इनसिड
INCID

NON-STRUCTURAL ASPECTS OF FLOOD MANAGEMENT IN INDIA

ABRIDGED VERSION

भारतीय राष्ट्रीय सिंचाई एवं जल निकास समिति
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INDIAN NATIONAL COMMITTEE ON IRRIGATION AND DRAINAGE

FOREWORD

Floods constitute one of the major national calamities faced by India almost every year resulting in substantial loss of life, large scale damage to property, disruption of community lifelines besides entailing untold misery to the millions. Concerted efforts have been made over the years to reduce the damage due to floods and mitigate the sufferings of the people. Various structural flood control measures were taken up in the past including construction of reservoirs, embankments, drainage channels, etc. It is, however, now realised that absolute and permanent protection to all flood prone areas and for all magnitudes of floods by structural measures alone is impossible and also not economically viable. The emphasis has therefore been rightly shifted to non-structural measures like Flood Plain Zoning and Regulation, Flood Forecasting, etc., to effectively supplement the structural measures for providing sustainable protection to flood affected areas. Non-structural strategies such as controlling future developments in flood-prone areas, automation of flood warning systems, obligatory insurance of structures and crops in flood plains etc. are increasingly adopted by many countries including Canada, France, Hungary, Poland, U.S.A. etc.

A detailed Publication providing an extensive coverage of the Non-Structural Aspects of Flood Management in India was brought out in February, 1993 by the Indian National Committee on Irrigation and Drainage (INCID) to serve as a reference document to all those engaged in Flood Management in India. This detailed Publication circulated widely within and outside the country was very well received. The recent large floods of 1993 and their consequent damage in the North-eastern States, West Bengal, North Bihar, Uttar Pradesh, Himachal Pradesh, Punjab, Haryana, Maharashtra, Karnataka and Tamil Nadu have again highlighted the importance of the Non-Structural Aspects of Flood Management in

India. An abridged version of the Non-Structural Aspects of Flood Management in India covering the damage due to recent large floods is now brought out to meet the growing demands from different parts of the Country. I hope that this abridged version would be a useful guide to a large number of functionaries engaged in Flood Management.

Thanks are due to the INCID Working Group on Flood Management headed by the Chief Engineer (FM), Central Water Commission and the Convenor Shri M.L. Baweja, Director (FCD), Central Water Commission but for whose sustained efforts, the earlier detailed publication and the present abridged version might have run into rough weather. Their contributions as well as the assistance of Shri R. Rajappa, Chairman and Managing Director, WAPCOS, Shri A.S. Rao, Member-Secretary, INCID and Chief Consulting Engineer, WAPCOS, and Shri N.K. Dikshit, Consultant, WAPCOS who have played a significant role in bringing out these publications, are gratefully acknowledged.

MSReddy

NEW DELHI

MARCH, 1994

(M.S. REDDY)
Secretary, MOWR &
Chairman, INCID & CWC

NON-STRUCTURAL ASPECTS OF FLOOD MANAGEMENT IN INDIA

(ABRIDGED VERSION)

1.0 INTRODUCTION

India is a vast country with various agro-climatic regions having varied climate and rainfall patterns. It is,therefore, not uncommon to find one part of the country under the grip of severe floods due to excessive rainfall, while another is afflicted with drought. Many a time, it so happens that some areas in the same State, have excessive rainfall and floods, while some other areas suffer due to poor rainfall and consequent drought. Although man has had to live with floods ever since he came into existence, the impact of floods was perhaps, not felt to the same extent in the past, as it is now experienced, due to lesser population inhabiting the land and lesser pressure of industrial activities and other developmental works on the plains then. With the rapid increase in population and resultant developmental activities, the flood plains are being increasingly occupied, as a result of which, flood damage continues to show an increasing trend inspite of substantial flood control measures undertaken in the past few decades.

2.0 FLOOD PROBLEM IN INDIA

2.1 General

The average annual rainfall in India is about 1150 millimetres with significant variation in its areal distribution. The South-West monsoon is the principal rainy season accounting for 80% or more of the annual rainfall and most of the floods occur during this season although some parts of Tamil Nadu, Andhra Pradesh and Orissa are subject to floods by North-East Monsoon also. The river systems can be grouped into

four regions, viz. Brahmaputra; Ganga; North-West; and Central India & Deccan Region. The National Flood Commission estimated in 1980, the area liable to floods as 40 million hectares. Considering the areas affected under different frequencies of flood viz. 25, 50, 100 years or higher (flood frequency in a period is the magnitude of flood occuring once in that period), it has been assessed that the protectable area is 32 million hectares, of which 13.8 million hectares has already been protected by the end of the Seventh Five Year Plan (1985-90).

