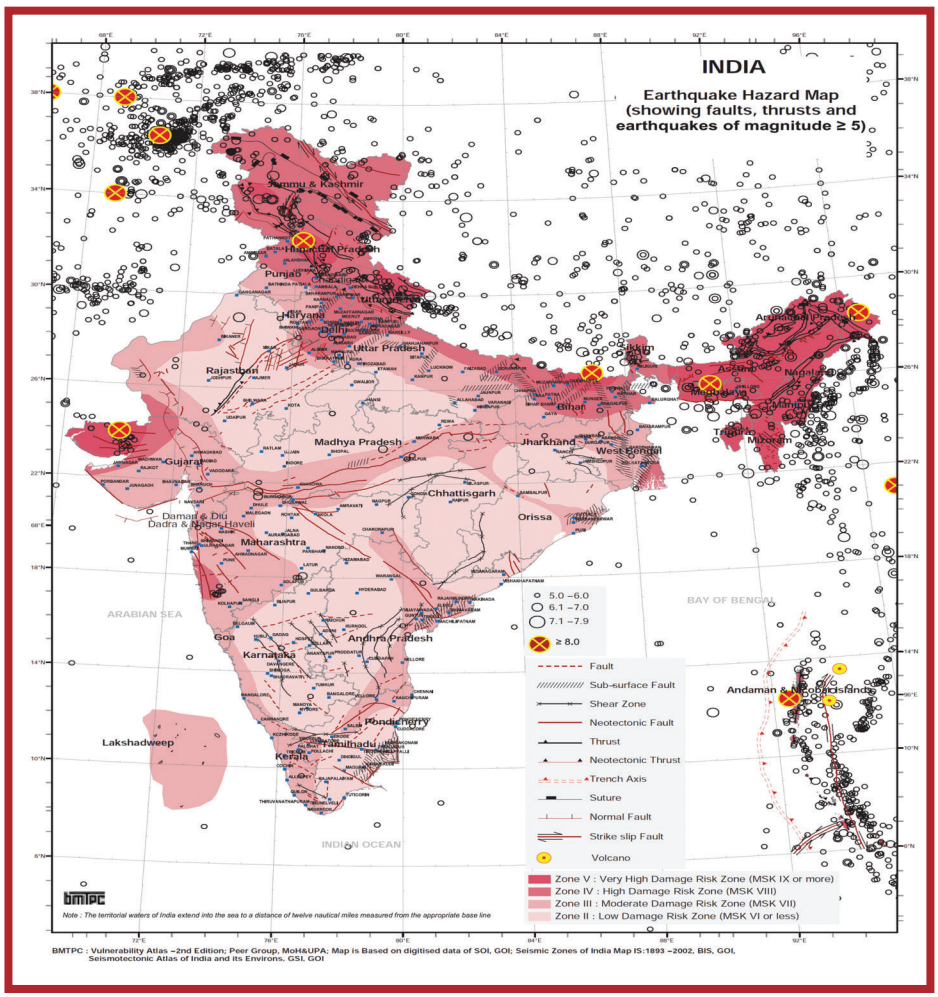
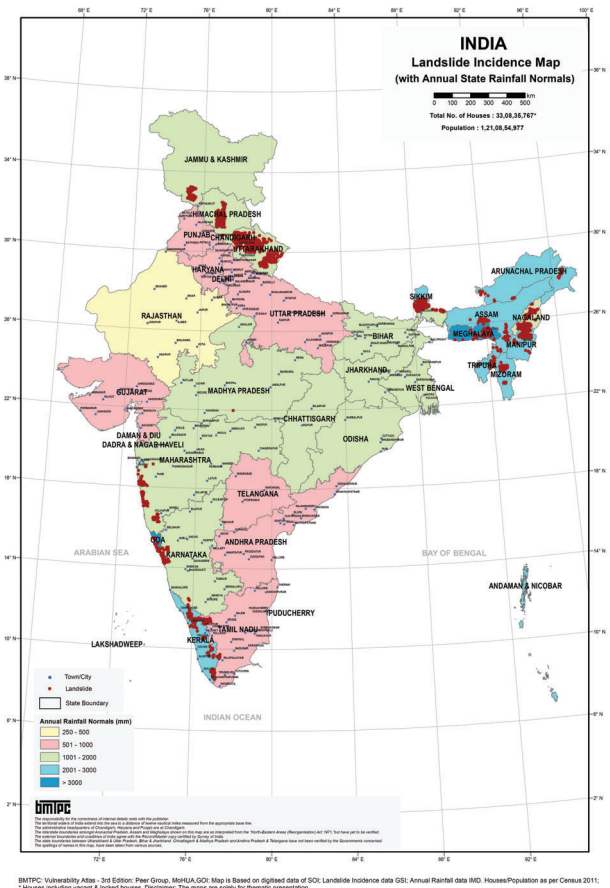


Fig. 6 Earthquake related seismic zone map of India

(Source: NDMP 2019)

1.3.4 ICT for Landslides Management: Special Features

Disturbances in the inherent stability of a slope generate landslides. They may occur in conjunction with severe rainfall or as a result of droughts, earthquakes, or volcanic eruptions. Rainfall, snowmelt, changes in water level, stream erosion, changes in groundwater, earthquakes, volcanic activity, disturbance by human activities, or any combination of these events can cause landslides in slopes already on the edge of moving. Human activities such as unjustified cutting trees, construction, mineral extraction, and quarrying, combined with heavy rainfall, have enhanced the vulnerability of the Himalayan Mountains, resulting in higher incidence of landslides in the region (NDMA 2012). Landslide hazard zonation map of India is given in Fig. 7.



BMTPC, Vulnerability Atlas - 3rd Edition: Peer Group, MoHUA,GOI: Map is Based on digitised data of SOI; Landslide Incidence data GSI; Annual Rainfall data IMD. Houses/Population as per Census 2011; * Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

Fig. 7 Landslide hazard zonation map of India

(Source: NDMP 2019)

1.3.5 ICT for Forest Fire Management: Special Features

Wildfires are among the most destructive forces on Earth. When these fires burn into towns and cities on the edges of forests or wildlands, the economic damage and potential loss of life can be massive. Meanwhile, hotter global temperatures and extreme heat waves increase the danger from wildfire spread.

The technology used to tackle large area fires has become more sophisticated to respond to this threat. Firefighters from highly-trained ground and air teams. Helicopters and air tankers carry water, suppressant foam, and flame retarding chemicals direct to fire hotspots.

Today's firefighters are tackling massive wildfires by using the most sophisticated technology. Whether it's with a modified jumbo jet or state of the art thermal imaging cameras, we take a look at the tech behind fighting some worlds most devastating fires.

Command and control centers are turning to unmanned aerial vehicles (UAVs) to keep costs down and provide additional capabilities. Small quadcopters and larger fixed-wing aircraft can fly over fires for much longer periods.

Infrared and thermal cameras can see through smoke to monitor ground teams and let them know when conditions change. UAVs can provide georeferenced aerial images, heat maps, and temperature scales of fire zones. Specialist drones can even carry hoses to less accessible areas. In the future, swarms of autonomous drones could be used to track wildfires and spot fire spread. Thermal imaging technology has become widespread and less expensive to use. Handheld cameras and devices that attach to smartphones allow firefighters to see through smoke and find active fire hotspots, or undergrowth that is burning without producing smoke. Identifying these hotspots allows crews to target the most active and dangerous parts of a wildfire and divert manpower to tackle it is more effectively.

Sub-Module 2

Requirement of ICT Network During Various Phases of Disaster Continuum

2.1 Introduction

Natural disasters cannot be avoided at the current level of science and innovation, and communities might just have to live with a certain degree of risk – the degree of danger being dependent on the extend of scientific and technological advancement available for insertion in disaster management and the resources given by the government. when actions related to prevention, mitigation, and preparation are given top priority, i.e., As a result, in the case of natural disasters, the holistic DM cycle has been focused on four overlapping phases: mitigation, preparedness, response, and recovery (NDMA 2012).

The needs unique to each stage of disaster management, as well as the consequences for the information and communication systems and components used, are explored further below.

2.2 ICT for Mitigation Phase

Pre-disaster operations include the formulation and publication of zoning regulations and construction rules, as well as the compilation of important baseline data, as well as the analytical and modelling capabilities needed to plan for, respond to, and recover from a catastrophe occurrence. Mitigation may also involve enacting legislation prohibiting the construction of structures in earthquake, flood, or tsunami-prone zones. The work of monitoring these is made feasible by utilising existing datasets connected to geographic characteristics in GIS. These tasks are not time-critical in most cases, but they are necessary for developing the ICT infrastructure (NDMA 2012).

2.3 ICT for Preparedness Phase

Early warning, first responder community development, community

preparation, logistical support, supply, and resource systems required for disaster response & relief, and early warning and monitoring operations before catastrophes are all examples of preparedness activities. For example, in rural locations, full national coverage is still an issue that has to be solved via the use of various technologies. The major concerns are public knowledge through radio announcements and access to catastrophe web pages. This category also includes distance learning and other training activities that employ interactive video (NDMA 2012).

2.4 ICT for Response Phase

Property and casualty information, resource information, and response priorities all need unique access capabilities beyond standard commercial telephone/ Internet services. Time is of the essence while dealing with disasters. Access to logistical assistance options for supplying relief goods, damage surveys, baseline maps, equipment, human resources, and finances are required. The importance of communication between response teams and with the broader population increases dramatically.

Communication that is quick, dependable, customizable, and regulated is critical for effective disaster response operations. Extreme conditions of infrastructure damage, communication traffic peaks, mobile users, and sensitive data create major problems (NDMA 2012).

2.5 ICT for Recovery Phase

Re-evaluation on the mitigation procedure as well as historical databases are essential for avoiding similar mistakes in the future. Concerns about timeliness are put aside in favour of efficiency, and the internet is frequently used for such transfers. As a result, it's apparent that the need for access, privacy, and bandwidth vary depending on the stage of the disaster. Today's disaster information infrastructure should have a balanced mix of individual techniques to meet a wide range of needs. The Internet provides a good ICT support for the recovery and mitigation phases, but during the preparation and reaction phases, urgent and life-critical communications necessitate more resilient solutions. Creating a reliable National Disaster Communication Network (NDCN) will satisfy the ICT need for a reliable response (NDMA 2012).

2.6 GIS Platform Inevitable for Holistic DM

For effective disaster management, timely information on the incidence, advancement, and regression of disasters during various phases is required, which can be obtained by combining real-time space technologies with corresponding ground data usually available on a Geographic Information System (GIS) platform linked to the Global Positioning System (GPS). The apparent benefit of creating a dynamic map, as opposed to a static map, is the availability of real-time information illustrating the cause and effect relationship, which is highly useful to disaster managers at all levels of the DM administration, including the community (NDMA 2012).

Remote sensing and GIS may help with things like identifying evacuation routes and detecting susceptible infrastructure and essential lifelines, among other things during the preparedness and reaction phases. It also helps with logistical preparation so that relief supplies can be delivered by showing previously accessible information on road, bridge, airport, train, and port conditions and limits. Apart from that, GIS may be used for tasks such as evacuee camp planning (NDMA 2012).

It is feasible to measure the amount of food supplies, bed space, clothing, medication, fire tenders, medical and paramedics that will be necessary at each shelter using GIS data based on the number of predicted evacuees. Online monitoring of the progress of ongoing activity in the recovery phase is made easier with GIS. GIS can graphically represent current project status by swiftly updating data as work progresses and/or is concluded. At the National Emergency Operation Centre's (NEOC) consolidated GIS interface, current status may be readily checked and retrieved.

It is simple to visually observe critical information on the location, progression, and/or regression of the disaster in real time and to prepare appropriate action plans for post-disaster scenarios of response efforts that can be transmitted to various stakeholders (such as incident commanders at EOCs and disaster response personnel) for quick and effective communication.

These GIS information products might be used by disaster relief personnel and the business sector (e.g., insurance companies) in the post-disaster recovery phase, replacing the existing paper and clipboard approach (NDMA 2012).

Sub-Module 3

Existing Communications Base and ICT Support - Situation Analysis

3.1 Introduction

Government PSUs like BSNL, PGCIL, and others, as well as private telecom service providers like Reliance Communication, Bharti, and others, have installed an extensive optical fibre based communication (OFC) network across the country, with over 800,000 km of existing fibre line laid by these service providers. To offer satellite connection, the country has a number of significant satellite-based communication networks, including NICNET, POLNET, and the ISRO DMS Network. Additionally, the country is home to more than 10 mobile service providers. Likewise, there are networks set up by the relevant agencies in the country, to disseminate early warnings of various natural disasters. In the drive to enhance rural infrastructure, telecom connectivity has been given top attention (NDMA 2012).

This sub-module contains an explanation of the country's numerous communications networks, as well as hazard forecasting and warning networks. Different technological possibilities are discussed, as well as the limits of current communication and ICT assistance are explained toward the end of this sub-module.

3.2 Existing Telecommunication Network of Various Service Providers/ Government Agencies

Numerous important communication networks that have already been built in the nation, as well as those that are in various different stages of implementation by various authorities, are summarised in the following sections.

3.2.1 National Emergency Communication Plan (NECP), Ministry of Home Affairs, Govt. of India

As the Nodal Ministry for Disaster Management, the Ministry of Home Affairs has taken the lead in disaster management and mitigation in the country. The United Nations Development Initiative (UNDP) has partnered with MHA to execute the GOI-UNDP Disaster Risk Management (DRM) programme in 169 of the most susceptible districts across 17 states (NDMA 2012).

The National Emergency Communication Plan (NECP), which was developed in 2004, was designed to handle law enforcement, crisis, and disaster scenarios. The Plan is largely a satellite-based network based on POLNET, with backup assistance from NICNET and VPN (DMS). The voice-centric system with limited data processing capabilities is designed to offer communication linkages between National, State, and District Emergency Operations Centers (EOCs), as well as Mobile and Transportable EOCs, for deployment at emergency and disaster locations.

3.2.2 Disaster Management Support (DMS) Network of ISRO

The Disaster Management Support (DMS) Programme has been launched by the Department of Space (DOS) as a primary application activity to utilize the capabilities of space-based technology for disaster management applications in the country. As part of this effort, the Indian Space Research Organisation (ISRO) has launched a VSAT-based Virtual Private Network (VPN) on the EDUSAT Satellite in the extended 'C' Band as part of its Disaster Management Service (DMS) Program. Various centres of the Indian Space Research Organisation (ISRO) are working on various aspects of the DMS Programme (NDMA 2012). The schematic representation of DMS network is represented in Fig. 8.

The National Remote Sensing Centre (NRSC) in Hyderabad serves as a point of delivery for aerial and space-enabled inputs, as well as other critical data layers, for use in the pre-disaster, during-disaster, and post-disaster stages of disaster management via Decision Support Centre (DSC). The DSC has the ability to mobilise aircraft for aerial data collection.

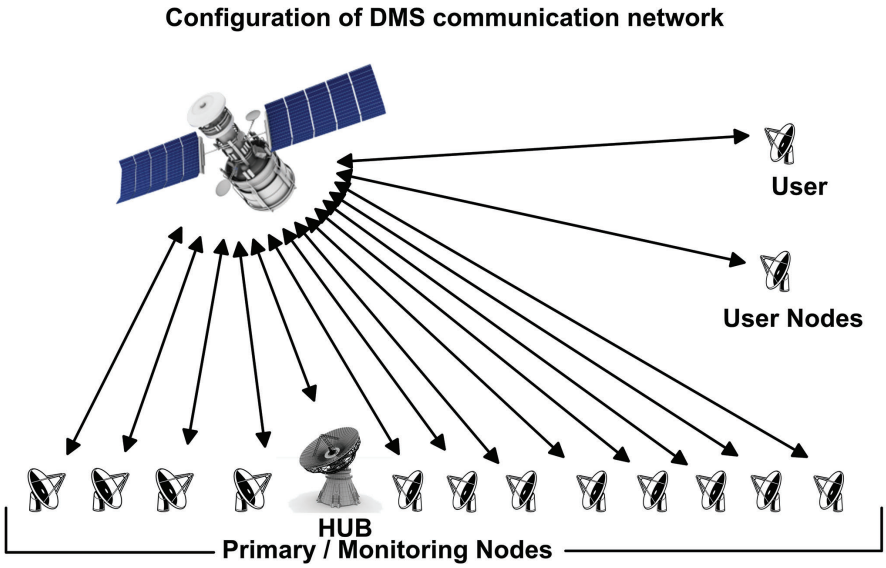


Fig. 8 A schematic representation of DMS network

3.2.3 Police Telecommunication Network (POLNET)

POLNET is a satellite-based specialist wide-area network (running on the C-band of INSAT-3E) created by MHA for the modernisation of the country's police telecommunications. TDM/TDMA, SCPC/DAMA (Demand Assigned Multiple Access), and DVB-S are some of the most recent Very Small Aperture Terminals (VSAT) technologies (Digital Video Broadcast-Satellite).

3.2.4 National Informatics Centre (NICNET) Infrastructure

The National Informatics Centre (NIC) is the government's and affiliated institutions' central information technology organisation for informatics development and networking. In 1990, NIC launched a nationwide initiative named "Natural Hazards Management Information System" to support the United Nations National Natural Disaster Reduction Decade Program (NDMA 2012).

3.2.5 State Wide Area Network (SWAN)

SWAN is the approved scheme of the Government of India for interconnecting state headquarters with district headquarters and district headquarters with block headquarters with minimum 2 Mbps leased lines in order to create a secure government network for delivering Government-to-Government (G2G) and Government-to-Center (G2C) services for support (NDMA 2012). A schematic representation of State Wide Area Network (SWAN) is given in Fig. 9

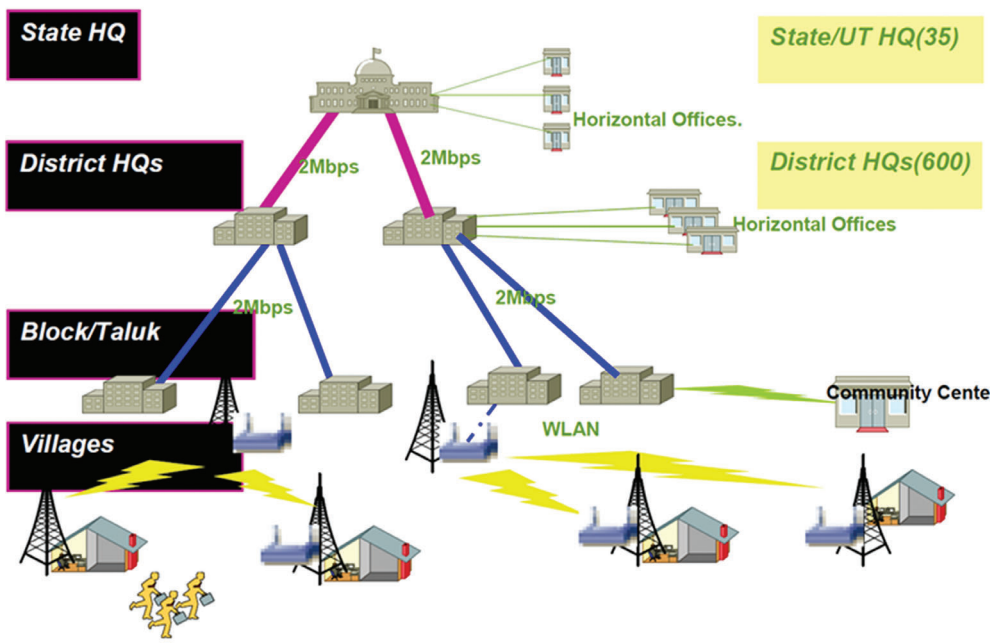


Fig. 9 State Wide Area Network (SWAN)

(Source : NDMA 2012)

The whole outsourcing procedure, involving consulting on the most effective PPP model, may be carried out in a democratic way by a competent consultant organisation under the guidance of the State's implementation committee.

3.2.6 Railway Communication Network

An extensive connection network for voice communication to aid train operations are available with Indian Railways since the outset. The initial analogue microwave systems were upgraded with digital microwave systems for the major train lines due to growing need for a high number of such connections.

