5. MAJOR ACHIEVEMENTS DURING THE DECADE

5.1 Through Space Technology application:

i. Agricultural Drought Monitoring has been carried out on fortnightly basis to provide near-real-time information on agricultural condition at District and Sub-District level during the paddy season. Eleven States of India have been covered.

ii. Based on the improved relationship obtained between vegetation index and major crop yield from August month onwards, the early warning on relative yield assessment is provided at District level.

iii. District-wise flood affected area statistics were generated during 1998 floods and information furnished to the Relief Commissioners of the States of Assam, UP and Bihar.

iv. Cyclone impact assessment was conducted successfully in recent past in Gujarat using multi-satellite data and ground verification.

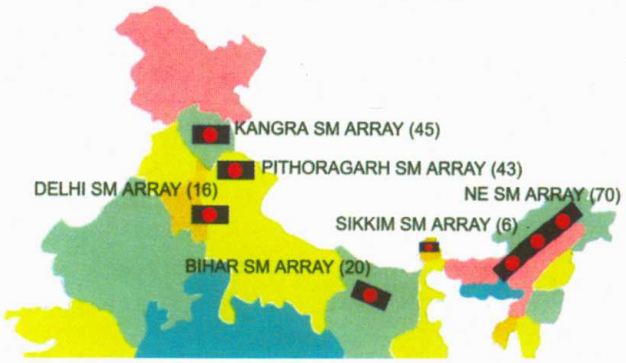
5.2 Through the NCDM

The NCDM and State Faculties at ATIs have already conducted numerous research documentation and other activities and training of personnel both from government and non-government sectors resulting in better situation in assisting the Central and State Relief Commissioners in the management of natural disasters.

The NCDM is also taking up collaborative action planning projects on Urban Risk Reduction and Capacity Building with organisations such as SEEDS and Disaster Mitigation Institute.

5.3 Through DST initiated projects:

- Induction of broadband digital stations with state-of-the-art communication links.
- 20 observatories of IMD in the shield region upgraded. Ten stand-alone digital observatories added.
- National Seismological Data Centre (NSDC) at IMD established
- Project databases at RRL, Jorhat and WIHG, Dehradun.
- Deep drilling at Latur has revealed sub-surface fault characteristics in the zone of the 1993 Maharashtra earthquake.
- Seismic tomography has brought out the velocity structure at Koyna.
- Precursory studies on Radon and Helium have shown correspondence with local seismicity in the Himalaya.
- Additional information generated on historical earth-quake in northern India covering medieval period.
- Data generated from the strong motion accelerograph network are used for engineering applications.



Strong motion accelerograph arrays
Source: Earthquake Research in India, Earth System Science Division, Department of Science and Technology, Government of India, 1999

- Strong motion instruments and digital accelerographs developed and field deployed.
- 160 scientists trained in seismic instrumentation, data acquisition and processing.
- Five special publications brought out.

5.4 Disaster Related Standardisation

A number of building codes and guidelines were developed through the Bureau of Indian Standards, BMTPC and SERC as stated below:

- ***Earthquake Resistant construction***

i IS 1893:1894 'Criteria for Earthquake Resistant Design of Structures'.
ii IS 4326:1993 'Earthquake Resistant Design and Construction of Buildings' - Code of Practice.
iii IS 13827:1993 'Improving Earthquake Resistance of Earthquake Building - Guidelines'.
iv. IS 13828: 1993 'Improving Earthquake Resistance of Low Strength Masonry Buildings - Guidelines'
v. IS 13920: 1993 'Ductile Detailing of Reinforced Concrete Structures subjected to Seismic Forces - Code of Practice'

- ***Flood Damages***

i. IS 13739 : 1993 'Guidelines for estimation of flood damages'.

- ***Hill Area Development***

i. IS 14496:1998 'Guidelines for preparation of landslide - Hazard zonation maps in mountainous terrain.
ii IS 14458:1998 'Guidelines for Retaining Wall for Hill Area : Part 1 Selection of type of wall; Part 2 Design of retaining/breast walls; Part 3 Construction.
iii Guidelines for Design and Selection of Building Materials for Residential Buildings in Hilly Areas of Seismic Zone V (under preparation).

- ***Guidelines for Improving Hazard Resistant Construction of Buildings and Land Use Zoning***

i Land use zoning in hazard prone areas - Guidelines (BMTPC).
ii Improving flood resistance of housing - Guidelines (BMTPC).
iii Improving wind/cyclone resistance of buildings - Guidelines (BMTPC).
iv Improving earthquake resistance of buildings - Guidelines (BMTPC).
v. Guidelines for Design and Construction of Buildings and Structures in Cyclone Prone Areas (SERC, Chennai).