2.2 Development before Independence of the Country (1947)

Almost all the civilisations which flourished in ancient times in the fertile river valleys, have left behind an account of impressive flood protection works. The ancient flood control measures consisted of embankments along the rivers and tributaries and channel improvements. Flood protection embankments were constructed on a number of rivers whose maintenance was given due importance by the then rulers. At the time of independence (1947), embankments existed along the rivers Damodar and various channels of Sunderbans in West Bangal; Mahanadi, Brahmani and Baitarni in Orissa; Gandak and some stretches along Ganga and other rivers in Bihar; Brahmaputra and some stretches along its tributaries in Assam and along Cauvery in Tamil Nadu, in a total length of 5280 km, providing protection to an area of 3 million hectares.

2.3 National Policy on Flood Problems and Remedies.

During the first three years of the First Five Year Plan (1951-56), an amount of Rs 14 million was spent on flood control programme which resulted in completion of 656 kilometres of embankments along the Ganga, Burhi Gandak and other rivers in Bihar (456 km) and along Brahmaputra (60 km) and other rivers (140 km) in Assam.

With the devastating and unprecedented floods of 1954, the Government of India announced a National Policy on Flood Control

which resulted in a comprehensive approach to the problem. In the initial policy statement of September 1954, the programme of implementation was outlined as follows :

A. Immediate Phase (Within two years)
   a) Embankments at related sites.
   b) Revetments and spurs, as a measure of protection of towns against river erosion.
   c) Intensive collection of data, investigation and preparation of project reports for short term phase.

B. Short-term Phase (from 3rd to 7th year)
   a) Embankments.
   b) Channel Improvements.

C. Long-term Phase (from 8th to 12th year)
   a) Construction of selected storage reservoirs.
   b) Additional embankments wherever necessary.

D. Beyond Long Term Phase (After 12 years)
   a) Other Long Term Measures.

E. Inter-se priority in the programme.

Besides the programme indicated in the policy statement, flood warning and watershed management were also to be added as important measures needed. Subsequently, a number of Committees both at official level and Ministers' level recommended implementation of the programme from time to time and gave proper directions for its success.

The total investment on the flood control programme during the first six Five Year plans and Annual Plans from 1951 to '85, was Rs 17,628 million which protected an area of 13.01 million hectares. The investment during Seventh Five Year Plan (1985-90), however, was Rs 9494 million which was indeed a big effort when compared to the achievement in the first six Five Year Plans. The additional area protected in the Seventh Plan was 0.79 million hectares. Thus, the

total investment upto the end of 7th Plan was Rs 27,122 million which provided a reasonable protection to 13.8 million hectares.

2.4. Flood Damage.

a) Past Floods.

Heavy flood damage had occurred in the country during the years of 1955, 1971, 1973, 1977, 1978, 1980, 1984, 1988 and 1989. An analysis of data available from the States for the period 1953-90 reveals that the average annual value of damage to crops, houses and public utilities in the country was around Rs 9380 million. On an average, an area of about 7.95 million hectares was flooded, of which, average crop area affected was of the order of 3.7 million hectares. The floods claimed on an average 1532 human lives and 10,000 heads of cattle every year.