Following that, when information technology systems were being planned, it was agreed to use OFC as a foundation to meet bandwidth demand through RAILTEL Corporation, a railway-owned PSU that connects 451 districts out of 626 districts through a state-of-the-art dedicated 35000km, Fiber based broadband and multimedia network laid along an exclusive Right of Way (RoW) along railway tracks. RailTel is also deploying a broadband wireless access (BWA) network across India in addition to the aforementioned services. BWA is a standards-based WiMax (Worldwide Interoperability of Microwave Access) technology for "last mile" solutions that use high-speed wireless access to link consumers to RailTel ISP/MPLS POPs (NDMA 2012).

3.2.7 BSNL Communication Network

Founded in October 2000, Bharat Sanchar Nigam Ltd. (BSNL), is a significant telecommunications company in India that offers a wide range of services such as wireline, CDMA mobile, GSM mobile, Internet, Broadband, Carrier service, MPLS-VPN, VSAT, VoIP services, IN Services, and so on (NDMA 2012).

3.2.8 Power Grid Corporation of India (PGCIL) Network

Power Grid Corporation of India, a Navratna Company and a Government of India Enterprise, has made major contributions to the growth of the Indian Power Sector. It is India's major transmission utility and one of the world's largest electric power transmission utilities, with a massive network of over 74000 circuit kilometres of transmission lines that transport 45 percent of the country's total power output (NDMA 2012).

3.2.9 Network of Department of Atomic Energy (DAE)

In addition to a significant number of important public sector undertakings,

industrial units, and aided institutes, the Department of Atomic Energy (DAE) has a big number of R&D institutes involved in exploitation of nuclear science and technology for different social purposes. DAE has built a communication network, which primarily consists of three wide area networks (listed below) interconnected by a gateway such as ANUNET, NPCNET, and others, for the quick and efficient operation of these facilities (NDMA 2012).

3.2.10 Common Services Center (CSC) Scheme

The CSC is a key component of the Government's National e-Governance Plan (NeGP), which was adopted in May 2006 as part of the National Common Minimum Programme's pledge to implement e-governance on a large scale. In the fields of e-governance, education, health, telemedicine entertainment, and other private services, the CSCs would deliver high-quality and cost-effective video, audio, and data content and services. The CSCs will provide web-enabled e-governance services in rural regions, including application forms, certifications, and utility payments like as power, telephone, and water bills, among other things (NDMA 2012).

3.2.11 The National Knowledge Network

Under the 11th Plan, the country is establishing the National Knowledge Network (NKN), which will connect over 10,000 educational institutions and research organisations to promote knowledge and information transfer across a very high bandwidth.

3.2.12 Emergency Planning and Response System, Ministry of Environment, Forest and Climate Change

In collaboration with the NIC's Remote Sensing & Geographic Information System (RS & GIS) division, the Ministry of Environment, Forest and Climate Change has developed a communication system called "GIS Based Emergency Planning and Response System for Major Clusters of Industries (GEPRES Ver-1.0)" to assist various response agencies in planning emergency situations arising from hazardous chemical spills.

3.2.13 NDMS Pilot Project

NDMA has implemented a pilot project to create a satellite based National Management Communication Network covering the following locations:-

- National Level - 03 (MHA, NDMA & NDRF HQ)
- States/UTs - 36 (All State Capitals and / UT Administration HQs)
- Selected Vulnerable Districts - 81 Nos

The aim of the project is to provide fails afe communication by facilitating voice/data communication amongst EOCs of vulnerable Districts, respective State HQs, MHA, NDMA, NDRF HQ and disaster sites through satellite in case of failure of terrestrial network due to any disaster. Each Site has been provided a fixed VSAT terminal and an ISAT Phone. The Project has been completed on 31 March 2019 and handed over to the States/UTs.

3.3 Existing Hazard Forecasting and Warning Network

In the following sub-sections networks that have already been created specifically for danger forecasting and warning are discussed.

3.3.1 Cyclone Forecasting and Warning Network

Currently, the India Meteorological Department's Area Cyclone Warning Centers (ACWC) creates specific warning bulletins that are broadcast every hour in local languages via a network of 252 analogue receivers in the field. This analogue Cyclone Warning Dissemination System (CWDS) network will be replaced with Digital CWDS (DCWDS) receivers and a larger number of DCWDS stations throughout India's east and west coasts.

3.3.2 Seismological Observations Network

The India Meteorological Department, as the nodal agency, operates a nationwide network of Seismic Stations for seismological observations across the country. These stations have accumulated data over a long period of time, which may be utilised to do proactive Hazard Risk Analysis to aid in mitigation efforts.

3.3.3 Drought Warning Network

The Department of Space created the National Agricultural Drought Assessment and Management System (NADAMS) for the Department of Agriculture and Cooperation. The drought assessment is evaluated on the basis of a district's satellite-observed green vegetation cover (both area and greenness) in any given time period with that of any prior year over a similar time period.

3.3.4 Flood Forecasting and Warning Network

Floods, whether heavy or disastrous, are destined to happen on a regular basis. They are uncontrollable and unpreventable. Embankments and large dams help to mitigate floods to a certain degree, but they may also present issues of water must be released for the safety of infrastructure. Floods might be reduced slightly by increasing green cover in the watershed region, substantial water collecting, groundwater recharge, and other measures.

Floods will, nevertheless, occur regularly, and we must learn to deal with them in order to limit harm and maximise advantages. Flood predictions aid in the optimal control of multifunctional reservoirs that have or do not have flood cushions. The Central Water Commission (CWC) provides this service to virtually all of India's main flood-prone inter-State river basins. The CWC has launched numerous extension and modernisation plans to cover additional regions and make forecasting more effective and reliable, in order to overcome the limits of the present system. In addition, the IMD has been expanding its network of Automatic Rain Gauges. IMD, CWC, and State Governments are collecting hydrological data from various river basins (collected using Bureau of Indian Standards certified automated sensors for rainfall and river flow measurements) in a centralised method for distribution and archive (NDMA 2012).

3.3.5 Tsunami Warning Network

The Regional Tsunami Warning Centre (RTWC) has been established at the Indian National Centre for Ocean Information Services (INCOIS) in Hyderabad as a result of the devastating tsunami on December 26, 2004 (which was triggered by an under-ocean EQ off Sumatra, Indonesia, with a magnitude of 9.1 mw, killing over 2,30,000 people, including about 10,000 from India). Since December 2007, this national early warning system for tsunamis and storm surges in the Indian Ocean has been operating (NDMA 2012).

3.3.6 INSAT Based Distress Alert Transmitter for Fishing Boats

The Indian Space Research Organization (ISRO) collaborated with an Indian company to create an INSAT-based Distress Alert transmitter (DAT) with technical assistance from the Space Applications Centre (SAC) in Ahmadabad. The Indian Coast Guards expressed a need for a satellite-based Distress Alert Transmitter to be used in deep-sea fishing boats. In the event of an emergency, the fishing boat sends a brief message via satellite indicating its location and kind of emergency to a central site for rescue operations. The Planning Commission of India has recommended a length of 1076 kilometres (NDMA 2012).

3.3.7 VHF Radio Communication System for Fishermen Community in Tamil Nadu

The Planning Commission of India authorised the Tamil Nadu government's plan to build a communication network for the whole coastal region of Tamil Nadu, which stretches for 1076 kilometres, as part of the Tsunami Project Implementation. The government agreed in principle to a pilot project in Ramanathapuram District to investigate the availability of voice communication for small boat and voice and data connectivity for fishing community motorised vessels (NDMA 2012).

3.4 Communication Modes available for Disaster Forecasting and Warning

Various technical solutions are employed in disaster communication during different phases of disaster management, taking into consideration the time sensitivity and volume of data transfer required for reliable and efficient communication to the appropriate stakeholder at the right time. Nevertheless, all science and technology alternatives with public and private ICT operators, must be activated into service to ensure that the early warning and forecasting of disasters reach the community in the likely affected area, in order to achieve the primary disaster management goal of eliminating/minimizing the loss of life (NDMA 2012).

Numerous technology possibilities for disaster management in broad and Early Warning & Forecasting of natural disasters in particular are briefly discussed here, along with their relative benefits and drawbacks. These conventional and new communication mediums can be utilised alone or in combination to achieve

the shared objective of disseminating catastrophe alerts as fast and correctly as feasible. Depending on the nature of the disaster, the impacted locations, and the socioeconomic level of the affected populations, certain methods may be more successful than others. Radio and television, telephone, civil defence public address systems, email/internet, mobile transmitting, amateur radio, satellite communications, and other communication channels provide Early Warning Dissemination in general. The next paragraphs go through each one in depth (NDMA 2012).

(i) Radio and Television

Radio and television are the most conventional electronic media for disaster warning, and their efficacy is significant since they may be used to swiftly distribute a warning in an easily comprehensible and vernacular language based early warning to a vast population, even in areas where tele-density is low. The main disadvantage of these two forms of media is that their efficacy is considerably decreased at night, when they are usually turned off (NDMA 2012).

Following the 2004 tsunami in the Indian Ocean, several radio makers are considering introducing new digital radio alert systems that will activate even if the set is turned off. A unique signal delivered by a terrestrial transmitter or a satellite would be used to automatically tune to an emergency broadcast channel in order to activate the alert (in case of digital receivers, this would be somewhat easier).

(ii) Telephone (Fixed and Mobile)

Telephones may play a critical role in providing early warning to communities of imminent disasters, perhaps saving many lives. A timely telephone conversation from a resident of Nallavada village in Pondicherry who was working in Singapore at the time, warning of the approaching tsunami, saved entire population of 3,600 people, as well as those of three neighbouring villages, before the tsunami reached the shore.

A technique known as “telephone trees” can improve the effectiveness of telephone calls by warning communities of imminent hazards. When a person receives a warning message (by phone or other methods), he or she is required to make a certain number of phone calls (typically four or five) to others on a

pre-prepared list. This method not only guarantees that the warning message is sent on time, but it also ensures that there is little duplication of work. Nevertheless, there are two disadvantages to utilising telephones to issue catastrophe alerts. Telephone penetration, especially in rural and coastal regions, is woefully inadequate. Another disadvantage is the congestion of phone lines that often happens shortly before and during a crisis, leading in many phone call not being answered during that critical moment (NDMA 2012).

(iii) Short Message Service/Cell

Broadcasting Short messaging service (SMS) is a service that allows short messages to be sent between mobile phones, other portable devices, and even landline telephones. It is accessible on most digital mobile phones. Many people of coastal regions impacted by storms are unable to reach family and friends using traditional landline phones, but may readily connect with one another using SMS as long as the network is operational. This is due to the fact that SMS operates on a separate channel and may be delivered or received even when phone lines are busy. Another advantage of SMS over phone calls is that a single message may be sent to a number of people at the same time (NDMA 2012).

(iv) Internet/Email

The Internet is a worldwide network of networks that allows computers of all types to interact and exchange services in a direct and transparent manner. The internet offers a new, possibly revolutionary, quick, and low-cost method of communicating intra-national and worldwide catastrophe warnings. Although the Internet is widely accessible, it does not guarantee a certain schedule and is prone to congestion and interruption. Despite this disadvantage, numerous disaster-related activities have already begun in the Internet community. The level to which experts such as first responders, other stakeholders, and others use the Internet, email, and instant messages in disaster warning is entirely dependent on their penetration within a community and the extent to which they are used by experts such as first responders, other stakeholders, and so on (NDMA 2012).

(v) Intranet/VPN

An intranet is a segmented network of network nodes with tightly regulated access that is generally operated by a single company. Passwords, security

firewalls, and other methods are used to give access to and from the external Internet. It's also known as a virtual private network (VPN). Large traffic surges can be recognised and handled more simply, and communications can flow without concern of congestion, because all users are from the same organisation.

(vi) Amateur Radio

Amateur radio (also known as "ham radio") operators have aided their communities/countries during disasters for nearly a century by offering reliable and efficient communications to disaster response organisations at a short notice especially when conventional communications infrastructure fails by transferring emergency messages on voice mode about the well-being of survivors and information.

Amateur radio operators were the vital connection between the islands and the Indian mainland during the Indian Ocean tsunami, which damaged electrical and communications infrastructure in the Andaman and Nicobar Islands. They also assisted in the coordination of rescue and relief activities.

(vii) Community Radio

Even if there aren't many examples of community radio being utilised effectively for disaster warning, it's still a platform that can be highly useful. INCOIS has created a disaster warning system to determine the usefulness of this media.

(viii) Sirens

Sirens can be utilized in conjunction with other ICT media for final, localised delivery, however they are not always an ICT-based solution. A storm struck Bangladesh in the early 1970s, killing more than 300,000 people. However, when the government installed an elaborate early warning system, a subsequent hurricane of equal strength claimed the lives of 3,000 people rather than 300,000.

3.5 Other ICT based Initiatives (IDRN, NANADISK, NDEM)

The following are a number of ICT-based initiatives and network solutions

that have been planned/developed to assist disaster management via their transmission across different networks.

(a) The UNDP's Disaster Risk Management Programme created the Indian Disaster Resource Network (IDRN), a web-based on-line information system (ie. www.idrn.gov.in). The Indian Disaster Resource Network serves as a disaster resource inventory, storing a complete database of available material and human resources, as well as their locations, in order to respond to catastrophes quickly. It must, however, be updated on a frequent basis.

(b) The National Disaster Knowledge Network (NANADISK) was envisioned as a "Network of Networks" connecting key libraries, disaster risk reduction institutes, and Indian and worldwide data repositories. The Network's goal was to raise public awareness via information, build knowledge-based businesses, and enable training programmes via cyberspace (albeit the Network has yet to be formed).

(c) MHA created a GIS-based National Database for Emergency Management (NDEM) in conjunction with other Ministries/Agencies through NRSC in order to build communication connections among decision makers at different levels and response teams/personnel at the disaster impacted location.

3.6 Limitations in Existing Communication and ICT Support

Several communication and information technology related infrastructures are active in both the public and commercial sectors, but they are all in a "stand-alone" mode and must be properly connected. For example, the present police network works as an Intranet without allowing citizens access to this captive network, despite the fact that such access is critical in crisis circumstances. The urgent requirement is to connect them to a common network (through appropriate routers / gateways in EOCs at various levels of administration) that can be used as needed for disaster management based on existing infrastructure.

Sub-Module 4

Disaster Management Support (DMS) & National Database for Emergency Management

4.1 Disaster Management Support (DMS) Network of ISRO

The Disaster Management Support (DMS) Programme has been launched by the Department of Space (DOS) as a primary application activity to harness the benefits of space-based technology for disaster management applications in the country. As part of this effort, the Indian Space Research Organisation (ISRO) has launched a VSAT-based Virtual Private Network (VPN) on the EDUSAT Satellite in the extended 'C' Band as part of its Disaster Management Service (DMS) Program. Various centres of the Indian Space Research Organisation (ISRO) are working on various aspects of the DMS Program.

The Decision Support Centre (DSC) at the National Remote Sensing Centre (NRSC) in Hyderabad acts as a central point of delivery for aerial and space-enabled inputs, as well as other key data layers, for use in the pre-disaster, during-disaster, and post-disaster stages of disaster management. The DSC has the capability to mobilise aircraft for aerial data collection.

India is prone to many natural disasters like floods, landslides, cyclones, forest fires, earthquakes, drought, etc. Satellites provide synoptic observations of the natural disasters at regular intervals that help in better planning and management of disasters. In order to better understand the risks due to such disasters, it is necessary to integrate satellite and field based observations and to work towards risk reduction principles. Satellite communication and navigation systems also play an important role in disaster management with improved technological options.

Disaster Management Support (DMS) Programme, comprehensively addresses various aspects of natural disasters in the country, using space based inputs. ISRO disseminates relevant information in interactive geo-spatial domain through various geoportals like Bhuvan, National Database for Emergency Management

and MOSDAC for the administrators to better understand the impact and for improved decision support.

ISRO provides the satellite based near real time information support to Central Ministries / Departments and State Ministries / Departments, prior during and after major natural disasters. In addition, ISRO also provides capacity building in use of Space technology inputs in Disaster Management Support (NDMA 2012).

ISRO is actively involved with various other countries with regard to disaster management, through international frameworks, such as, International Charter 'Space & Major Disasters', Sentinel Asia, UNESCAP and so on.

4.2 Cyclones

4.2.1 Preparedness

With large coast line, India is susceptible to cyclones. It is important to understand the impacts of cyclone, with respect to its earlier footprints, low lying areas, etc, wherein satellite images provide such inputs. Using historical satellite data and Digital surface models, these inputs are derived.

4.2.2 Early Warning

ISRO uses geo-stationary and low earth orbit satellites for providing experimental inputs on cyclogenesis, cyclone track, cyclone intensity. INSAT series of satellites with frequent imaging provide the cyclone parameters for near real time analysis.

4.2.3 Response

Near real time information on inundation due to cyclones is derived, using optical and microwave SAR data and the information is provided to the concerned departments. During 2018, ISRO provided information on inundation to Odisha, Andhra Pradesh States during TITLI, PHETHAI, etc (Fig. 10).

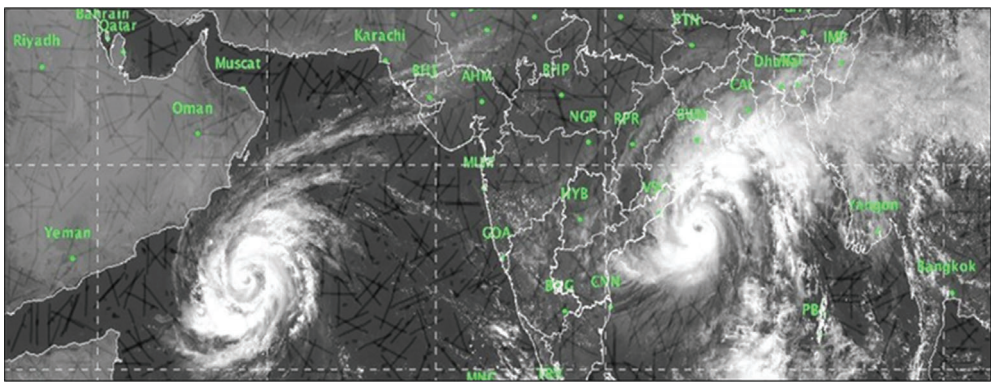


Fig. 10: Example of satellite information provided by ISRO during cyclones to various states

(Source: www.isro.gov.in)

4.3 Case Studies

4.3.1 Cyclone AMPHAN – Satellite Data for Impact Assessment

On the evening of May 20, 2020, Super Cyclonic Storm AMPHAN made landfall near Digha in West Bengal, devastating numerous regions of the state, including Kolkata. Over the cyclone-affected areas, ISRO programmed Indian and other satellites and gathered a collection of photos. The microwave pictures below show a comparison of the condition on the ground in sections of Kolkata, West Bengal, before and after the storm (Fig. 11). (https://www.isro.gov.in/disaster-management-support/cyclone-amphan)

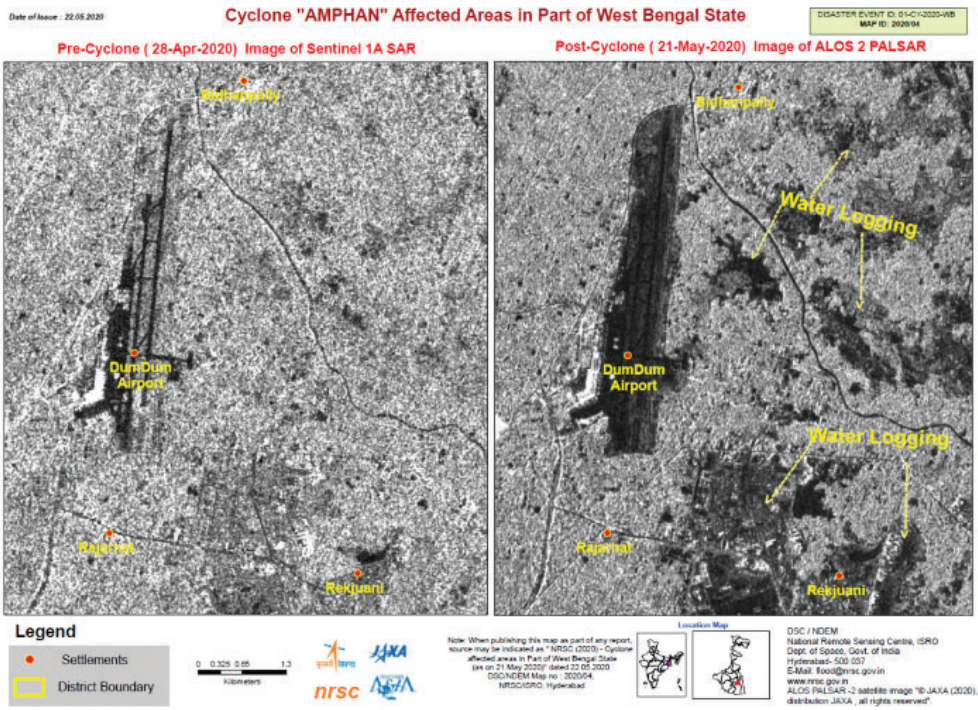


Fig. 11: Inundation in and around Dum Dum Airport, Kolkata during Cyclone AMPHAN

(Source: www.isro.gov.in)

Note: Dark colours in the images indicate wet areas / smooth surfaces. In right side image, dark colour depicts inundation due to cyclone.