5.5 Flood Forecasting

CWC had established 145 flood monitoring and forecasting stations in different reverain systems covering major parts of the country before 1990. During the Decade 12 more such stations have been established. The forecasting accuracy is increasing as will be seen from the following table:

S.No	Year	No. of Forecasts issued	Accuracy of Forecasts	
			No. of forecasts within ±15 cm	% of Accurate Forecasts
1	1991	5234	4890	93.4
2	1992	3588	3418	95.3
3	1993	5226	5066	96.9
4	1994	5472	5159	94.3
5	1995	5394	5203	96.5
6	1996	4983	4826	96.8

5.6 Hazard Assessment & Mapping

- Seismic hazard map of India and adjoining regions giving contours of expected values of acceleration having 10% probability of exceedance in 50 yr. has been prepared. This is available with GSHAP website (NGRI).
- Data on cyclone tracks over the last 100 years have been digitized, and using a knowledge based computer software developed in-house, the probability of cyclone crossings along the coastal regions for a given origin of a future cyclone can be determined (SERC).
- Analytical modelling for carrying out risk and vulnerability analysis for structural systems, and regions exposed to cyclone damage based on knowledge based expert systems and neural network methodologies have been developed (SERC).
- Risk analysis of cyclonic wind speeds has been carried out and a cyclonic wind speed map developed for the coastal regions of the country (SERC).

5.7 Awareness and Information Dissemination

A number of brochures and fliers with regard to earthquakes and cyclones have been printed and distributed to the lower level technical personnel as well as the disaster affected people on a large scale such as the following:

a. Posters

(in English, Hindi, Tamil and Telugu languages) on Improvements in Building Layouts; Improvements to Roofs and Walls of Buildings; Improvements for Thatched Roofs and Mud Walls and Improvements to Tiled/A.C. Sheet Roofs to reduce damage due to cyclones.

b. Brochures on the following:

i. Guidelines for Mitigating Damage to Dwellings (in English, Hindi, Tamil, Telugu, Oriya and Bengali).
ii. Guideline on House Construction in Chamoli Earthquake affected areas (in Hindi by HUDCO, BMTPC).
iii. Guideline 1 - Earthquake Resistant construction of houses in Chamoli earthquake affected area (in Hindi by HUDCO, BMTPC)
iv. Guideline 2 - Repair and Retrofitting of damaged houses in Chamoli earthquake affected area (in Hindi by HUDCO, BMTPC)
v. Retrofitting of stone houses in Marathwada Area of Maharasthra, March 1994 (BMTPC).
vi. Earthquake and Building, A guidebook to understand the relationship between the two (Arya, Revi, Jain) 1994.
vii. Build Your Home with Earthquake Protection (BMTPC).

Similar brochures were made for Jabalpur earthquake affected area.

c. Preparation of Bibliographies

Annotated Bibliographies were compiled as follows:

i. Earthquake Effects on and Earthquake Resistant Design and Construction of Non-Engineered Buildings (BMTPC).
ii. Cyclone Effects on and Cyclone Resistant Design and Construction of Non-Engineered Buildings (BMTPC).

d. Preparation of Video Films

Training Films were prepared in VHS format in English and Hindi on retrofitting of stone houses as follows:

i. A Stitch in Time - An introduction to Seismic Retrofitting of Stone Houses (English 15 minutes, BMTPC).
ii. Seismic Retrofitting in 4 parts (Hindi, 45 Minutes, BMTPC)
   - Installation of headers
   - Reduction of weight on the roof
   - Installation of knee braces
   - Installation of seismic bands.
iii. Video film on 'Tackling Landslides by ES and AVRC-University of Roorkee
iv. 'Build a Safer Tomorrow' by BMTPC.

e. Post Disaster Damage Assessments

i. Andhra Cyclone Identification Mission – an independent appraisal Nov 1996 (Taru Research and Information Network).
ii. Post-earthquake guidelines for damage assessment, repair and retrofitting of houses and reconstruction and new construction of houses in the earthquake affected areas of Jabalpur and Chamoli have been prepared in bilingual form using Hindi and English for training of the technical staff (BMTPC, TARU, Arya).

5.8 Cyclone Warning and Management

Saving of human lives in the severe cyclone of 1990 at Andhra Pradesh and 1999 in Gujarat through reliable cyclone warnings issued and the evacuation carried out by Government of Andhra Pradesh and Gujarat respectively saved thousand of precious lives as compared with huge loss of lives that had occurred in earlier cyclones in 1977 and 1998 in the same areas.

Andhra Pradesh presents success story of disaster management through Cyclone Emergency Reconstruction Project carried out from 1990-94 under which besides DWS, cyclone shelters were constructed in cyclone prone areas. This programme is further expanded thereafter through the Decade.