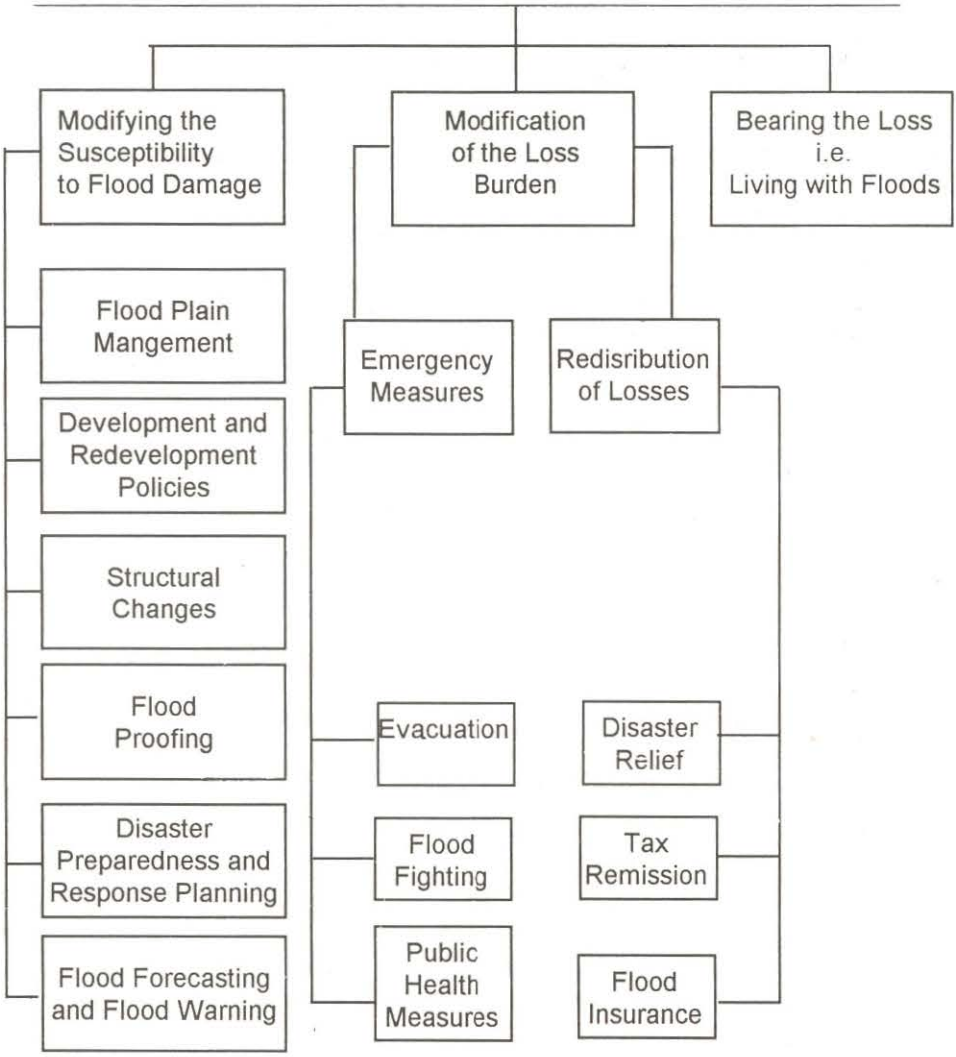
b) Recent Floods of 1993.

Severe floods had occurred in the North-eastern States of Assam, Mizoram, Tripura and Manipur causing submergence of large cultivated areas, wide-spread land slides disrupting rail and road traffic and acute drainage congestion. The mighty Brahmaputra, Barak and its tributaries inflicted severe damage to crops and loss of life and cattle, submerging an area of 0.46 million hectares affecting a population of 2.3 million in 20 out of 23 districts of Assam mainly. The rivers of North Bihar flooded an area of 0.571 million hectares, affecting a population of 4.545 million, causing damage to public utilities valued at Rs 2843 million, besides loss of human lives and cattle.

As per the preliminary assessment, an area of 0.607 million hectares was inundated in Punjab, affecting a population of 2.5 million and a crop area of one million hectares. In Haryana and Himachal Pradesh also, vast stretches of area were affected.

Detailed assessments to the damage of irrigation works, communication

NON-STRUCTURAL METHODS OF FLOOD MANAGEMENT



networks, electricity installations, crops and properties would be made by the various State Governments when more accurate data regarding damage would be available.

3.0 PAST APPROACH TO FLOOD MANAGEMENT IN INDIA.

The general approach in the past has been one of adopting structural measures like embankments, reservoirs, anti-erosion and bank stabilisation works etc. With the launching of National Policy on Flood Control in 1954, the tempo of construction of structural works had increased rapidly from year to year, with the result, the length of embankments increased from 6000 kilometres in 1954 to 15,675 kilometres in 1990, besides improvement of 30,857 kilometres length of drainage channels.

4.0 NEED FOR REVIEW OF STRATEGY.

For assessing the effectiveness of past measures and evolving future approach, a National Commission on Floods (Rashtriya Barh Ayog) was set up by Government of India in 1976. In the report submitted in 1980, the Commission, inter alia, laid great stress on proper flood management by adopting both the Structural and Non-Structural Measures. Subsequently, specific problem of the Ganga and the Brahmaputra were reviewed by a High Level Committee. As a result of these reviews, the flood management strategy evolved was aimed at a suitable blend of structural and non-structural measures with emphasis on latter which provide long-term strategy with time and cost effectiveness to mitigate the flood fury.