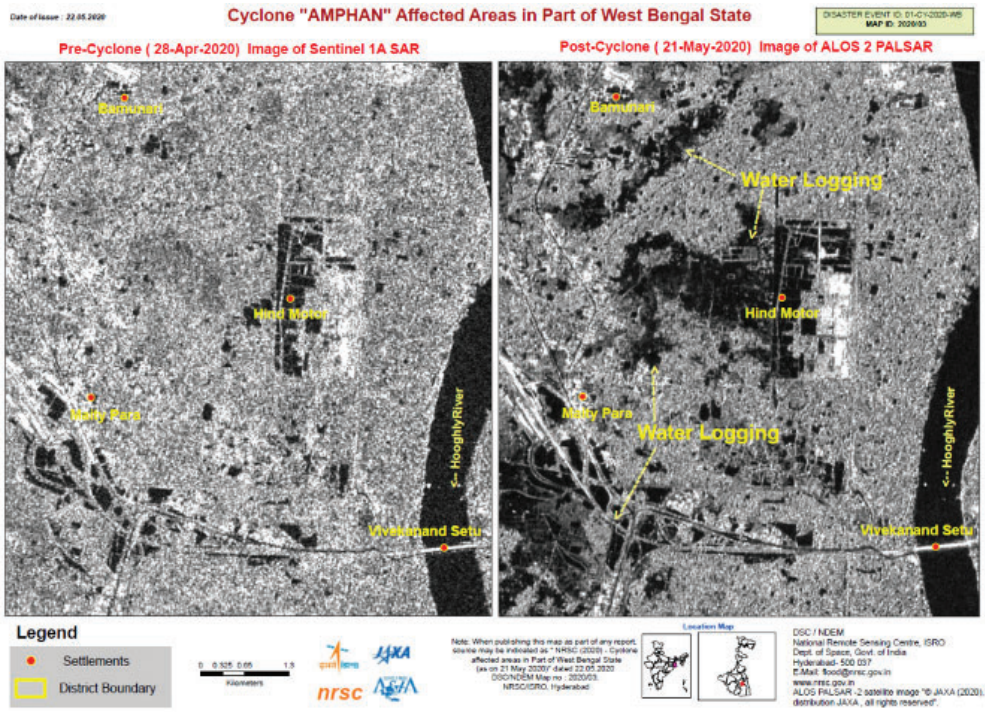


Fig. 12: Inundation near Hind Motors, Kolkata

(Source: www.isro.gov.in)

Note: Dark colours in the images indicate wet areas / smooth surfaces. In right side image, dark colour depicts inundation due to cyclone.

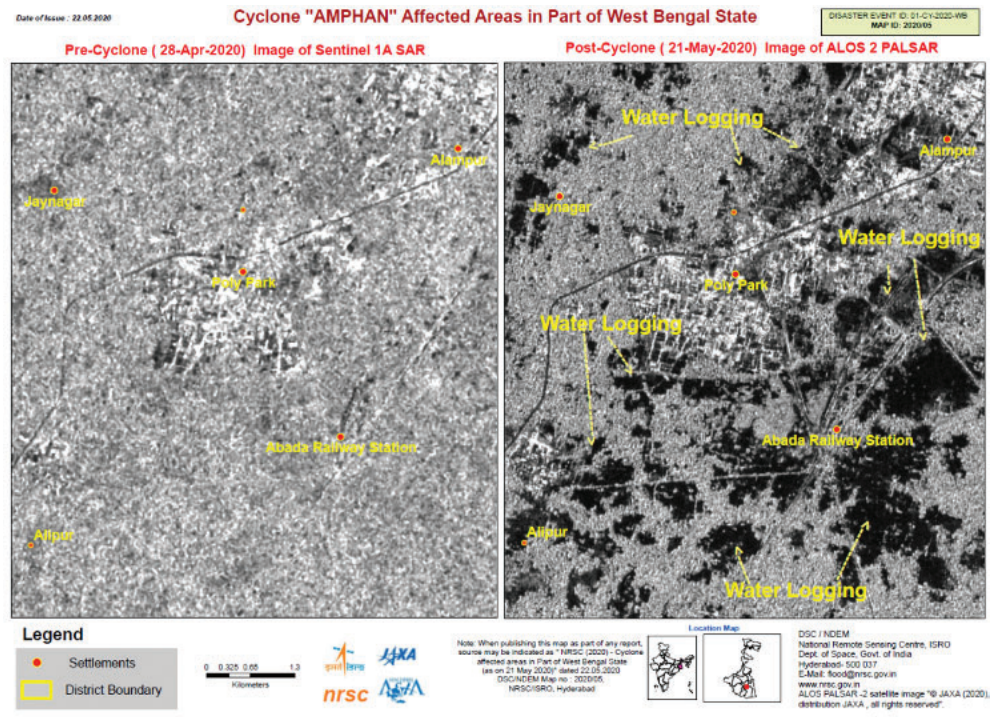


Fig. 13: Inundation near Poly Park, Dhulagori, Kolkata

(Source: www.isro.gov.in)

Note: Dark colours in the images indicate wet areas / smooth surfaces. In right side image, dark colour depicts inundation due to cyclone.

Low Lying Areas - Odisha State

For better preparedness and understanding the situation, ISRO generally provides information on low lying areas (based on Digital Surface Models, DSMs), historic inundations due to cyclones, etc. For example, this information provided in Fig. 14 to 18 helped Odisha Govt decision makers and response forces to plan their preparations during 2013 Phailin Cyclone, in a better way.

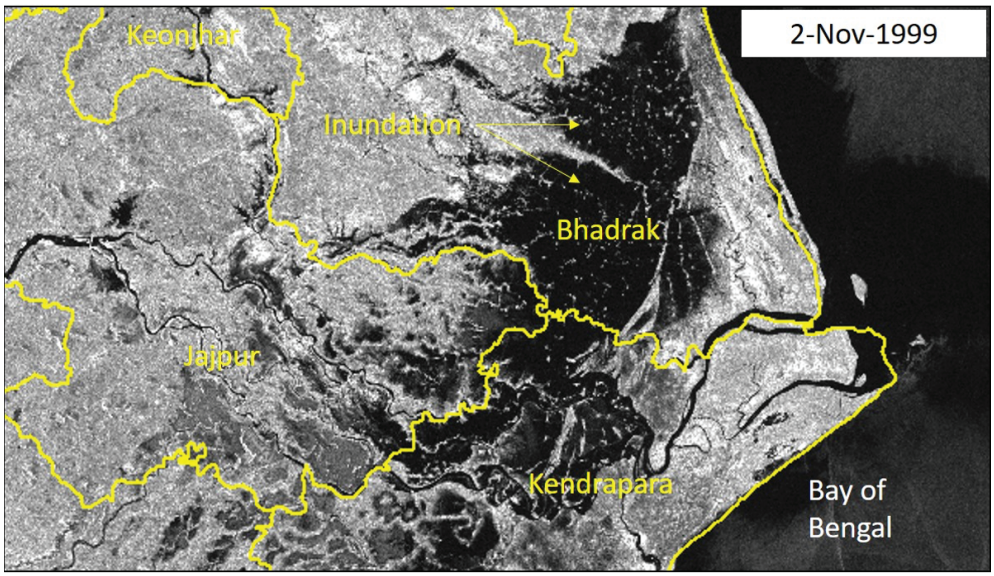


Fig. 14: Information provided by ISRO to Odisha Govt to help decision makers

(Source: www.isro.gov.in)

Inundation - Odisha State

For better preparedness and understanding the situation, ISRO generally provides information on low lying areas (based on Digital Surface Models, DSMs), historic inundations due to cyclones, etc. For example, the information provided in Fig. 15 helped Odisha Govt decision makers and response forces to plan their preparations during 2013 Phailin Cyclone, in a better way.

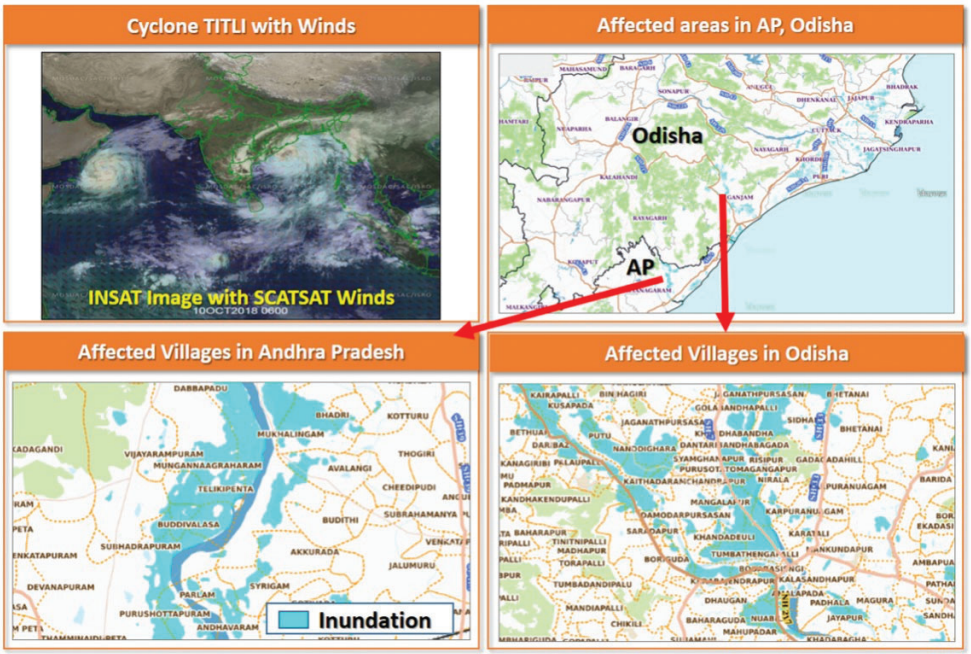


Fig. 15: Information provided by ISRO to Odisha Govt to help decision makers during 2013 Phailin Cyclone

(Source: www.isro.gov.in)

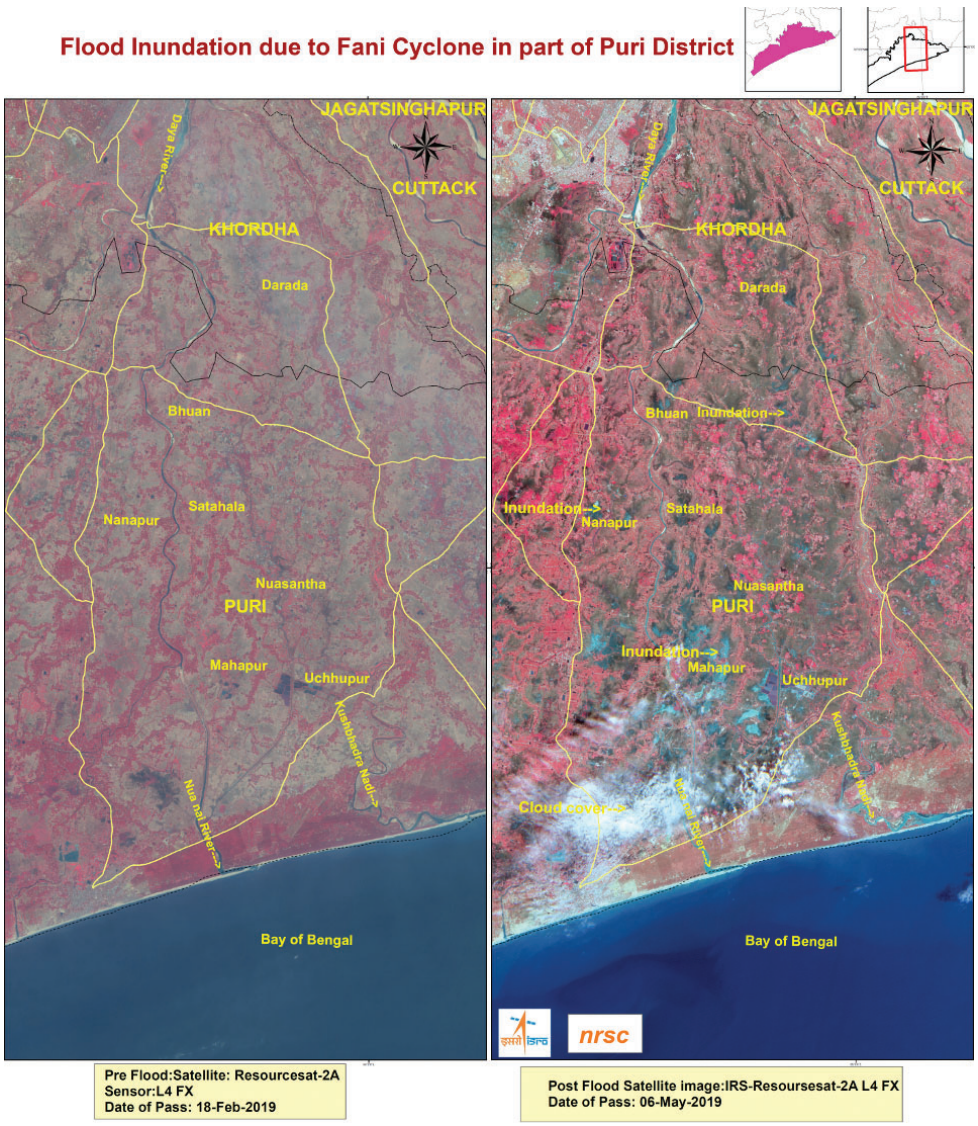


Fig. 16: Flood Inundation due to Fani Cyclone in part of Puri District

(Source: www.isro.gov.in)

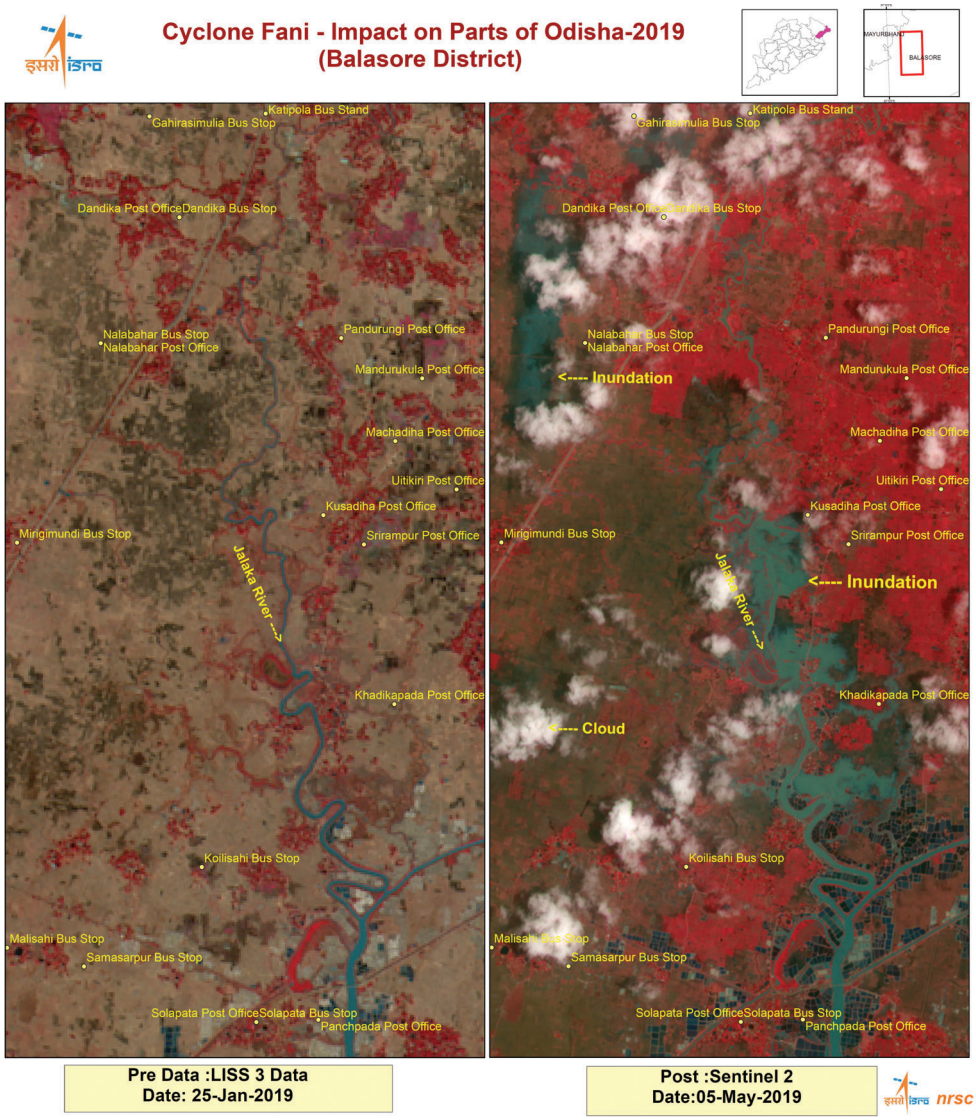


Fig. 17: Cyclone Fani - Impact on Parts of Odisha-2019 (Balasore District)

(Source: www.isro.gov.in)

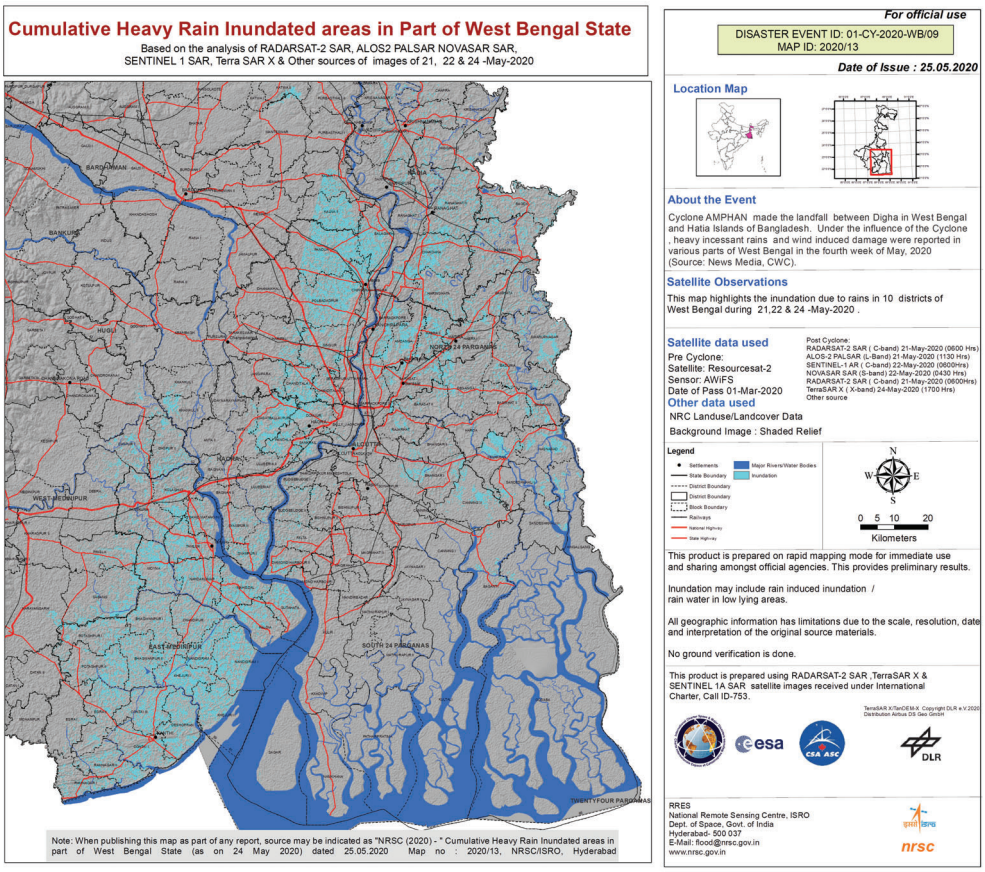


Fig. 18: Commutative heavy rain inundated areas in part of west Bengal state

(Source: www.isro.gov.in)

Note: Dark blue colours in the images indicate permanent water bodies / river. Light blue (cyan) colour depicts inundation due to cyclone.