5.0 NON-STRUCTURAL MEASURES.

Non-structural measures contrary to the structural measures of flood plain management, rather than aiming to mitigate the flood damage by trying to keep the flood waters away from the people, strive to keep

the people away from flood waters, bearing in mind the stark reality that the flood plains in fact, belong to the river and that the floods are not only a curse, but also a blessing in disguise in some ways. It contemplates use of flood plains judiciously, simultaneously permitting to vacate the same for use of the river whenever the situation so calls for. This technique allows the use of flood plains reducing the hazard, while retaining its beneficial effects.

In view of cost effectiveness of the non-structural measures and speedier implementation, as more and more human encroachments and activities are taking place in the flood plains in our country, the main thrust is now on the non-structural flood management measures.

The non-structural measures which are being implemented are:

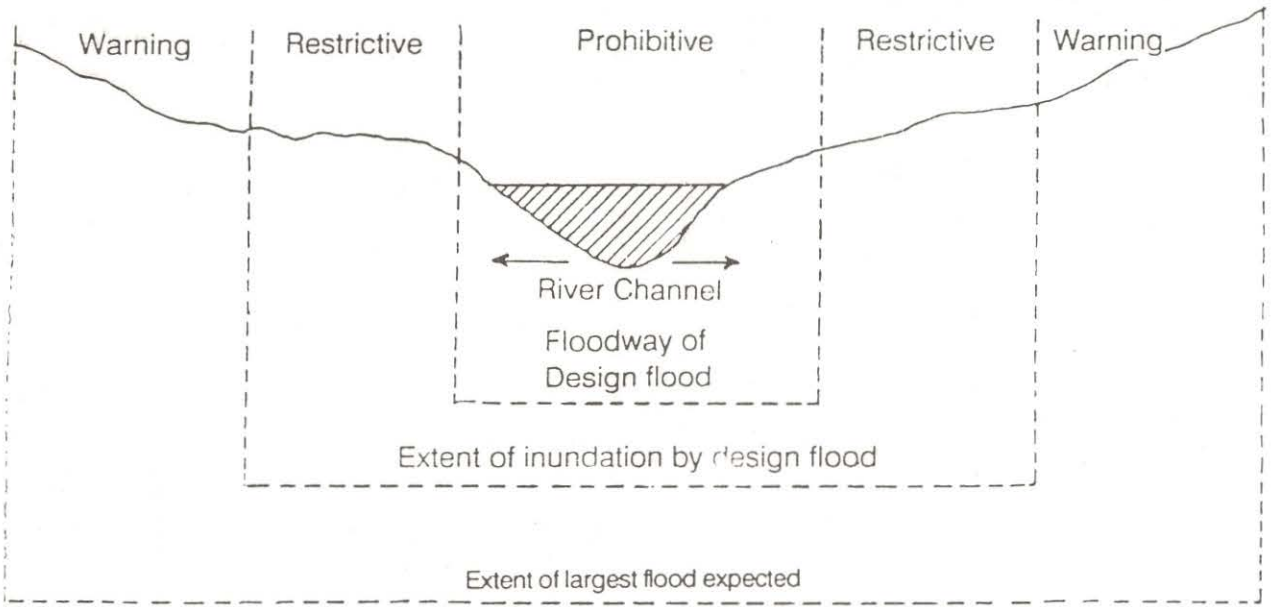
A. Modifying the Susceptiblity to flood damage.
   i. Flood Plain Management
   ii. Flood Proofing Including Disaster Preparedness and Response Planning.
   iii. Flood Forecasting and Warning.

B. Modifying the loss burden.
   i. Disaster Relief.
   ii. Flood Fighting including public health measures.
   iii. Flood Insurance.