4.4 COVID-19 - Geospatial Technology Based Solution

Department of Space/ ISRO is supporting various State Governments, by providing Geo-spatial tools and location based solutions to fight against COVID-19, including national level Corona virus tracker (Fig. 19). At the same time, ISRO also made an attempt to study various impacts due to lockdown in terms of status of atmospheric parameters and water. The department could carry out varieties of studies with different States using geospatial technology

under Bhuvan Geoportal, deployed at NRSC, Hyderabad. These tools and services have been gainfully utilised by some of the State Governments in the country.

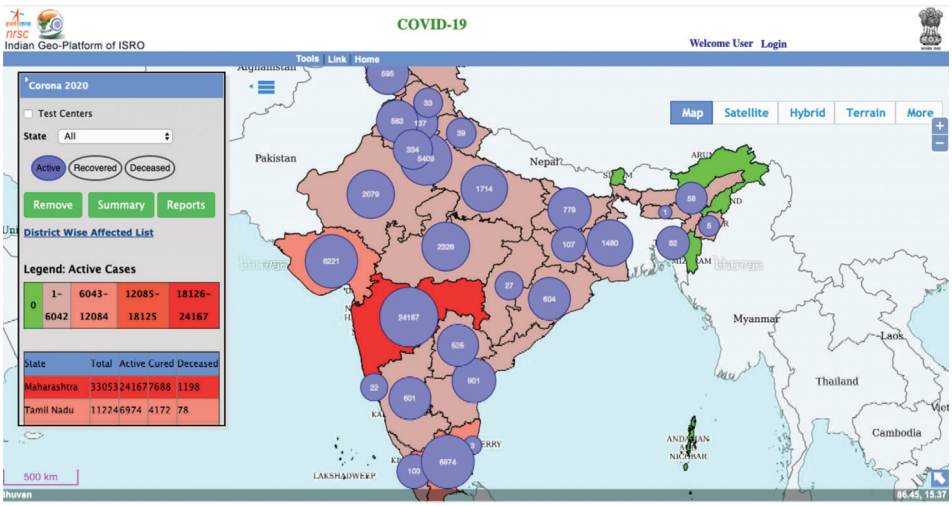


Fig. 19: Bhuvan Geo-portal showing State-wise COVID-19 cases

(Source: www.isro.gov.in)

Monitoring and managing COVID-19 in our country is quite complex as it hosts more than 1.3 billion population, in addition to a huge population of livestock and pets. NRSC, ISRO customised Geo-portal and developed 'Bhuvan-COVID-19' at national level to track the pandemic and update common public on current situation (Fig. 20).



Fig. 20: Time series information on the COVID-19 cases in the country

(Source: www.isro.gov.in)

The geoportal provides many other interest graphic presentations at national level as part of sensitising common man on the Covid-19 situation on a regular basis, based on the data presented by MoHFW portal. While the Covid-19 dashboard depicts dynamic information of the status of the pandemic at national level, many state level applications were developed and deployed, that are described as follows.

Bihar State: For Bihar State, a unique tool is deployed that helps in mapping the Epi-centre of the infections and depict containment zones Or hotspots for containment with tertiary buffer zones to manage the pandemic at field level. This is implemented as per Government stipulations to effectively fight, localise and contain the virus. This tool is helping various districts in the Bihar State for easily identifying the villages, their population, etc in the containment zones. At the same time, very high resolution satellite images are able to provide household level information for management teams to draw strategies at local level.

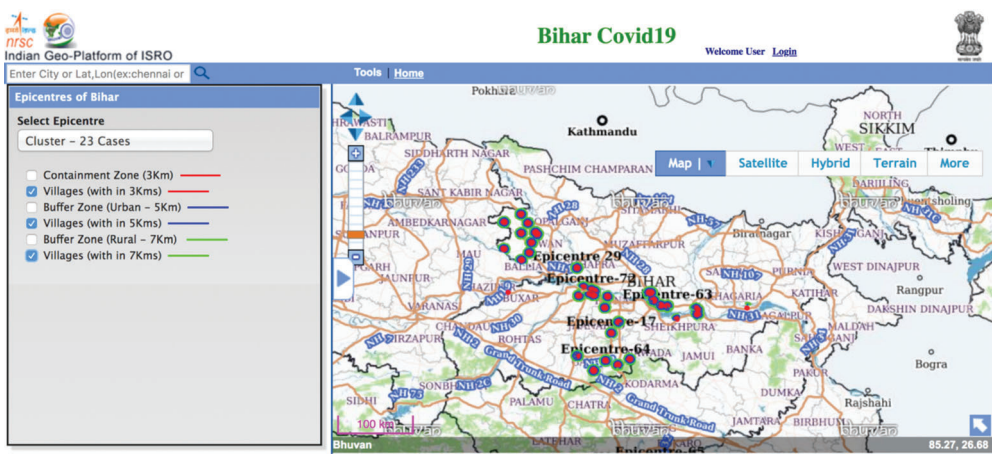


Fig. 21: Bihar State Geo-visualisation of COVID-19 cases

(Source: www.isro.gov.in)

4.5 Floods

4.5.1 Preparedness

Based on integration of historic satellite datasets acquired during major floods in different States, flood hazard map layers were prepared for Assam, Bihar, Odisha, Andhra Pradesh, Uttar Pradesh, West Bengal and Entire Country.

4.5.2 Early Warning

Using hydrological modelling of satellite and ground based hydro-meteorological inputs and digital elevation models, experimental spatial flood early warning systems are established for selected river reaches like Andhra Pradesh (Godavari), Odisha (Mahanadi) and Assam (Brahmaputra).

4.5.3 Response

Near real time information on flood inundation is derived on an operational basis using optical and microwave SAR data and the information is provided to the concerned departments of Kerala, Assam, Bihar, Uttar Pradesh, Odisha and Andhra Pradesh States.

4.5.4 Flood Inundation Footprints-India

a. Bihar Floods in 2019

Bihar experienced severe floods in 2019, three waves of flood hit the state of Bihar over a period of four months, causing major flooding problem and damage to life and property in many parts of Bihar. Flood layers and value added products were provided to the concerned State and Central Disaster Management departments Bhuvan and NDEM Geo-portals. Almost 20 lakh hectare area covering in 34 districts of Bihar was observed to be affected by floods. Satellite images showing flood inundation in part of Darbhanga District, Bihar State (2019) is represented in Fig. 22 and detail view of flood inundation in part of Darbhanga District (2019) is represented in Fig. 23.

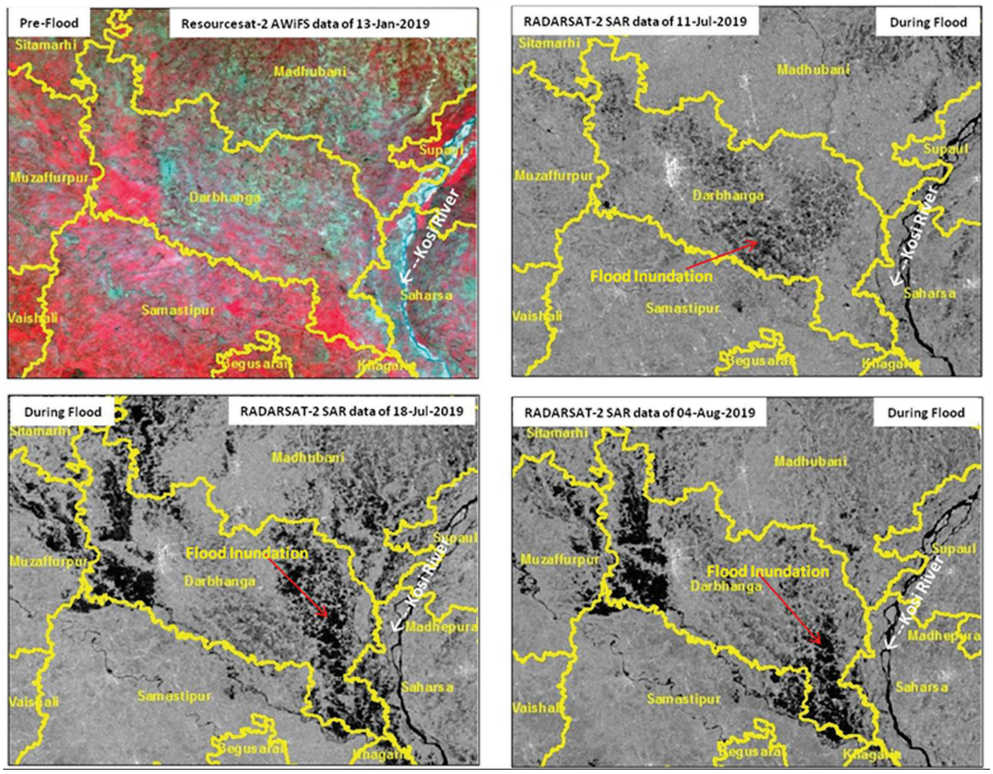


Fig. 22: Satellite images showing flood inundation in part of Darbhanga District, Bihar State (2019)

(Source: www.isro.gov.in)

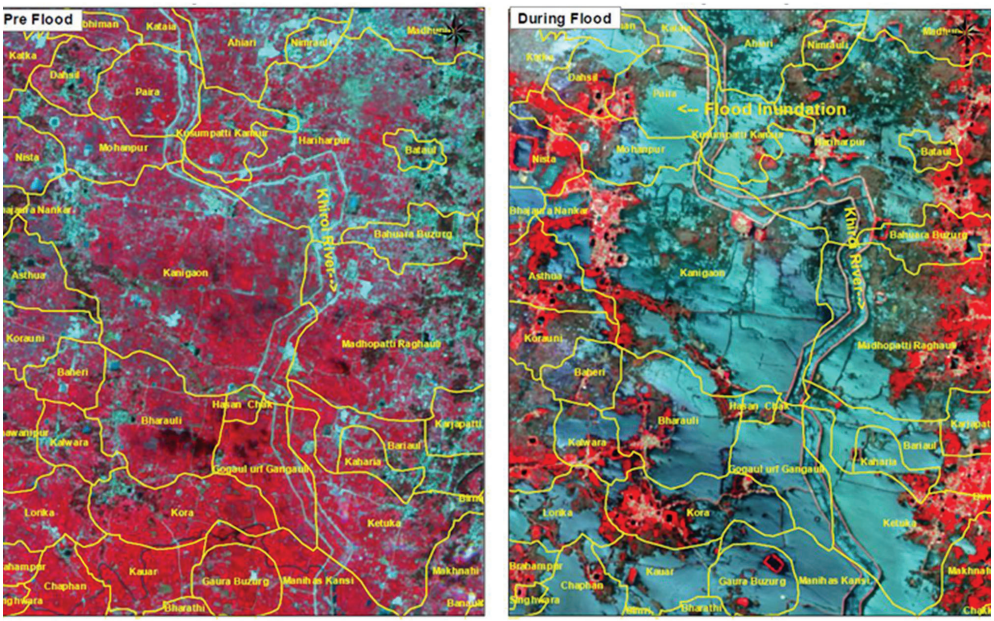


Fig. 23: Satellite images showing detail view of flood inundation in part of Darbhanga District (2019)

(Source: www.isro.gov.in)

b. Rishikesh-Badrinath Route - Uttarakhand

Rain induced landslide early warning system is developed for selected pilgrim routes in the country, on experimental basis. This system is designed by integrating the rainfall intensity forecast with landslide hazard zones prepared for the routes. Fig. 24 Illustrate the probability of occurrence of landslide along Rishikesh-Badrinath route, Uttarakhand State. In rainy season, these could be interactively used on Bhuvan Geoportal.

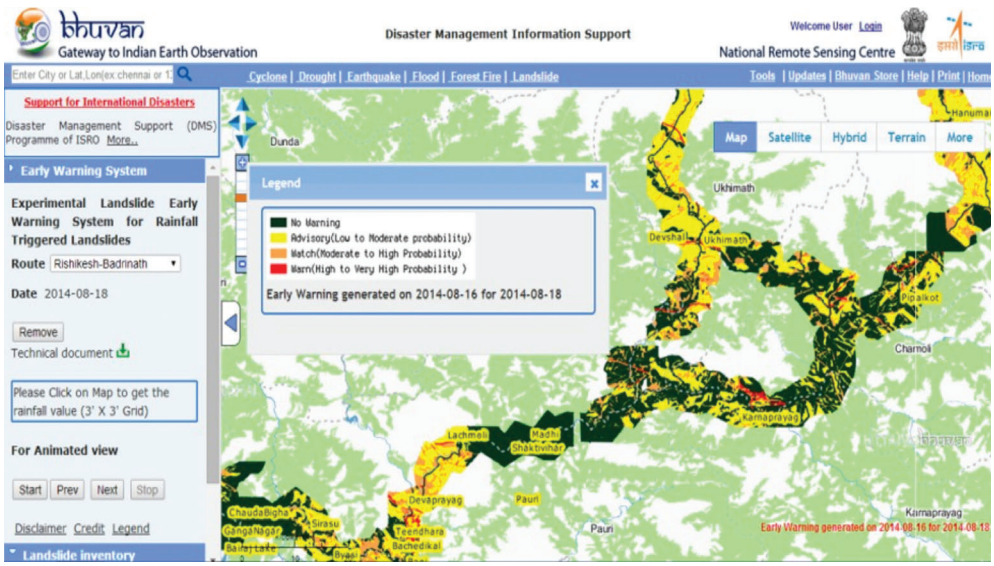


Fig. 24: Illustration showing probability of occurrence of landslide along Rishikesh-Badrinath route, Uttarakhand

(Source: www.isro.gov.in)

4.6 Landslides - Karnataka

Landslides occurred in Kodagu, Karnataka due to heavy rainfall in August, 2018. These events resulted in many damages to existing infrastrucure in Dakshina Kannada and Kodagu districts. Over 900 landslides were identified in various taluks of Kodagu, Dakshina Kannada and other districts of Karnataka using synoptic satellite data coverages. These were made available to GSI, Karnataka State Disaster Monitoring Centre and others (Fig. 25).

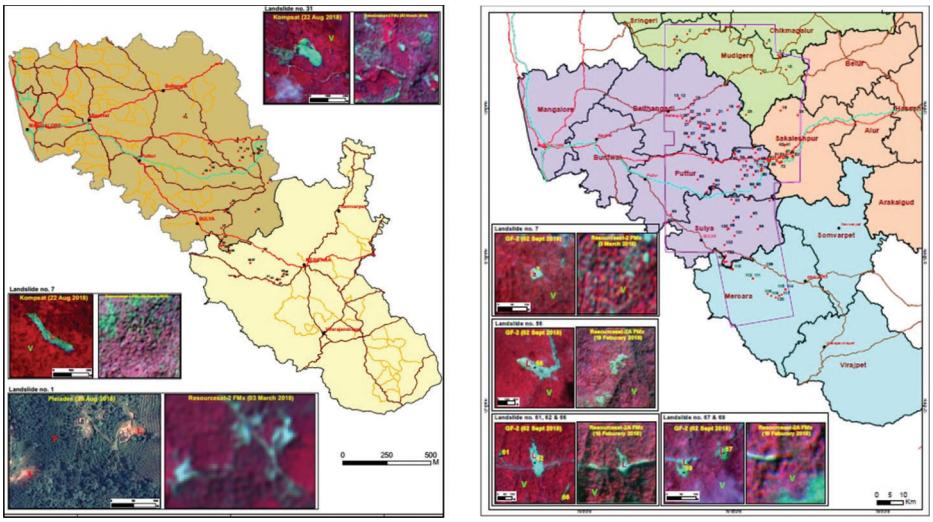


Fig. 25: Information provided by ISRO to GSI, Karnataka State Disaster Monitoring Centre and others

(Source: www.isro.gov.in)

4.7 Forest Fires

4.7.1 Preparedness

ISRO prepares Forest Fire Regime maps using historical forest fires observed from satellite data. These maps help in identifying critical areas where forest fires are prevalent and the average duration of forest fires. These details help the decision makers.

4.7.2 Early Warning

Many attempts are made to use multi-criteria approach in GIS environment to provide early warning and vulnerability maps. More research in such area further continued on experimental basis.

4.7.3 Response

ISRO regularly prepares Forest Fire alert maps using satellite data and provides to FSI and other State Forest Departments. This near real time data dissemination through Bhuvan Geoportal and SMS alerts help forest department for taking quick action. During 2018, burnt area assessment was done for Uttarakhand, Jammu & Kashmir and Tamilnadu.

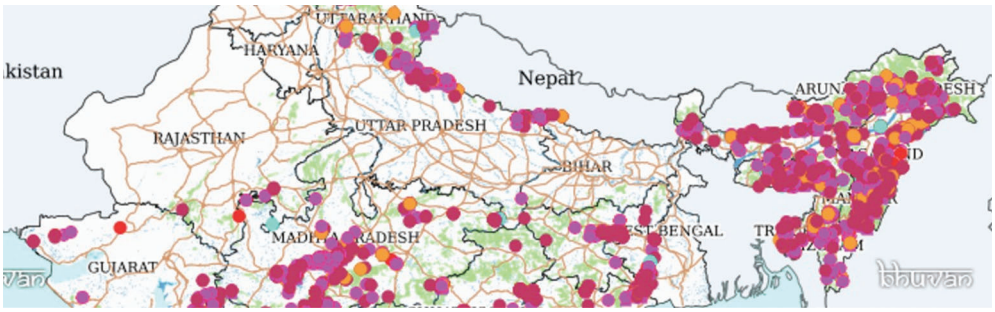


Fig. 26 Burnt area assessment information provided by ISRO

(Source: www.isro.gov.in)

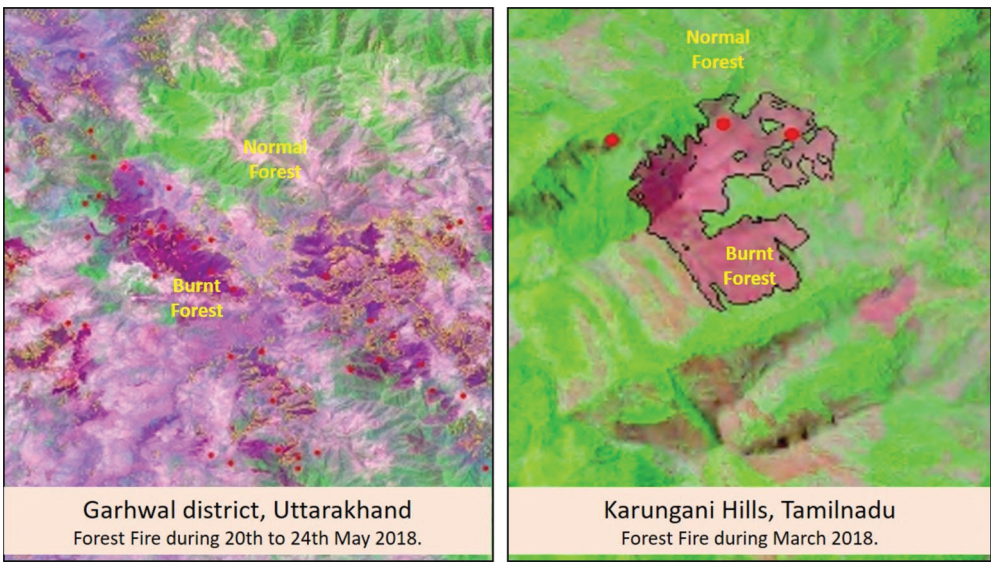


Fig. 27: Forest fire in Garhwal district, Uttarakhand and Karungani Hills, Tamilnadu

(Source: www.isro.gov.in)

4.8 National Database for Emergency Management

The Committee of Secretaries (CoS) has entrusted the responsibility of implementing NDEM to NRSC/ISRO. NDEM is GIS based National Repository for entire country coupled with a set of Decision Support System tools to assist in disaster management. The objectives of NDEM are represented in Fig. 28.



Fig. 28: Objectives of NDEM is represented
(Source: www.isro.gov.in)

NDEM V 3.0 is equipped with comprehensive multi-scale database, decision tools and Mobile Apps.

- Monitoring Departments: MHA, NDMA, PMO, NIDM, IDS
- Forecasting Departments: IMD, CWC, INCOIS, SASE
- Relief & Rescue Forces: NDRF, SDRF
- State Disaster Departments: All State/UTs DM Dept. officials
- District Disaster Departments: 718 Districts from all state & UTs

Note: MHA – Ministry of Home Affair; NDMA – National Disaster Management Authority; PMO – Prime Minister Office; NIDM – National Institute of Disaster Management; IDS – Indian Defence Services; IMD – Indian Meterolocal Department; CWC – Central Water Commission; INCOIS - Indian National Centre for Ocean Information Services; SASE - Snow & Avalanche Study Estt; NDRF – National Disaster Response Force

Sub-Module 5

GIS-Based National Disaster Management Information System

5.1 Introduction

Natural disasters, unlike man-made disasters, cannot be avoided at the current level of scientific and technological. However, adequate mitigation and preparedness measures, commensurate with the amount of resources and technology available, can reduce the impact of natural disasters in terms of loss of life, property, and environmental damage.

To determine the degree of perceived risk, mitigations and preparedness programmes should be based on (i) the level of protection targeted (e.g., protecting lifeline resources/infrastructures requires a higher level of protection to ensure that these vital resources/infrastructures survive the worst possible hazard impact) and (ii) the level of science and technology base along the level of mitigation.

5.2 Knowledge-based Tools for Holistic DM

Over the last decade, significant developments in computing capabilities have provided huge storage space at a low cost, while improvements in the INSAT system's communication and meteorological capability have been operationally employed to detect, monitor, and predict cyclones.

Inundation mapping of all significant floods in the country, drought severity assessment using satellite data on fortnightly/monthly time scales, landslide zonation of pilgrimage routes in the Himalayas, and cyclone monitoring and damage assessment are examples of recent successes. The capacity of the Global Positioning System (GPS) to precisely pinpoint the location of a place is being utilised to track plate tectonic ground movements (NDMA 2012).

5.2.1 Development of Vulnerability Analysis and Risk Assessment Tools

The "Vulnerability Analysis and Risk Assessment" (VA&RA) of people, habitats,

and infrastructures in various regions of the country with respect to various natural hazards is the single most important scientific tool that needs to be deployed for empowering stakeholders at all levels of administration.

5.2.2 Development of Decision Support System (DSS) in Virtual Environment

There are a number of different Decision Support System tools that are required during and after an event, such as the Vulnerability Analysis and Risk Assessment (VA&RA) tool for pre-event scenarios. Timely information on the location, advancement, and regression of disasters at various stages of the disaster portrayed in a dynamic map is critical for effective disaster management, and this can be produced in a Geographic Information System (GIS) linked to the Global Positioning System (GPS), derived by integrating real-time space-based imageries of the hazards with the corresponding data.

When a flood or cyclone warning is issued, immediate action should be taken to reduce the effect, for which scientific inputs in the form of knowledge-based DSS should be made accessible to district authorities in a ready-to-use manner. The major focus should be on the event's anticipated effect in terms of the size of the impacted region, location specific characteristics, population affected, and the availability of resources for people evacuation and relief, as well as a fast evaluation of damages (NDMA 2012).

The Geographic information system allows for easy visualisation of the disaster's dynamics over time and the preparation of appropriate action plans for rescue and relief as well as post-disaster scenarios, which can then be distributed to various stakeholders such as disaster response personnel, incident commanders at EOCs for faster and effective execution with outstanding coordination. Instead of forecasting cyclones in terms of time and space or floods in terms of rainfall data/rise in water level, it would be most desirable and effective if the initiation, progression, and recession scenarios could be customised in terms of cyclone / flood influenced area and likely infrastructure damages expected (NDMA 2012). Because of their vulnerability to various catastrophe types, such a study might reveal regions that should be rezoned or controlled.

Similarly, because most disasters have unique features, the availability of a computerised virtual environment would enable a simulation system for evaluating disaster preparedness in a computerised environment in the pre-

event scenario. It would improve the ability to test under various circumstances and determine the needed adjustments in response frequently with a large number of preparation factors in a short amount of time and at a low cost.

In the absence of such simulated testing, full-scale mock drills or catastrophe simulations can be used to assess readiness. However, these must be thoroughly designed, implemented, and assessed in order to be comprehensive enough to test all aspects and functions of preparation.

5.3 Rationale for Establishment of NDMIS

In view of the critical requirement for disaster management tools such as VA & RA and DSS (rather than depending just on voice, data, or video), NDMA should build a National Disaster Management Information System (NDMIS) to offer the required knowledge-based information to be built on a GIS platform. NDMIS is a loosely defined system of hardware and software for collecting, storing, retrieving, mapping, and analysing geographic, demographic, topographic, infrastructural, socioeconomic data, and other data across the country. Such data are overlaid on a digitised base map (prepared at the appropriate scales with necessary contour intervals) and hazards profile data in conjunction with satellite imagery to generate knowledge-based information such as the VA&RA tool, computerised virtual environment for use in pre-event scenarios (ii) and Decision Support Systems (DSSs), which are the most effective em (NDMA 2012).

5.4 Development of NDMIS

The advancement of NDMIS, on the other hand, necessitates the availability of the following technical inputs:

(i) Digital Cartographic Base at appropriate scales and contour intervals;

(ii) India's upgraded hazard maps in terms of various natural hazards (in terms of locations, frequency, duration, and intensity); and

(iii) GIS – database linked with GPS.

The GIS-Database is subsequently described in more depth.

5.4.1 GIS-Database

The data requirements for hazard/emergency management may be divided into two categories: core data sets and hazard-specific geospatial data. Core data sets and hazard-specific data (must be acquired from many sources and brought to a single platform with well-defined standards and suitable format), as well as dynamic data in spatial and non-spatial forms, are the geospatial data needs for disaster management. To make decision-making more effective and objective, geographical data must be connected to non-spatial information such as socioeconomic and infrastructural data. The core data sets are those that are usually required for catastrophe management (e.g. topographical, hydrological, socio-economic, infrastructural details etc). Hazard-specific geographic data sets are geospatial data sets that are unique to a certain hazard or emergency, such as a cyclone, flood, landslide, earthquake, fire, structure collapse, and so on (fig 28).

Input Maps GPS enabled Field Data, such as topographical sheets from Survey of India, Soil taxonomy map, etc., and Satellite Data (Indian Remote Sensing (IRS) data) are the key components of a multi-layered GIS for Disaster Management. For usage in GIS software, all geographically referenced data is modelled as either a Vector data model or a Raster data model. Furthermore, issues such as data uniformity and standardisation, data appropriateness and quality, and the need for conversion, as well as database organisation in Relational Database Management System (RDBMS), digitization of input maps, layer formation, attribute attachment, and development of digital base map, would be major tasks.

5.5 Participatory Agencies and Nodes in NDMIS

Some of the aforementioned nodes, such as GSI, IMD, CWC, NRSA, INCOIS and others, have been recognised as big volume data providers for NDMA (NEOC) and NCMC (PMO) decision making and are therefore classified as major nodes with a data transfer rate of 2Mbps between them. With 512Kbps data connections, the SEOCs are identified as user nodes. The user nodes are originally SEOCs located in the capitals of states that are prone to several hazards. In Phase II, there will be 182 user nodes, and in Phase III, there will be 433. The nodes are divided into two groups: main nodes and user nodes.

The major nodes are either data repository nodes (NRSA, MHA) or those with substantial data transport requirements (INCOIS, IMD, and so on). State

Emergency Operations Centers (SEOCs) in the capitals of multi-hazard-prone states are generally the user nodes (22nos in Phase I).

5.6 Active Players of NDMIS

The NDMIS system is GIS repository for data and services from a system perspective and is a geographically distributed network of users accessing a centralised national-level GIS repository for data and services from a system perspective. Being a complicated system with a centralised database and its own set of users on one end and participating end-user agencies on the other. Clients, Data producers, Data validators, Information creators (service providers), and Security managers are some of the system's most active participants.

5.7 Approaches to Establishment of NDMIS

The whole NDMIS and Communication System must be developed and executed with the following requirements in mind Disaster management stakeholders such as decision makers, local authorities, threatened community etc. Requirement for rescue and relief teams at catastrophe sites should be paid special emphasis. Domain Functions for disaster management needs to be prioritised. Interaction, coordination and execution needs to be strengthen via horizontal domain communication and vertical domain communication for command & control purpose.

NDMIS and Communication System needs to be strengthened for assisting in disaster affected sites.

5.8 Special Features for Design of NDMIS

Some of the specific features involved play a vital role in the effective design of NDMIS systems and network architecture. The following are some of the most essential NDMIS components:

- Data Preparation and Validation
- Documentation

- Quality
- Data Availability
- Replication and Mirroring Management
- Interoperability
- Performance and scalability
- Performance
- Scalability
- Application Services
- Security and Protection of Data
- Impact of Enhanced Security Levels on System Response
- Data Protection

Sub-Module 6

Satellite Communications for Disaster Management

6.1 Introduction

Every disaster has its own set of difficulties, needs, conditions, and context. However, there are two recurrent variables that apply to all situations: the site of the disaster and the exact timing of the disaster are both unexpected. There is a risk of loss of life, property, and infrastructure in every catastrophe event. When any area's communication infrastructure is damaged, satellite communication plays a role, and satellite technology plays an undeniably important role in catastrophes, particularly in re-establishing communication ties. Small aperture earth stations, including as fixed VSATs, vehicle-mounted earth stations (VMES), and transportable earth stations, are the most feasible alternatives for providing emergency telecommunication services for relief efforts in any crisis situation. Both catastrophe victims and those participating in emergency response operations rely on such communication linkages. Satellite communications are very resilient (physically and in terms of redundancy), independent of terrestrial infrastructure, and capable of providing load sharing and surge capacity solutions for bigger locations.

There are several benefits associated with use of using satellite communications such as ubiquitous coverage, instant infrastructure, independent of terrestrial infrastructure, temporary network solutions, rapid provisioning of services etc. Satellite communications such as VSATs, mobile-satellite terminals, ancillary equipment etc can carryout a variety of functions such as voice and data communication, position information transmission, crucial image transmission, field reporting, data collection etc.

6.2 Case studies

6.2.1 Chamoli, Uttarakhand Flash Floods: 7 Feb, 2021

The 2021 Uttarakhand flood, also known as the Chamoli disaster, began on 7 February 2021 in the environs of the Nanda Devi National Park, a UNESCO World Heritage Site in the outer Garhwal Himalayas in Uttarakhand state, India. It

was caused by a large rock and ice avalanche consisting of material dislodged from Ronti peak. It caused flooding in the Chamoli district, most notably in the Rishiganga river, the Dhauliganga River, and in turn the Alaknanda—the major headstream of the Ganges. At least 72 people were confirmed to have been killed (Wikipidia 2021).

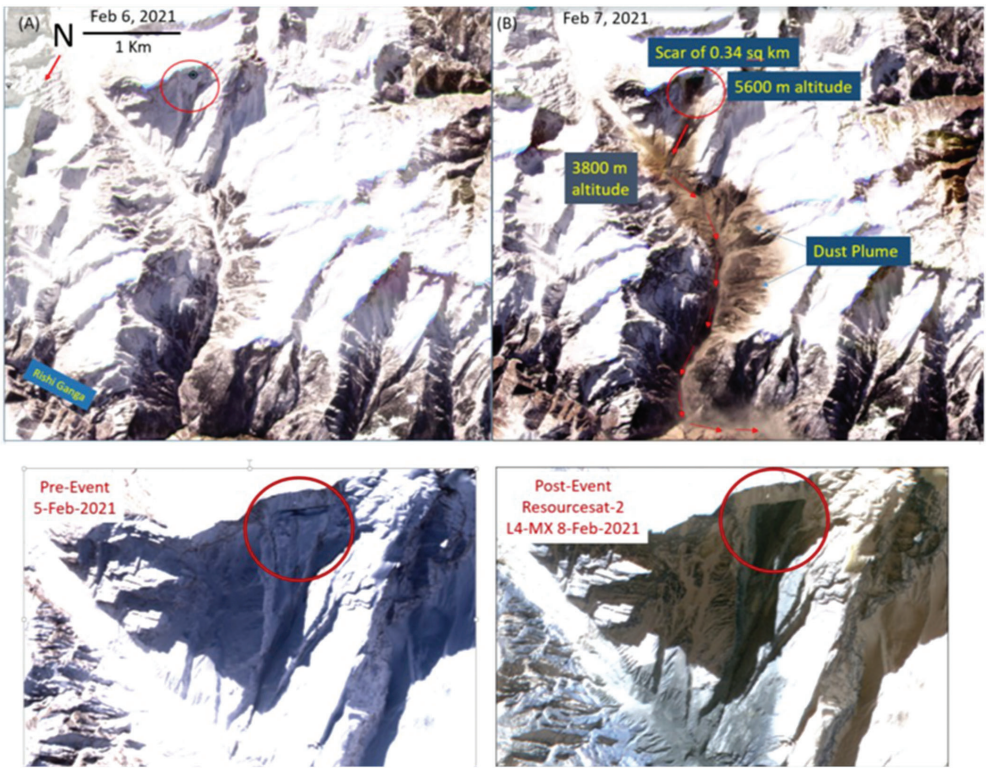


Fig. 29: Maps generated by ISRO for Chamoli, Uttarakhand Flash Floods: 7 Feb, 2021

(Source: www.isro.gov.in)

6.2.2 Haiti Earthquake 2010

In January 2010, Haiti was struck by a huge earthquake. To assess the extent of damage to infrastructure and monitor state of the country experts used satellite images. During this event, crucial data such as detection of damaged roads and bridges for enabling intel and aid agencies to send supplies to those in

need was extracted using satellite technologies. On 12 January 2010, a severe earthquake struck Haiti. The after image represented in fig 30, acquired on 18 August 2010 shows which buildings are still destroyed, where new buildings have been erected and the exact distribution of makeshift shelters. The changes in the buildings were automatically recorded. The DLR Earth Observation Center used processing methods based on machine learning and data from the remote sensing satellite GeoEye-1, which has a resolution of 0.5 metres (DLR 2021).

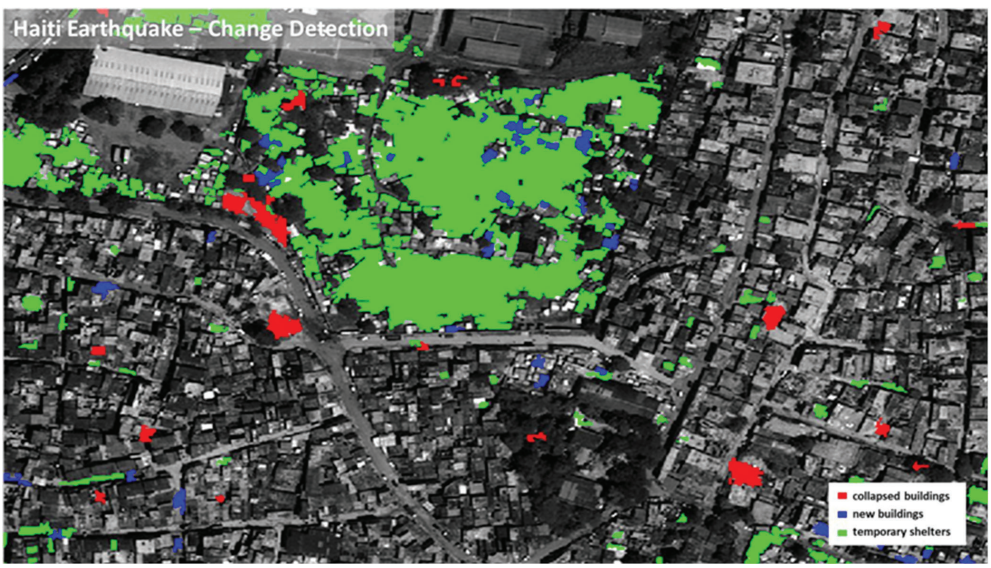


Fig. 30: Haiti earthquake change analysis.
(Source: GeoEye-1 satellite data, processed by DLR)

6.2.3 Wild Fire Portugal, 2017

In 2017, Altice/PT, a telecommunications provider, deployed satellite backhaul as a backup service for the terrestrial network to overcome the limitations of terrestrial networks during seasonal wildfires in Portugal in June 2017. When the terrestrial backhaul failed, a satellite was used to connect the core network until the terrestrial backhaul network was restored. NASA's Terra satellite collected this natural-color image with the Moderate Resolution Imaging Spectroradiometer, MODIS, instrument on June 18, 2017 represented in Fig. 31. Actively burning areas, detected by MODIS's thermal bands, are outlined in red. Smoke pours out of the fiery region and drifts north. Smoke is also seen drifting into Spain as well (NASA 2021a).



Fig. 31: Natural-color image collected NASA's Terra satellite collected (NASA image courtesy Jeff Schmaltz LANCE/EOSDIS MODIS Rapid Response Team, GSFC)

(Source: NASA 2021a)

6.2.4 Nepal Earthquake 2015

The 2015 Gorkha Nepal earthquake struck Central Nepal on 25th April 2015, with earthquake magnitude of 7.8 M, caused tremendous damage and loss with 8,857 death, 22,304 injuries and estimated 10 billion US dollar (about 50% of Nepal's nominal GDP). Post disaster assessment showed that majority of the building affected were stone/brick masonry structures lacking structural design, whereas the most of RCC buildings were undamaged. When all the local communication system collapsed, satellite communication, community

Radio stations played an important role in restarting the vital link to help the affected community after the earthquake. The community radio services were broadcasting from tents and open air. NASA data and expertise provided valuable information for the response to the April 25, 2015, magnitude 7.8 Gorkha earthquake in Nepal (Fig. 32). The quake has caused significant regional damage and a humanitarian crisis. It was the strongest earthquake to occur in that vicinity since a magnitude 8.0 quake there in 1934 that caused more than 10,000 fatalities (NASA 2021b).