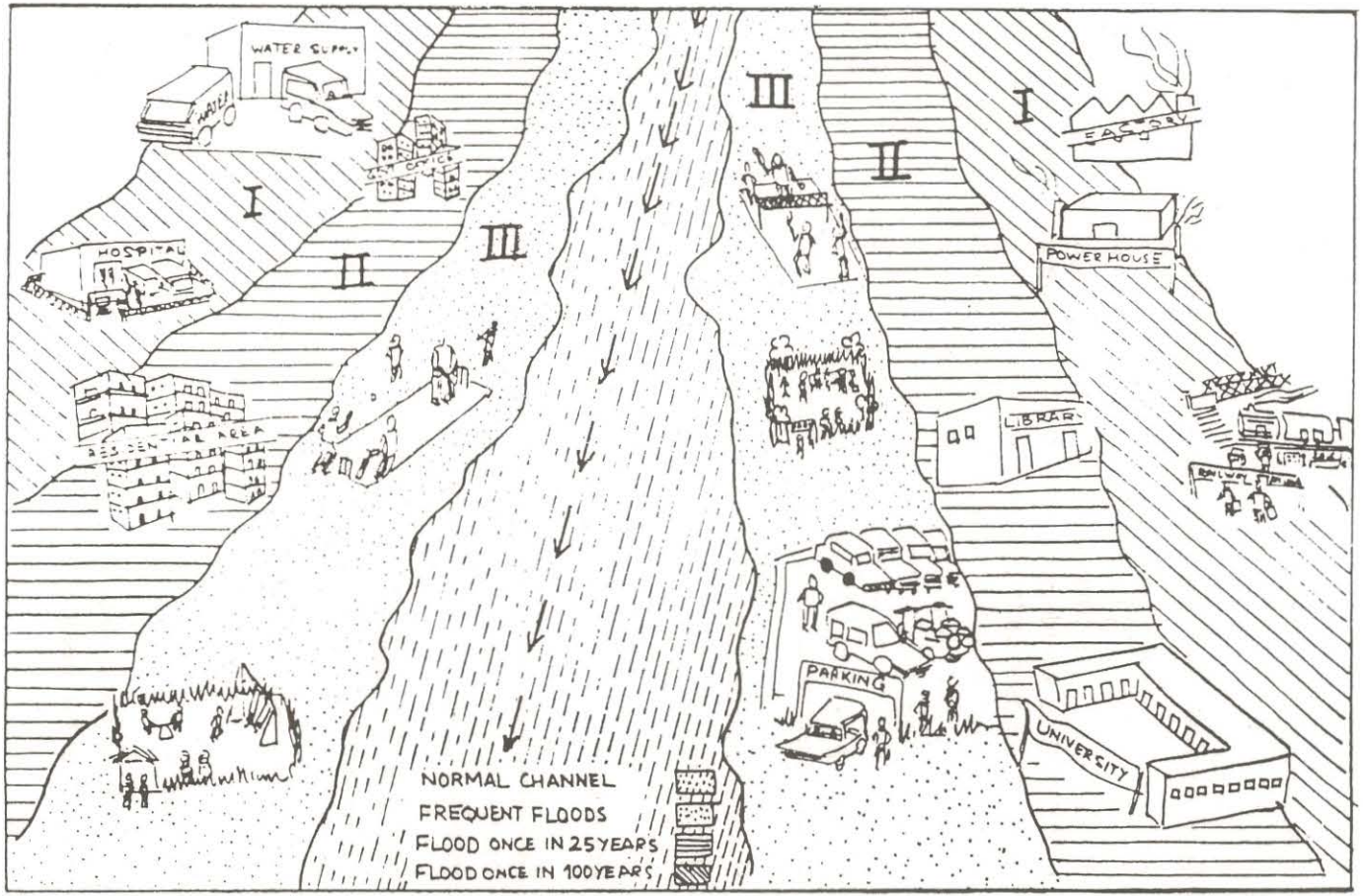
The progress made under each of the above measures is briefly brought out in the succeeding paragraphs.

5.1 Flood Plain Management

The basic concept is to regulate the land use in flood plain zoning in order to restrict the damage potential. The Rashtriya Barh Ayog (1980) recommended that flood plain management measures should be undertaken and suitable legisation enacted wherever necessary. Accordingly, Central Water Commission (CWC) prepared guidelines



FLOOD PLAIN ZONING



FLOOD PLAIN ZONING

for flood plain zoning and also a model bill way back in 1975, which was circulated by the then Ministry of Irrigation to all the States advising them for enactment of suitable legislation. In order to help the States to properly demarcate the flood prone areas according to various flow frequencies, CWC also initiated through Survey of India, preparation of flood risk maps to a scale of 1:15,000 with a contour interval of 25 cm. By the end of Seventh Plan (1985-90), an area of 50,000 sq km was covered by these Surveys against the total area of 100,000 sq km identified by the States. The progress made by States towards enactment of legislation on the lines of model bill circulated by the Central Government, was not encouraging. Only one State viz Manipur had enacted the legislation. The matter is in different stages of consideration in different States and needs to be expedited. Voluntary agencies can, however, create awareness among people occupying the flood plains to co-operate with the Government to enable implementation of Zoning objectives.