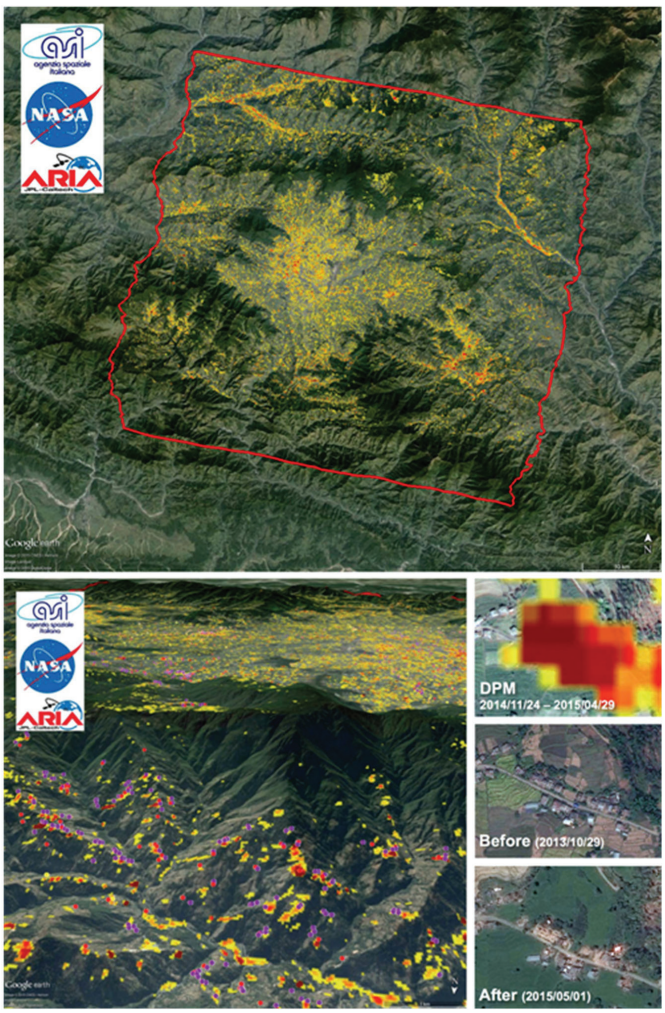


Fig. 32: NASA-Generated Damage Map to Assist with 2015 Gorkha, Nepal Earthquake Disaster Response

(Source: NASA 2021b)

6.2.5 China Earthquake 2008

On May 12, 2008, Sichuan Province in People's Republic of China was struck by one of the most catastrophes earthquakes with measured 8.0 M, the death toll has reached about 69,227 deaths, 374,643 injuries, 17,923 missing and an estimated direct economic loss of 845.2 billion RMB. The communication network was completely cut-off in some of the worst affected areas, while communications in other areas were facing high congestion due to drastically increased traffic. In this situation, satellite technologies stepped in to provide emergency communications and the vital on-ground information.

Satellite communication can support governments, UN agencies, NGO-aid agencies, military forces, hospital organisations, airlines, and television networks when natural disasters occur. Information can be distributed over large areas and can be used to inform agencies and enable them to make better decisions, coordinate help and intervention, inform the population and announce relief provisions, and take preventative actions to minimise damage. Satellite images of the Beichuan area of Sichuan, released by Taiwan's National Space Organisation in the days after the 12 May earthquake, showed huge landslides are represented in Fig. 33. The river running down from the mountains and through the devastated town of Beichuan was blocked by earth (seen as brown). Roads were covered and buildings swept away. Locked rivers formed about 30 lakes in the earthquake zone, like the one illustrated here, upstream of Beichuan. Lakes like this pose a serious flood risk to people living downstream. Creating channels to drain the lakes before any flooding can occur is a key task for the Chinese authorities.

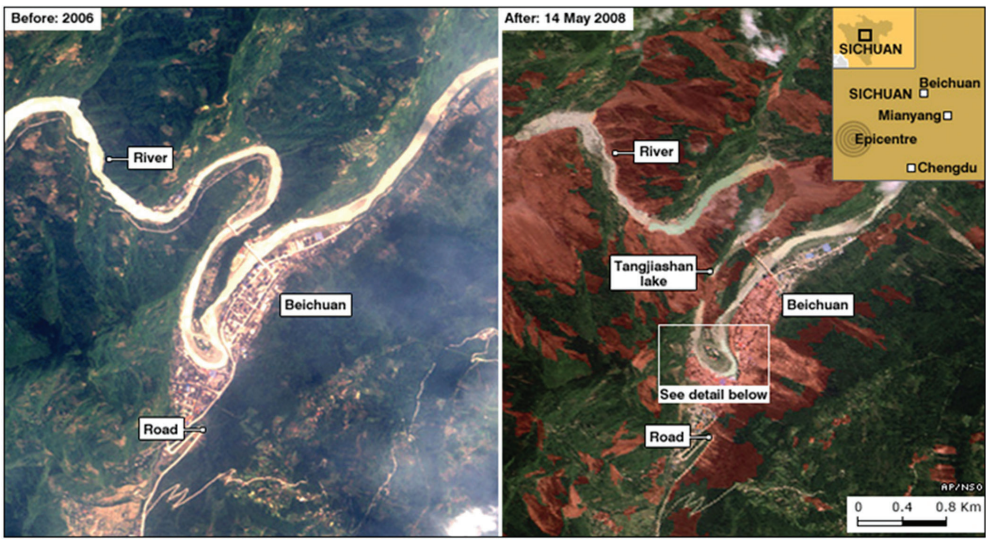


Fig. 33: Satellite images of the Beichuan area of Sichuan, released by Taiwan's National Space Organisation in the days after the 12 May earthquake, showed huge landslides

(Source: BBC 2021)

6.3 ISRO Satellites for Disaster Management Applications

Satellite Communication utilisation has become wide spread and ubiquitous throughout the country for such diverse applications like Television, DTH Broadcasting, DSNG and VSAT to exploit the unique capabilities in terms of coverage and outreach. The technology has matured substantially over past three decades and is being used on commercial basis for a large number of applications. Most of us are touched by satellite communication in more ways than we realize (ISRO 2021).

The potential of the technology for societal applications continue to fascinate ISRO and efforts are on to leverage the benefits of technology to the betterment of mankind. Important initiatives pursued by ISRO towards societal development include Tele-education, Tele-medicine, Village Resource Centre (VRC) and Disaster Management System (DMS) Programmes. The potential of the space technology for applications of national development is enormous (ISRO 2021).

Table 1: Satellites for Disaster Management Applications

Launch Date	Launch Mass	Launch Vehicle	Orbit Type	Application	Remarks
EOS-01	Nov 07, 2020		PSLV-C49/ EOS-01	LEO	Disaster Management System, Earth Observation
RISAT-2BR1	Dec 11, 2019	628 Kg	PSLV-C48/ RISAT-2BR1	LEO	Disaster Management System, Earth Observation
RISAT-2B	May 22, 2019	615 Kg	PSLV-C46 Mission	LEO	Disaster Management System, Earth Observation
INSAT-3DR	Sep 08, 2016	2211 kg	GSLV-F05 / INSAT-3DR	GSO	Climate & Environment, Disaster Management System
INSAT-3D	Jul 26, 2013	2060 Kg	Ariane-5 VA-214	GSO	Climate & Environment, Disaster Management System

Source: (ISRO 2021. https://www.isro.gov.in)

Sub-Module 7

Emergency Operations Centres: Connectivity, Database & Applications Development

7.1 Introduction

In the event of a crisis, the Emergency Operation Centres (EOCs) is a central command and control centre responsible for implementing disaster preparedness and disaster management concepts at a strategic level. All EOCs have the same basic functions: collect, evaluate, and analyse data; make choices that safeguard life and property, preserve organisational continuity, and adhere to relevant laws; and distribute those decisions to all affected organisations and persons.

After receiving the first information about the incidence of a major natural disaster, the Emergency Operation Centres (EOCs) operate at full capacity around the clock for a period determined by the concerned nodal ministry in order to effectively deal with the crisis that results from the disaster (NDMA 2012).

7.2 Flow of Information for EOCs at Different Levels

The information flow and information needs for disaster management in EOCs may be divided into two categories namely a) Command and Control Purpose and b) for Interaction, Coordination and Execution purpose. The information flow for Command Control is vertical, whereas that for interaction, coordination, and execution is horizontal.

7.2.1 For Command and Control

For the command and control, the information flow is as given below

i) NDMA ⟷ SDMA and NDRF (Two way Communication)

ii) SDMA ⟷ DDMA and NDRF (Two way communication)

iii) DDMA ⟷ NDRF (Two way communication)

7.2.2 For Interaction, Coordination & Execution

For interaction, coordination, and execution in the horizontal domain, the NDMA is linked with Early Warning/Forecasting agencies (NRSC, NTRO, CWC, IMD, GSI, SAC, NCP/INCP and CBOs/others), important central government agencies (PMO, NCMC, MoD, NEC, MEA, NIDM, NIC, and BSNL), and various Emergency Support Functionaries (NDMA 2012).

In the horizontal domain, equivalent and analogous connections, as applicable at the SDMA/DDMA level, must be identified and designed for interaction, coordination, and execution.

7.3 Functional Role of NEOC of NDMA

(i) Maintain cartographic base with GIS platform for all the districts (with priority to multi-hazard prone districts) at appropriate scales along with Hazard Profile Information of the Districts and carryout VA & RA at appropriate scales for various applications in DM continuum and Decision Support Systems in advance (NDMA 2012).

(ii) Develop DMIS for prevent ion, mitigation, preparedness and capacity development programme at various levels of administration in a proactive approach.

(iii) Receive Early Warnings to disasters (in a pro-active approach to DM), from EW Agencies and convey the same time-sensitive warnings to the affected community in multimode, multi-lingual & in real/near real time basis.

(iv) Cater for real/near real time situation awareness for management, the response forces and also, for general public and media. System should provide shared common picture of the disaster site to various management and response constituents and also, for media briefings and bulletins.

(v) Receive data in the horizontal domain & providing the knowledge to the field personnel in command and control mode.

(vi) Maintain of Web Sites with National and Regional languages, State and District Disaster Management Portal Development with value added services.

(vii) Execute data mining and Simulation Systems for the pre-disaster scenarios.

(viii) Call Centre based help lines during disaster.

(ix) Keep close contact with the State Governments affected by natural disaster and gather information about the disaster affected areas and provide advisories.

(x) Interact with other Central Ministries/ Departments and coordinate the relief and rescue activities and continuous monitoring of the impact of the disaster.

(xi) Prepare the daily situation report and apprising the Cabinet Secretary, NDMA and the other important functionaries.

(xii) Publishing the daily situation report on the website.

(xiii) Provide information to National Crisis Management Committee (NCMC) for the following activities:

- Review every year contingency plans formulated by the Central Ministries/ Departments
- Review the measures required for dealing with natural disasters.
- Coordinate the activities of the Central Ministries and State Governments in relation to disaster preparedness and relief, and obtain information from the Nodal Officers of the Ministries/ Departments on measures relating to the above.

7.4 Stakeholders of NEOC, NDMA

(i) Forecasting & EW Agencies (IMD, CWC, GSI, NRSA, NIDM, NTRO, INCOIS, Survey of India, NSDI, SAC, etc.)

(ii) Central Govt. Agencies (MHA, NDMA, PMO, DOS, DCPW, NIC etc)

(iii) Emergency Support Functionaries (ESF)

7.5 Applications and Database Required at NEOC

7.5.1 Application Requirement

The applications that are required in Emergency Control Rooms may be divided into six groups. Vulnerability Analysis and Risk Assessment System, Alert Messaging System, System Administration and Tools are all used to meet the demands of the Pre-Disaster Scenario. Incident Reporting System, Decision Support Systems for Relief and Rescue Management are some of the tools that may be used to meet the requirements of people in a disaster situation. Resource Analysis and Emergency Relief are needed to meet the demands in the post-disaster scenario.

7.5.2 Objectives of Application Development

To address a complicated DM problem, the whole application development should focus on achieving objectives such as connection among multiple stakeholders, data standardisation, operations automation, resource sharing, and a unified virtual environment.

7.6 Applications and Database at the State EOCs

The State Relief Commissioner (SRC) serves as the state's nodal person for coordinating relief efforts. As soon as a crisis scenario arises, the State SRC will construct an Emergency Operation Centre. The Additional Relief Commissioner and the Officers/Staff of the Emergency Operations Centre help SRC in carrying out his duties (NDMA 2012).

After receiving information on the disaster event, the SEOCs and DEOCs operate 24 hours a day, seven days a week for a set period of time. The State and District Emergency Operation Centres hold all catastrophe predicting and warning information, as well as action plans for execution and contact information for various agencies. It must contain up-to-date information on all resources and contingency plans in order to respond quickly in the event of an emergency.

The EOCs' tasks include continuously transmitting information to the NEOC on the crisis as a result of a natural catastrophe until the situation improves. EOCs are in charge of receiving orders and relaying them to the necessary agencies for rapid action. The EOCs' tasks include gathering and submitting information to the NEOC about the deployment of relief measures. The EOCs' tasks include keeping state-level authorities up to date on developments on a regular basis. The EOCs' tasks include keeping state-level authorities up to date on developments on a regular basis. District-level relief committee review the relief initiatives.

7.7 Applications and Database at the District EOCs

Sub Divisional Officers, Tehsildars, Block Development Officers, and Village Level Officers support the District Collector as the focal point at the district level. Following natural disasters, an Area Emergency Activities Centre (EOC) will be established in the district to supervise rescue and relief operations on a daily basis.

Sub-Module 8

Facilities Provided at EOCs

8.1 Generic Requirements at EOCs

In the event of an emergency or catastrophe, Emergency Operation Centres (EOCs) with the necessary Static/Mobile Communication Access Platforms (SCAP/MCAP) at the backend provide a work environment and a secure location to coordinate activities and make mission-critical decisions. Its efficient working depends on space adequacy (ergonomically and elsewhere), functional needs, back end connectivity, and required power pack management (NDMA 2012).

The scale and sophistication of the design, as well as the front-end equipment, would be determined by the EOC's intended degree of operation. Nationally (NEOC2 under NDMA and NEOC1 under MHA) and at the state level, EOCs would have to be built and operated in a comparable manner. The EOCs for vulnerable areas and the NDRF Battalions' Mobile Emergency Operation Centres, on the other hand, will be constructed and equipped differently.

8.2 Facilities at NEOC and SEOCs

For efficient and effective functionality of NEOC and SEOCs, several facilities are essential. Some of the facilities required at NEOC and SEOCs are Work Stations, satellite phones, V-small-aperture terminal, computer systems, Laptops with encoding/ streaming card, IP phones, Voice over Internet Protocol (VoIP), Video / LCD based TV Screens, Projection system, Call Centre positions, systems for public address, Local area network (LAN) with Servers to provide data center facility, Wireless IP Phones, Routers, Facility Centre (heavy duty printer, photocopier, scanner and other office requisites like binding & lamination machine and so on), Power pack, Pantry, Wash Room & Rest Room for the EOC Staff.

8.3 Facility at Operational Control Room (OPS) at NDMA/MHA

In NDMA Bhavan, a facility at the NDMA/MHA Operational Control Room (OPS) will be built, and NEOC will be linked to the NDMA-OPS room using dependable

redundant communication means. The NDMA's OPS room will be replicated in the Ministry of Home Affairs (MHA), which will be linked to the NEOC through a redundant communication link (NDMA 2012).

8.4 Facilities at DEOCs

The DEOCs would generally include the Work Stations, satellite phones, V-small-aperture terminal, computer systems, Laptops with encoding/ streaming card, IP phones, Voice over Internet Protocol (VoIP), Video / LCD based TV Screens, Projection system, Call Centre positions, systems for public address, Local area network (LAN) with Servers to provide data center facility, Wireless IP Phones, Routers, Facility Centre (heavy duty printer, photocopier, scanner and other office requisites like binding & lamination machine and so on), Power pack, Pantry, Wash Room & Rest Room for the EOC Staff.

8.5 For Incident Commander at Affected Site

8.5.1 ICT Needs at Incident Command System (ICS)

Management and coordination issues, rather than a lack of resources or a strategy's failures and faults, are the most common causes of response problems. An integrated communication platform in support of ICS is necessary in the context of communication support. This would typically be based on the Mini Mobile Communication Pack (MMCP) at the district level, followed by the Mobile Emergency Operational Center (MEOC) maintained by the NDRF. Having a consistent communication plan in place ensures that responders are able to communicate with one another during an event. Equipment, methods, and systems for communication must work across jurisdictions (interoperably). Prior to an event, an integrated voice and data communication system, comprising equipment, systems, and protocols, must be developed (NDMA 2012).

8.5.2 Mini Mobile Communication Pack

The Districts Headquarters have a Mini Mobile Communication Pack (MMCP). As the local administrative authority, DC/DM must relocate or propose a person to move to the site as the Incident Commander (unless in the case of a nuclear or radiological emergency, in which case DC/DM must take command

of the Incident Commander personally). It is also planned to provide 312 Multi Hazard Prone (MHP) districts in the country with transportable "Mini Mobile Communication Packs" (MMCP) that, in the event of a disaster, could be moved immediately to the disaster site (in a vehicle organised by DC/DM) under the affected district arrangements for restoring basic essential communications until national level resources are deployed (NDMA 2012).

8.6 At NDRF Headquarters

NDRF battalions are outfitted with a vehicle-based Mobile Communication Access Platform (MCAP) equipped with communications systems for efficient use as a MEOC in crisis scenarios. Certain preparations for communication have been created at base camp so that comprehensive communication assistance is available for their internal command, control, and administrative tasks as well.

Sub-Module 9

Technology, Emerging Trends and R&D Requirements

9.1 Introduction

Infrastructure development is not a one-time event; rather, it is a continual and growing process. On the one hand, exploitation of technological innovations with state-of-the-art next-generation networks and a plethora of software applications on the horizon is absolutely critical for disaster management Continuum management; on the other hand, it is equally important that stakeholders involved in the DM at various levels understand these wide range of available technological platforms in generic terms, so a comprehensive understanding is required. In this framework, the goal of this Chapter is to explore the evolving technological backdrop in very broad terms.

The overview of basic telecommunication concepts such as switching, multiplexing, and others, which are regularly employed in modern communication systems, is presented in this sub-module. Then there's a look at other network technologies including mobile networks, satellite networks, and so on. Because fast technology advancements are on the horizon, the following section includes a quick sketch of potential situations. Innovation brings a slew of new features that are critical for improving DM with increasing efficiency and shorter response times in various stages of natural disasters. Hence, it is very essential to underline the importance of research and development in telecommunications and ICT.

9.2 Multiplexing and Modulation

Information, medium and carrier are crucial component of increasing traffic Carrying Capacity Telecommunication system. Information might be in the form of speech, data, or visual signals, and it can be analogue or digital. Analog signals are considered continuous, but digital signals are non-continuous and have two states: "1" and "0." (indicating presence or absence of a voltage for example). The difference between voice and data is that voice is analogue and

data is digital. Voice is usually coded as '1' and '0' for transmission in current telecommunication networks, since they are digital.

9.3 Convergence of Voice, Video and Data Services

Generally, the telephone network (now referred to as a telecommunication network) has only served the needs of voice telephony (providing interconnection between various customers) for communicating with one another, and the Public Switched Telephone Network (PSTN) is a collection of interconnected systems (operated by various telephone companies and administrations around the world). The PSTN evolved from human-operated analogue circuit switching systems (plug boards) to electromechanical switches. The pure telephone network has evolved into a telecommunications network capable of transporting data and other services in addition to speech. With the rapid progress of technology, digital switches have become an integral element of the network, paving the way for the convergence of voice and data with the introduction of the Integrated Services Digital Network (ISDN).

9.4 Telecommunication Network Technologies

9.4.1 Satellite Communication Network

Communication with remote places has always been difficult, but with the introduction of satellite communication in the early 1960s, the problem of connectivity to remote and far-flung areas was overcome. Satellite communication allows for the coverage of large regions (national and worldwide) with the use of one or more satellites. Low Planet Circle (LEO) satellites orbit the earth at a distance of a few hundred kilometres and provide remote sensing and other services. Geo-synchronous satellites (GEOs), which orbit the earth at a distance of 36000 kilometres, are utilised for telecommunication and television transmission. Satellites in Low Earth Orbit (LEO) and Medium Earth Orbit (MEO) orbit at significantly closer distances (few hundreds to few thousand kms). However, because the satellite's location in orbit changes over time in relation to the earth, they need multiple satellites in their constellation to link to ground earth stations and provide continuous communication services. Similarly, because each satellite covers a smaller portion of the planet's surface, many earth stations are required. As a result, they are not widely used for communication (NDMA 2012).

9.4.1.1 Very Small Aperture Terminal (VSAT)

Very-small-aperture terminal (VSAT) technology has found use in a variety of situations where flawless communication is necessary. Terrestrial lines have a number of challenges when it comes to reaching remote and inaccessible places. On a VSAT network, uptime of up to 99.5 percent is possible. The deployment is only 4 to 6 weeks long. Very-small-aperture terminal (VSAT) services make things very simple for a customer by providing a single point of contact for operation, maintenance, fast fault isolation, and troubleshooting. VSAT networks have a huge capacity for expansion. Changes in the business environment and traffic loads that can be readily accommodated on a technological migration path are considered in this section. Additional VSATs may be deployed quickly to allow network expansion to any location (NDMA 2012).