For regulating land use in different flood zones, the priorities envisaged are :

Priority 1

Defence installations, industries, public utilities like hospitals, electricity installations, water supply, telephone exchanges, aerodromes, railway stations, commercial centres, etc.

The buildings should be located in such a fashion that they are above the levels corresponding to 1 in 100-year flood or maximum observed levels. They should be above the levels corresponding to a 50-year rainfall and likely submergence due to drainage congestion.

Priority 2

Public institutions, Government Offices, Universities, Public Libraries and residential areas.

Buildings could be located above 25 year flood zone with the stipulation that they are built on stilts or far higher levels as indicated above.

Priority 3

Parks and Play Grounds, Parking Places.

These could be located in areas vulnerable to frequent floods.

5.2 Flood Proofing.

Flood proofing measures help greatly in the mitigation of distress and provide immediate relief to the population in flood prone areas. It is essentially a combination of structural change and emergency action, not involving any evacuation. The techniques adopted consist of providing raised platforms for flood shelter for men and cattle and raising the public utility installations above flood levels.

In case of urban areas, certain measures that can be put into action as soon as a flood warning is received involve: Installation of removable covers such as steel or aluminium bulk heads over doors or windows, permanent closure of low level windows or other openings, keeping store counters on wheels, closing of sewer well, anchoring machinery, covering machinery with plastic sheet, seepage control, etc.

Flood proofing also tends to encourage persistent human occupancy of flood plains. Flood proofing measures taken in the past in India consisted of raising of a few flood prone villages, above pre-determined flood levels and connecting them to nearby roads or high lands. Under this programme, several villages were raised in Uttar Pradesh. In West Bengal and Assam also, land fills were attempted in villages to keep houses above flood levels in some areas, eventhough nearby agricultural lands were liable to inundation. The programme of

raising of villages taken up in the Second Plan Period, was subsequently discontinued because it was observed that this method did not provide any protection at all to the surrounding agricultural areas.

The objectives and scope of the flood proofing programme proposed to be undertaken in the near future, are as follows :

I. Quick Drainage Facility.

   a. Resuscitation of secondary and primary drainage channels after establishing the drainage blockage points;
   b. Provision of additional waterways;
   c. Clearing of clogged cross drainage works;
   d. Improving the gates of existing sluices and/or making their operation semi-automatic.

II. Potable Drinking Water and Sanitary Arrangements.
   a. Providing uncontaminated drinking water facility;
   b. Providing 'Sulabh Sauchalaya' Units i.e. efficient public lavatories.

III. Human Dwellings and Animal Shelters.
   a. Providing temporary shelters for population living within embankments;
   b. Providing raised platform or rehabilitation on high ground for population living in permanently drainage congested areas near confluence of rivers in flood affected areas;
   c. Providing raised platforms for animals.

IV. Storage facilities for food grains, fodder and other essential commodities.
   a. Providing flood storage facilities in "Block" headquarters for catering to flood shelters;
   b. Providing fodder storage facilities in "Block" headquarters.

V. Communication links like telephone/wireless/road/rail/boat.
   a. Providing road links from shelters to the "Block" headquaters;
   b. Raising of existing village roads in drainage congested

areas;

c. Providing a power boat for each of the shelters;
d. Provision of telephone/wireless communication to "Block" headquarters.

For this purpose, it is proposed to carry out frequency analysis which shall identify those areas which are prone to flooding every year, once in five years, once in 25 years and the rest. On the basis of such identification, the areas which suffer at least once in five years shall be selected for treatment.