9.4.1.2 Satellite Phones

Satellite phones are mobile phones that use a portable terminal to connect to a satellite (briefcase type). INMARSAT BGAN (Broadband Global Area Network) service is accessed via a compact, lightweight satellite terminal that may be rapidly and easily linked to a laptop PC and voice phone, among other satellite technologies. They're made for a single user who values portability above everything else.

9.4.1.3 INSAT MSS Type-D System

ISRO's Space Applications Centre (SAC) has created a tiny portable satellite terminal that uses the INSAT satellite for voice and data transmission (with active cooperation from Indian industry). The INSAT satellite is equipped with a unique Mobile Satellite Transponder that allows communication through a tiny terminal. The terminal was designed with voice communication as its primary purpose during a disaster when other communication systems are likely to fail. It may be used for emergency communication from anywhere in India. A portable Satellite terminal in a remote location can be linked to an EPABX at the Hub via satellite. In this method, a remote location may be added to the EPABX as an extension, and phone calls can be made between the remote site's portable satellite terminal and local phones connected to the EPABX. Antenna system is used by the Central Hub station. It uses the C band to broadcast and receive signals. The S band is used by portable satellite terminals to send and receive data (NDMA 2012).

9.4.2 Optical Fiber Communication (OFC) Networks

The introduction of optical fibre technology has altered communications network dynamics. It has solved the bandwidth constraints caused by traditional forms of communication, such as copper cable, microwave, and satellite, and it provides enormous bandwidth capacity at a low cost. In both local and long-distance communication, optical fibre communication offers a wide range of uses. Optical networking's economics have already resulted in its complete dominance of the worldwide terrestrial and submarine communication network's long-distance sector. With the exponential improvement of optical technology, its value proposition has become as appealing even for shorter distance applications, and the optical network has gradually progressed moving to consumer prices for high bandwidth applications (NDMA 2012).

9.4.2.1 Propagation Modes through Optical Fibers

Optical fibre may propagate in a variety of modes based on their physical structure as an optical waveguide. Optical fibres are categorised as single mode or multimode based on their propagation characteristics. Single mode fibres support only one mode of propagation, whereas multimode fibres offer several modes. As a result of the interplay between the modes, multimode propagation causes modal dispersion and modal noise, which restricts the fiber's transmission carrying capacity (NDMA 2012). Two governing variables, Raleigh scattering and IR absorption cause signal strength reduction (attenuation) when light passes through silicon fibres. Single mode fibres operating in the second window (1330nm) and third window (1550nm) are utilised for all telecommunication needs, since the attenuation is lowest at these wavelengths.

9.4.2.2 Dense Wave Division Multiplex (DWDM)

DWDM has offered terabits of bandwidth capabilities as well as a bit transparent medium over optical fibre lines, thanks to fast advancements in optical fibre technology (Fig. 34).

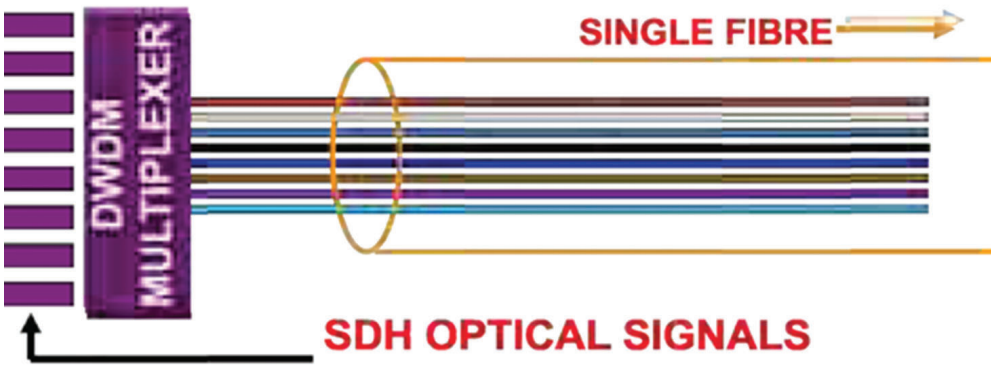


Fig. 34: Representation of optical fiber
(Source: NDMA 2012)

DWDM provides routes that are independent of data rate and format. As seen below, it ensures the transmission of all sorts of signals. (Fig. 35)

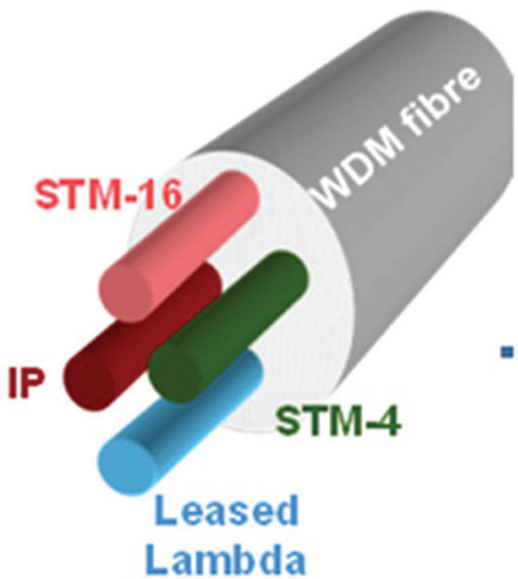


Fig. 35: Schematic representation of Dense Wave Division Multiplex
(Source: NDMA 2012)

9.4.3 Signal Transmission and Mobile Communication Technologies for Cellular Service

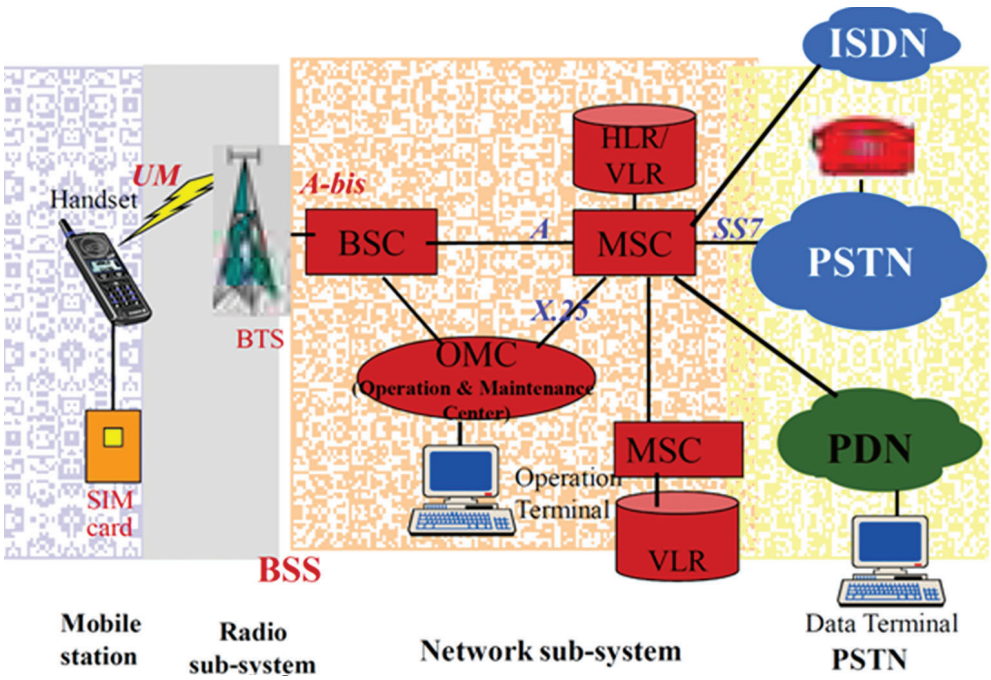
Transmission of Signals Transmitted signals (voice, video, and data) are transported over a carrier radio frequency (with the smallest feasible bandwidth of the frequency spectrum, bandwidth being a finite resource) to the destination for efficient communication. One of the most basic goals in data communication is to allow several transmitters/users to broadcast voice/data over a single communication channel with a given bandwidth without interfering. To put it another way, all communication systems must address the same fundamental challenge of efficiently splitting a particular RF spectrum among numerous users. This task of channel access in radio communication is accomplished through the concept of channel access/multiple access, which is accomplished through the use of various modulation/multiplexing techniques such as TDMA (Time Division Multiple Access), FDMA (Frequency Division Multiple Access), and CDMA (Code Division Multiple Access) (Code Division Multiple Access).

9.4.3.1 Mobile Communication

Cellular mobile communication has changed India's telecommunications sector by delivering an on-demand telephone at an inexpensive price. Cellular phone usage has grown in popularity among the general public (surpassing the number of traditional fixed telephones) and now accounts for 95.66 percent of the country's total telephone lines of 806.13 million (mobile + fixed) as of January 31, 2011. (NDMA 2012).

9.4.3.2 Global System for Mobile (GSM)

It's a cellular standard that uses digital modulation to offer voice and data services. GSM distinguishes itself from earlier and rival technologies in two main areas, in addition to delivering a variety of extra services. For starters, it allows users to roam between networks, allowing them to access their home network's services on another, linked network. The original voice-based service, as well as supplemental and text-based services, are all part of this package. Second, it comes with built-in security features like as authentication and encryption (Fig. 36). GSM devices utilise a smartcard called a Subscriber Identity Module (SIM) that includes operator and subscriber personal data to authenticate users and encrypt sessions (voice or data) over the air (NDMA 2012).



(Source:NDMA 2012)

The notion of frequency reuse underpins cellular networks, which means that the same frequency is utilised by several sites that are physically separated from one another, preserving the frequency spectrum. Numerous access, or the ability to serve multiple, simultaneous users through frequency reuse, is one of the most fundamental principles for any cellular telephone system. To put it another way, numerous users share a common pool of radio channels (spectrum), and any user can get access to any channel (users are not always assigned to the same channel), which is temporarily allotted for communication.

9.4.3.3 5G Cellular Network

5G is the 5th generation mobile network. It is a new global wireless standard after 1G, 2G, 3G, and 4G networks. 5G enables a new kind of network that is designed to connect virtually everyone and everything together including machines, objects, and devices.

5G wireless technology is meant to deliver higher multi-Gbps peak data speeds, ultra low latency, more reliability, massive network capacity, increased availability, and a more uniform user experience to more users. Higher performance and improved efficiency empower new user experiences and connects new industries. A key factor for successful emergency operations is reliable communication and real-time access to critical information. The use of a 5G network can help emergency service vehicles be tracked and improve response to emergency situations using IoT connectivity. The use of the e1Fleet console (manufactured by Emergency One), uses connectivity in fire engines to help carry out several tasks automatically.

9.4.3.4 Internet over Satellite

Internet over satellite is a high-speed Internet connection made through satellite in order to provide satellite broadband service and two-way access to the global Internet. This is accomplished through low-earth-orbit (LEO) satellites. Internet over satellite is the ideal solution for carriers, Internet service provider (ISP) corporate customers, Internet cafes and residential users because it allows them to access a connection through a two-way, very-small aperture terminal (VSAT) satellite dish using hub dishes provided by satellite broadband ISPs. Internet over satellite is a boon for rural Internet users who require broadband access because it does not use telephone lines or cable systems. Although cable systems and digital subscriber lines (DSLs) have high download speeds, satellite systems are faster than normal modems.

9.4.3.5 Internet of things (IoT)

The Internet of things (IoT) describes the network of physical objects that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet Things have evolved due to the convergence of multiple technologies, real-time analytics, machine learning, ubiquitous computing, commodity sensors, and embedded systems. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of things.

9.4.3.6 Big Data

Analyzing and observing Big Data patterns are not only a beneficial practice within businesses, it can also improve the efficiency and effectiveness of emergency and disaster management organizations. Thanks to the availability and usage of smart phones and social media, disasters can be measured with real-time information and met with a rapid, accurate and precise response. Big Data has the ability to enhance disaster recovery by utilizing community information and connecting victims with emergency responders and family.

Emergency personnel can minimize their search time and maximize their recovery time when they have access to real-time information emphasizing the areas most affected. Working along with professional insight and satellite imagery, Big Data has started trends that have already saved lives and proven effective within the emergency management field.

9.4.3.7 Machine Learning

Machine learning can provide new ways of looking into the complex relationships between models, and the actual understanding of the potential impacts of a hazard on the built environment and society. It aims to provide more accurate, efficient, and useful answers.

Evidence-driven disaster risk management (DRM) relies upon many different data types, information sources, and types of models to be effective. Tasks such as weather modelling, earthquake fault line rupture or the development of dynamic urban exposure measures involve complex science and large amounts of data from a range of sources. Even experts can struggle to develop models that enable the understanding of the potential impacts of a hazard on the built environment and society.

9.4.3.8 Base Station Subsystem (BSS)

The Base Station Subsystem establishes direct communication with the mobile device through an air interface and connects it to the Switching Center. The Base Station Subsystem is made up of two functional entities: the Base Transceiver Station (BTS) and the Base Station Controller (BSC) (NDMA 2012).

9.4.3.9 Base Transceiver Station (BTS)

The mobile's interface to the network is provided by the BTS. Each cell site

has a BTS, which is generally placed in the cell's centre to give coverage within the cell, which can cover an area of 30 to 40 square kilometres. The BTS coverage area is significantly smaller in a crowded, metropolitan environment. The absolute cell size is determined by the BTS's transmitting power and the number of consumers in the cell. The radio transceivers that constitute a cell are housed in the BTS, which also handles the radio-link protocols with the mobile phones (NDMA 2012).

9.4.3.10 Base Station Controller (BSC)

It keeps track of and manages a number of BTS. On one hand, it's connected to a number of BTSs, while on the other, it's connected to the Mobile Switching Centre (MSC). The BSC's primary responsibilities include frequency administration and BTS control, as well as full radio interface management via remote command of the BTS and mobile station, including radio channel allocation and release, and changeover management. The BSC's hardware can be found on the same site as the BTS, on its own independent site, or at the Mobile Switching Centre's site (MSC).

9.4.3.11 Mobile Switching Centre (MSC)

It may route calls from the fixed network and other service providers' mobile networks to a single mobile station via the BSC and BTS. MSC also sends particular data about individual mobile stations to the network. On one hand, the MSC interfaces with the BSS (via which it communicates with GSM users) and on the other, it interacts with external networks (NDMA 2012).

9.4.3.12 Home Location Register (HLR)

Temporary data on the SIM include such entries as (i) the address of the current visitor location register (VLR), which currently administers the mobile stations, some transient parameters for authentication and ciphering and the number to which the calls must be forwarded (if the subscriber selects call forwarding) (NDMA 2012).

9.4.3.13 Visitor Location Register (VLR)

All pertinent data for all mobiles currently situated in a serving MSC is stored in

the VLR. The permanent data are identical to the HLR data, but the temporary data differ somewhat. The Temporary Mobile Subscriber Identity (TMSI), for example, is stored in the VLR and is utilised for a short time to prevent the IMSI from being sent over the air – interface (NDMA 2012).

9.4.3.14 Code-Division Multiple Access (CDMA) System

CDMA stands for Code Division Multiple Access, and it is a digital cellular technology that employs spread-spectrum methods. Unlike rival systems that employ TDMA, such as GSM. CDMA routinely outperforms other commercial mobile technologies in terms of voice and data communications capacity, allowing more customers to connect at any one moment. It works on the 800 MHz band (NDMA 2012).

9.4.3.15 Future Trends

To enhance data rates of the air interface and offer entire IP network capabilities, LTE systems employ a lot of MIMO (Multiple Input Multiple Output) and higher order PSK (Phase Shift Keying) as transmission technologies. LTE systems offer sophisticated technological features including efficient power management, advanced authentication and encryption, advanced error correction techniques, and QoS (Quality of Service) support for various traffic kinds, among others. LTE establishes an end-to-end IP-based network capable of data speeds of 34 Mbps and greater (NDMA 2012).

9.4.4 Wi-Fi Technology

Wi-Fi stands for Wireless Fidelity, and it's a method of connecting to the Internet using a microwave wireless channel. Wi-Fi is a term that refers to any wireless technology defined by the IEEE 802.11 specification, which includes (but is not limited to) the wireless protocols 802.11a, 802.11b, and 802.11g. The Wi-Fi Alliance is the organisation in charge of publicising the name Wi-Fi and its connection to various wireless technology standards.

9.4.5 WiMAX (Worldwide Interoperability of Microwave Access) Technology

WiMAX is a wireless access service that provides IP connection to a large

number of customers across a vast geographic region at a cheap cost. WiMAX is a brand name for the IEEE 802.16 standard, which defines wide-area wireless data networking and is being embraced by manufacturers all over the globe to ensure equipment interoperability. WiMAX is widely regarded as one of the most effective "last mile" delivery technologies. Wireless local area networks (WiLANs), on the other hand, are designed to offer network connectivity within an office or at home. WiMAX may be used to link WiLANs together (NDMA 2012).

9.4.6 Public Mobile Radio Trunking System (PMRTS)

The Public Mobile Radio (PMR) system is a two-way radio that uses a one-to-many, point-to-multipoint calling mechanism. Two-way radios use frequencies between 66 and 88 MHz, 136 and 174 MHz, 403-520 MHz, and 800 MHz. As a consequence, urgent messages or critical information may be sent more quickly inside any business. Two-way radios are built on the foundation of the traditional VHF system. In traditional two-way radio communications, users have their own allocated frequency channel. Nevertheless, one drawback of two-way radio communications is that only one person may talk at any given time, and because there are only a finite number of frequencies, frequency congestion arises as the number of users grows. Another type of two-way radio communication known as radio trunking (Public Mobile Radio Trunking System (PMRTS)) overcomes this shortcoming by using a set of frequencies to enable simultaneous multiparty communication inside the group (NDMA 2012).

9.4.7 VHF Radios

The radio frequency band from 30 Mhz to 300 Mhz is known as very high frequency (VHF). High frequency (HF) frequencies directly below VHF are known as High frequency (HF), while Ultra high frequency (UHF) frequencies are the next higher frequencies (UHF). With a range somewhat more than line-of-sight from the transmitter, VHF propagation characteristics are excellent for short-distance terrestrial communication. The ionosphere does not generally reflect VHF radio, unlike high frequencies (HF), therefore transmissions are limited to the surrounding region (and do not interfere with transmissions thousands of kilometres away). Alternative communication networks, such as the GSM network, provide numerous advantages, such as smooth integration into the current network and broad coverage, as a result of rapid technical developments (NDMA 2012).

9.4.8 Portable AM/FM Broadcasting Radio Station

At a catastrophe scene, radio broadcasting is an effective means of disseminating information. The broadcast studio, transmitter rack, and antenna equipment are usually included in a packed portable radio station. Audio mixers, CD players, audio recorders, cassette players, and monitoring headsets are all available in the broadcast studio, which are necessary for generating information material. There are two sorts of broadcasting technologies: FM (Frequency Modulation) and AM (Amplitude Modulation). AM radio broadcasts on frequencies ranging from 535 to 1705 kHz, while FM broadcasts on frequencies ranging from 88 to 108 MHz. Because AM transmission is dependent on the ionospheric layer, coverage distance is affected by a variety of parameters such as soil conductivity, time of day (day/night), and RF propagation conditions (which shifts between day and night). As a result, the range of portable AM equipment for good reception is generally approximately 15 kilometres. FM radio, on the other hand, is based on line-of-sight transmission and can easily reach a 25-kilometer radius. A typical transmitter produces 500 watts of electricity.

9.5 Emerging Scenario

The dynamics of disaster management obviously imply that staying current with evolving technology is a must. Microelectronics, computers, sensors, and communications systems advance at a rate that is frequently quicker then individuals directly engaged can keep up with. With their widespread use, technologies, particularly informatics, communications, and computer technology, have no bounds. The upcoming Communication and Informatics revolution is a result of incredible advances in computerised information and communication technology.

The phrase these days is “Informatic Explosion,” and the world has already begun to move from an industrial to an information-based civilization. This technology transformation is incredible, and leveraging it is critical to meeting our country’s DM requirements. Emerging technologies are, in reality, convergently and seamlessly digitising the communication and information environment. As a result, we have access to a diverse and complicated range of developing technology options for updating and upgrading our disaster management communications and information networks (keeping in mind the budgetary constraints).

RF Identification Systems (RFID), IP Multimedia Subsystem (IMS), Orthogonal

Frequency Division Multiplex (OFDM), Telepresence, Advanced Technology for Detection and Tracking of Trapped People, Multiple Input Multiple Output (MIMO) Wireless Technology, Terminal Devices, Software Defined Radio (SDR), and Cognitive Radio (CR) for Spectrum Sharing (SpS) are just a few of the key emerging technological trends (MSTP)

9.6 R&D Efforts

As the requirements evolve, depending on the demand for quicker response in DM operations, a continual effort to investigate alternative solutions through R&D initiatives are required. In this part, we'll go through some of the potential R&D sectors.

(i) Multi Service Platforms:

Multi-service platforms that integrate voice, data, and video are a must-have. Because each of the stakeholders would bring in various communications / IT networks with different standards and protocols, these multi-service platforms would be fundamentally necessary to be utilised by first responders and other stakeholders in order to have successful inter / intra communications. MIMO (Multi Input/Multi Output) can provide enormous communication and ICT opportunities for catastrophe management over its whole life cycle (NDMA 2012).

(ii) Spectrum Management and Sharing:

This is a critical aspect of wireless communications, especially with the introduction of Cognitive Radio and Software Defend Radio (SDR). When a tragedy hits on a big scale and cuts across national borders, the problem becomes more acute. These radios will improve connection and allow important stakeholders to easily travel between different DM groups using different legacy systems.

(iii) Lower Power Lower Cost Cellular Technology:

The world is quickly transforming into a Mobile Information Society. It is not just technology that limits its execution, but also its procedures and infrastructures. Cellular technology with requisite priority sensitive communication support

needs to be fully researched and integrated into NDCN (National Disaster Communication Network) networks of today and the future due to its omnipresence and terminal equipment, i.e., cell phones with multi-various capabilities such as inherent PDA, low power requirement, and low cost. Also needed is R&D on harnessing energy from the environment, such as solar and wind, as well as improved traffic coordination, the use of passive devices, effective spectrum management, and the deployment of green house shelters (NDMA 2012).

(iv) Dynamically Configured Adaptive Networks for Enhanced Availability:

When a disaster strikes, the majority of communication problems/disruptions are caused by infrastructure damage. As a result, redundant and resilient infrastructure with the appropriate self-healing and delay tolerant network capabilities are required. The element of self-monitoring and network maintenance is equally essential. Even when infrastructure is largely destroyed, adaptive networks must be able to dynamically reconfigure and repair themselves even when infrastructure has been partially destroyed. Such networks are envisaged to be unattended systems with related applications relevant to disaster management, ranging from environmental sensing to infrastructural monitoring and emergency response. In this case, another aspect is location based monitoring of available communication infrastructural capacity and adaptive / selective access to available communication networks (NDMA 2012).

(v) Exploitation of RFID emerging technology:

This will help in identifying the locations and personnel, remotely for rescue and relief operation.

(vi) At a disaster site, fuel cells

At a disaster site, fuel cells serve as a power source. Fuel cells, which use an electrochemical mechanism to convert hydrogen or natural gas into electricity, have long promised abundant energy while releasing fewer pollutants than traditional power plants. While it is the most efficient and environmentally friendly, it still faces a number of technological challenges, such as cost and durability (due to the need for expensive precious metals such as platinum

and rare earth elements in some fuel cells, as well as corrosive materials in others), which have limited the use of fuel cells at their current technological levels. However, it is an area of potential technological growth, especially when hydrogen can be generated by splitting water using solar energy in a photothermal process (water and solar energy available freely in abundance). Such fuel cells would be particularly helpful in disaster regions, as they would provide a portable, stand-alone power plant that is both reliable and easy to operate, as well as being clean and environmentally benign.

9.7 Community Radio/Amateur Radio

During natural catastrophes such as cyclones, floods, landslides, tsunamis, earthquakes, and so on, ham radio and community radio play a critical role. However, in India, there is still a lack of understanding about these radio transmissions. In a crisis, volunteers from community radio and amateur radio can serve as frontline reporters. People who work in community media, such as community radio, have a closer contact with the community and have a greater understanding of the local context and the realities faced by victims. India's zero-casualty strategy to handling extreme weather events has made a significant contribution to the Sendai Framework's implementation and the decrease of fatalities from such occurrences. India's Zero Casualty Policy refers to the Indian Meteorological Department's "near pinpoint precision" of early warnings, which aided authorities in executing a well-targeted evacuation strategy and reducing fatalities in the aftermath of cyclonic storm Fani.

By disseminating information about disasters, educating the public about disasters, highlighting vulnerable zones, spreading warning and alert, reporting disaster events, gathering and transmitting information about affected areas, assisting in rescue and relief operations, disseminating information about public safety, and so on, early warning and communication play a critical role in disaster management. Media coverage of catastrophe events that is continuous and factual soon after a disaster assists reaction and decision-making processes, saving lives and property.

Thousands of lives have been saved as a result of public education and the quick, broad distribution of early warnings. A cyclone in Andra Pradesh, India, killed over 10,000 people in 1977, while a comparable storm 13 years later killed just approximately 910. The significant difference was due to the implementation of a new early-warning system linked to radio stations to inform residents in low-lying regions (R. K. Dave, www.training.fema.gov).

On June 13, 2013, Uttarakhand had a multi-day cloudburst that resulted in severe flash floods and landslides, killing 169 people and leaving 4021 persons missing (thought to be dead) (Satendra et. al., 2014). It was the greatest natural catastrophe to strike the country since the tsunami of 2004. Community radio stations were among the first responders, broadcasting and informing victims and emergency teams of critical information. Gram Vaani created running Relief News lines for Uttarakhand flood victims at various community radio stations, including Kumaon Vani (Mukteshwar), Henvalvani (Chamba Valley), and Mandakini Ki Awaz (Rudraprayag).

The 2004 Great Sumatra earthquake and Indian Ocean tsunami, commonly known as the Boxing Day Tsunami, struck on December 26th, 2004, with a magnitude of 9.3 Mw, wreaking havoc on the Andaman & Nicobar Islands (UT) and the mainland coasts of Kerala and Tamilnadu. The tsunami was one of the world's deadliest natural disasters, killing about 230,000 people in fourteen nations. According to government estimates, it killed 10,745 people in India (INCOIS, Indian Tsunami Early Warning Centre User Guide).

Ham radio, community radio, Immersat, and VSAT phones were utilised to help in relief and rescue activities in the early aftermath of the tragedy. Community media is frequently regarded as a form of broadcasting that provides voice to the voiceless and brings the concerns and challenges confronting the affected community to light. Though community radio has been around for decades, it is still in its infancy and need assistance from the district, state, and federal levels to develop, expand, and become an essential element of disaster preparedness.

The 1999 Odisha cyclone was the most powerful tropical cyclone ever recorded in the North Indian Ocean (NIO) and one of the region's most damaging. Over 10,000 people died as a result of the storm (www.ndma.gov.in), with a total damage cost of US $4.44 billion. Throughout the storm's existence, the Indian Meteorological Department (IMD) issued cyclone warning warnings on a regular basis. Doordarshan and All India Radio broadcast cyclone updates on an hourly basis to impacted areas, substantially reducing the number of deaths.

9.8 Social Media

The media serves as a central link between the general public and emergency response agencies, and it is critical in providing critical information to the public prior to, during, and after catastrophes. The media plays a role in disaster management by informing the public about disasters, issuing warnings

about hazards, gathering and transmitting information about disaster-affected areas, alerting government officials, relief organisations, and the public to specific needs, and facilitating discussions about disaster preparedness and response for continuous improvement.

During catastrophes or disasters, information is the most important commodity. Everyone requires it in order to make decisions. It is an essential aspect in an organization's ability to gain (or lose) visibility and credibility. Above all, it is necessary for rapid and effective assistance for those affected by a disaster. Information is the main element in the damage and needs assessment process and is the basis for coordination and decision making in emergency situations. It has a powerful impact on how national and international resources are mobilized. Public and social communication and media relations have become key elements in efficient emergency management. Technical operations in disaster situations must be accompanied by good public communication and information strategies that take all stakeholders into account.

Over the last decade, there has been an overwhelming amount of cases where false news spreads during crisis events, such as natural disasters and terrorist attacks. This misinformation proves to be very dangerous during these menacing situations, as the integrity and accuracy of emergency communications is of the utmost importance. Given that emergency communications are often needed for affected populations to make informed decisions regarding planning and evacuation, it is vital that misinformation is controlled in an effective and efficient manner. The threat of misinformation propagating throughout social media brings the need for timely and valid debunking posts from trustworthy accounts. In many of the cases where false information spreads during disaster events, government accounts and other major accounts turn to social media to supply the public with updated information (NDMA 2012).

Sub-Module 10

Common Alerting Protocol (CAP)

10.1 Introduction

Common Alerting Protocol (CAP) is widely used for exchanging public warnings and emergencies between alerting technologies. CAP facilities simultaneous dissemination of warning message over many warning systems to many applications such as Cell Broadcast, Google Public Alerts etc. This technique simplifies the task and enhances the effectiveness of warning dissemination to responsible officials.

CAP has several characteristics such as flexible targeting specific geographic areas, message in multilingual and multi-audience, phased and delayed effective times and expirations, enhanced message update and cancellation features, template support for framing complete and effective warning messages, digital encryption and signature capability, facility for digital images, audio, and video etc.

10.2 Indian Scenario

India's Common Alert Protocol compliant Integrated Disaster Platform is in use by Disaster management authorities. All Mobile Operators of India has been integrated with the platform and are in use for warning dissemination via SMS. Most Mobile Operators of India has been integrated with the platform for cell broadcasting. Now, Location based Social Media feeds can also be generated to ensure more penetration. All India Radio is now on board. Successfully integration testing completed in this year, Country wide roll out is in process. 65 % of the population has been covered in regional languages with Hindi, Tamil, Malayalam language support. CAP implementation in Indian Meteorological Department (IMD) centres located across the country is in process. Alert disseminations through Television is an advance stage. Various shareholder in the Common Alerting Protocol (CAP) and India's IDEWP-Working Model is represented in Fig. 37 and Fig. 38 respectively.

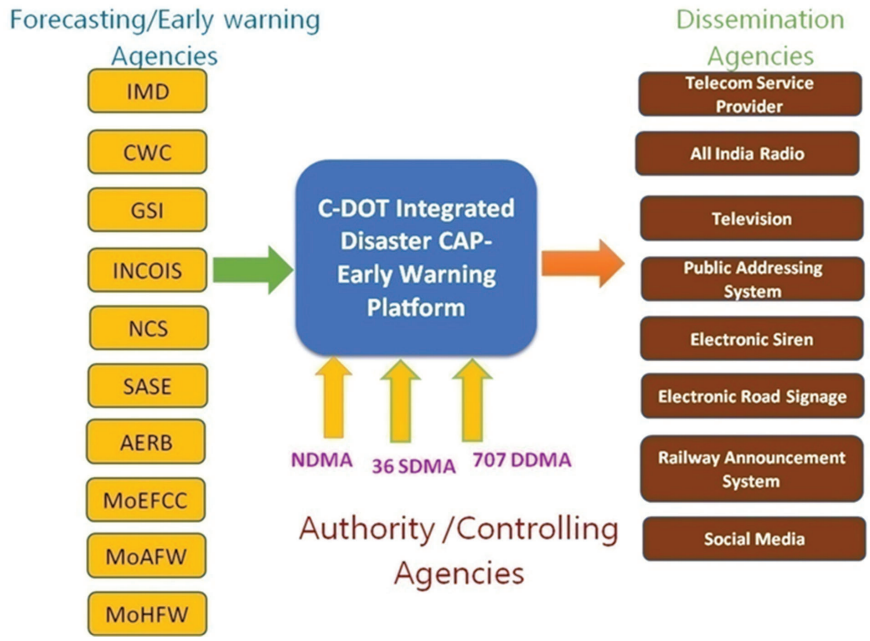


Fig. 37: Project shareholders in the Common Alerting Protocol (CAP)
(Source by Eliot Christian 2019)

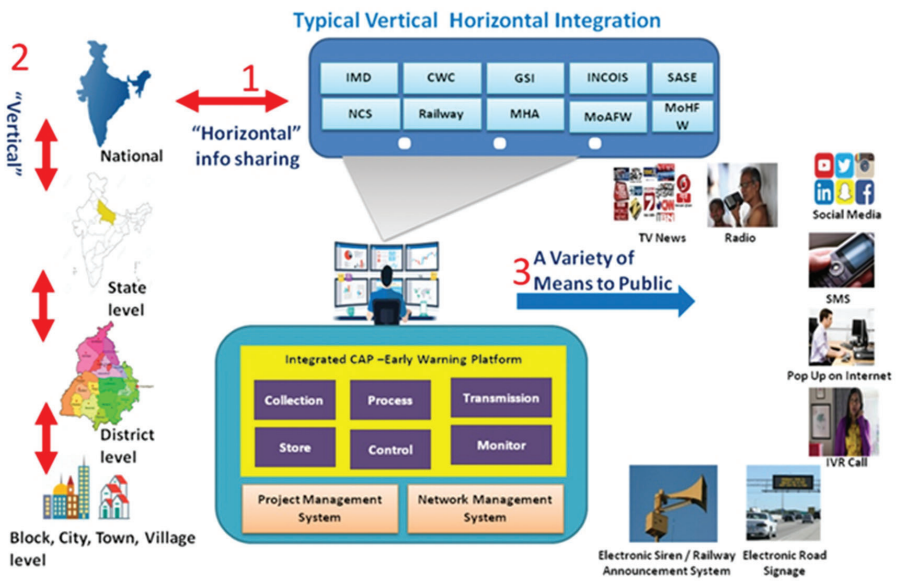


Fig. 38 India's IDEWP-Working Model
(Source by Eliot Christian 2019)

10.3 Case Studies

10.3.1 Use of CAP Platform in Shri Amarnath Yatra, 2018 & 2019

- Amarnath Yatra first test case of CAP Platform
- 260,000 People participated in pilgrimage for more than 40 days in 2018, it is one of the Holiest Pilgrimage of India
- Use of CAP Platform to minimize Casualties due to Tough Terrain and Extreme Weather Condition (Fig. 39)



Fig. 39: Glimpse of Shri Amarnath Yatra, 2018 & 2019

(Source: preparecenter.org)

10.3.2. CAP Platform used in Early Warning for Cyclone Fani, 2019

More than 0.25 Million SMSs were disseminated through C-DOT CAP Platform to warn people of Coastal Odisha



Fig. 40: Glimpse of Cyclone Fani, 2019
(Source: preparecenter.org)

10.4 IDEWP- Implementation Impediments

- Real time extraction of mobile number in the selected area by analyzing large set of VLR.
- Ensuring Quality of Service (QoS) in SMS dissemination in large area.
- Trade off between Tele-Density and SMS Dissemination Time.
- Smartphone penetration is limited to urban areas.
- All mobile handset doesn't support Cell Broadcast and Limited size of single CB message.
- Large number of Government and Private Organizations need to be integrated with CAP Early Warning Platform
- Support for Legacy systems of Dissemination Media

Sub-Module 11

Last Mile Connectivity

11.1 Introduction

The state government bears primary responsibility for disaster management, and last-mile connection is critical for successful and efficient disaster management. Currently, roughly 60% of villages have last-mile connection thanks to public and private network coverage. It is projected to cover 95 percent of the villages in the Indian Subcontinent in a few years. However, current last-mile connection is likely to be harmed in the event of a disaster.

During a disaster, the communication system is the first casualty in the region. Depending on the extent of the damage caused by the natural catastrophe, either one, a few, or the entire communication network architecture may have been completely disrupted. Even if police communication is working, the worst-case scenario is that the whole communication network has broken down, leaving the District Collector (DC) unsure of what is going on (the magnitude of the damage, for example) and what is necessary to take relief measures.

Every technology has its own use in terms of last-mile connection in a catastrophe situation. Satellite technology, for example, can provide a failsafe mechanism for providing last-mile communication to a catastrophe site. After arriving at the location, SAT phones will give quick, dependable phone access, regardless of topographical conditions. Satellite terminals have the ability to connect to the national network. With the aid of VHF technology, communication between rescue teams may be established rapidly. Depending on the degree of the damage, limited mobile service can be provided by deploying portable equipment utilising GSM/CDMA/Tetra technology. Areas cut off from the telecommunications network as a result of a catastrophe can be temporarily reconnected by stringing light-weight optical fibre cables through treetops/poles or deploying portable microwave devices.

11.2 Suggested Actions at State/UT Level

The disaster management guiding concept is comprehensive management based on proactive processes rather than the usual response-centric approach.

As a result, these National recommendations take a balanced approach to prevention and mitigation.

Setting up a new comprehensive infrastructure facilities telecommunication to handle every aspect of the disaster area in the country is a huge challenge. Careful planning on the part of agencies at the state/UT level, while building new telecommunication networks in accordance with the prevalent vulnerability profile, will go a long way toward achieving the goal of covering everyone's needs at all times. A few examples of such measures are mentioned below.

11.2.1 Utilisation of Traditional Communication System

The traditional method, which is commonly used by local populations as part of their local coping mechanism, should be adopted by state/UT authorities. Traditional communication techniques include torchlight (at night) and smoke (during the day) communication in remote tribal regions, as well as communal microphones put in Masjids, Temples, and Gurudwaras. This time-honored method allows isolated communities to be reached.

11.2.2 Communication for Fishermen

Community Deep-sea fisherman can use satellite or VHF mode to communicate with their fishing boat. For usage in fishing boats, ISRO has developed an INSAT-based Disaster Alert Transmitter (DAT). In the event of an emergency, the fishing boat sends a brief message to central places as soon as possible, informing them of its location and the nature of the problem, so that rescue efforts may begin as soon as possible. At the shore station, a Marine Radio VHF set may be used to make voice calls and receive longitude/latitude location data. It will also aid in the transmission of weather forecasts for oncoming cyclones to the boat's fishermen.

11.2.3 Public Mobile Radio Network

Congestion-free networks, distress calls, and other features are available on public mobile radios that are not available on traditional mobile systems such as GSM/CDMA access technologies. As a result, government organisations mostly employ PMR systems like Tetra to deliver such services. Police are one

such government agency for whom the Tetra system provides several benefits such as group communications, control room and dispatching operations, secure communications, direct mode of operations in the event of network breakdown, and so on. Some states have already begun to use a Tetra-based police network for communication. It is proposed that states develop a Tetra-based secure communication network for authorities such as the police and the SDRF, as this will make it simpler to establish contact between different agencies during a catastrophe.

11.2.4 Cyclone Resilient Mobile Towers

In extreme cyclonic conditions (when wind speeds reach around 180 km/h), communication towers (which offer mobile connection in the region) typically suffer damage during cyclone crisis situations. The mobile communications network is expected to be interrupted as a result of this. The towers can be strengthened by correct design to resist higher wind speeds (about 200 km/hr) and therefore avoid damage. Reputable organisations that specialise in tower structural design can be faced with the responsibility of developing an acceptable design for such unique mobile towers, which can then be accepted by Telecom Service Providers (while constructing the towers). It may cost more then regular towers, but funding for cyclone-resistant towers can be secured. The Department of Telecom established the Universal Service Obligation Fund (USOF) to subsidise the expansion of communications services in rural regions. State governments can collaborate with USOF officials to develop a system for providing subsidies to Telecom Service Providers for the construction of unique mobile towers in rural regions, particularly those near the shore.

11.2.5 WiMAX Technology

WiMAX (Worldwide Interoperability of Microwave Access) is a wireless access service designed to span vast geographical regions while delivering IP connection to a large number of users at a cheap cost. This is a new technology that is being standardised for convergent applications in the last mile that provide voice, video, and data. Because service providers in India are gradually offering this technology, state governments might consider it for deployment based on geography and danger profile for last mile connection.

11.2.6 Communication Platform for Protection from Floods

Elevated platforms for housing equipment must be considered by States/UTs

prone to recurrent floods of high frequency and severity to protect them from water entry and minimise breakdown during flood conditions.

11.2.7 Multi-Task Riverine Ship for Disaster

Management: Assam/West Bengal: The Brahmaputra and Ganges rivers in Assam and West Bengal, respectively, generate a variety of flood conditions that impair land-based connectivity, leaving river channels as the sole feasible mode of transit and travel during floods.

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