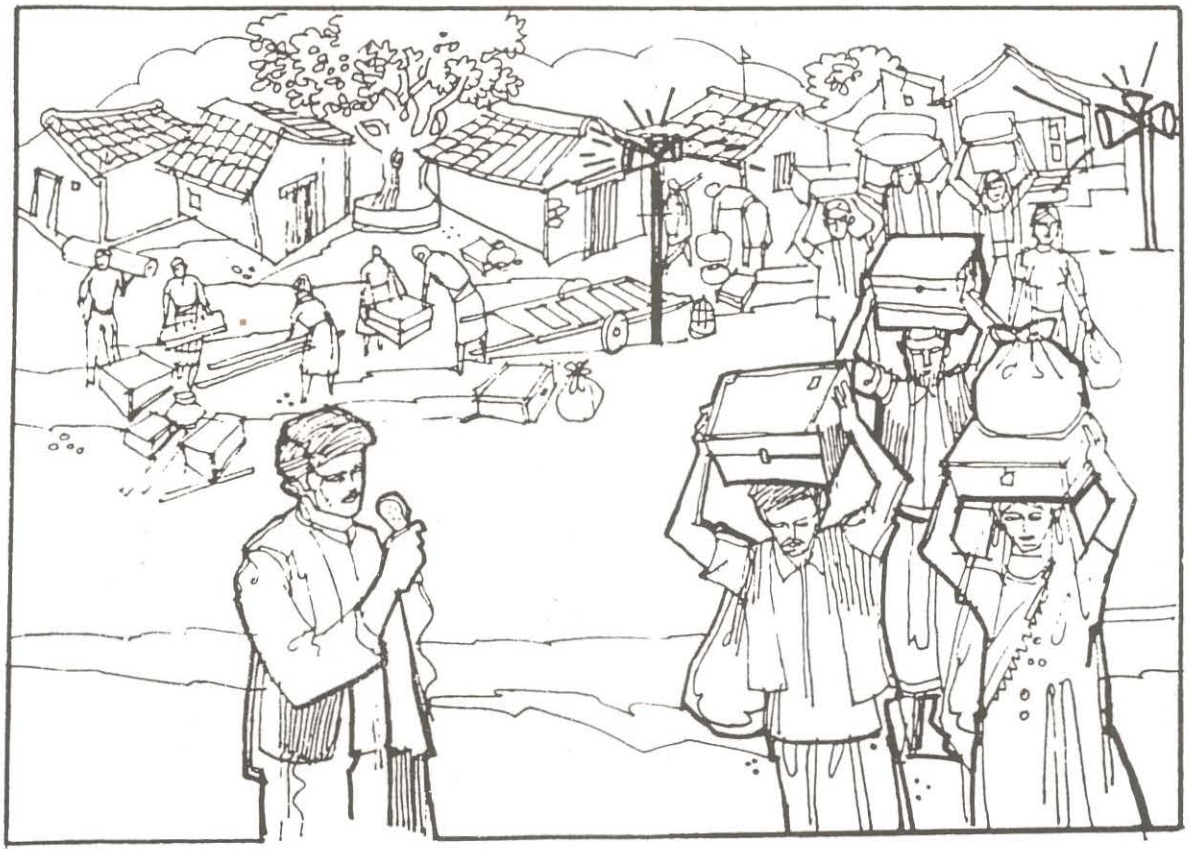
In the Eighth Five Year Plan (1992- 97), flood proofing programme is proposed in the Ganga basin States, more particularly for areas in North Bihar.

Disaster Preparedness and Response Planning.

The suddenness of disaster as well as its destruction potential render preventive action on a scale difficult to cope with a normal administrative set-up. The only way to meet such a situation is preparedness to face the disaster i.e. by a detailed planning for prompt and efficient response with anticipatory approach to natural disaster and to mitigate its impact by timely rescue, relief and rehabilitation operations. Disaster preparedness helps flood warning and inculcate in them a disaster conscious attitude between events.

These plans made in advance for disaster mitigation, warning, emergency operations, rehabilitation and recovery will involve activities such as training, post-disaster evaluation review and co-ordination of Central, State and local level preparedness programmes and research. Recovery planning will involve both long range and immediate recovery programmes.

The management of disaster in our country is primarily a Government responsibility. Voluntary agencies, Panchayats and Co-operative societies, due to their capacity to interact with the masses at grass root



FLOOD WARNING

level have enormous potential in playing a very vital and constructive role in creating awareness among the people towards disaster management.

The Ministry of Agriculture have brought out a Model Action Plan of disaster preparedness for Floods and circulated to States and Union Territories. A Group on Disaster Preparedness and Management set up by the Planning Commission had recommended constitution of a National Institute of Disaster Training and Management to look into all aspects of disaster management.

5.3 Flood Forecasting and Warning.

Of all the non-structural measures of flood management which rely on the modification of susceptibility to flood damage, the one which is gaining increased/sustained attention of the planners and acceptance of the public is the Flood Forecasting and Warning. Flood Forecasting and Warning was first commenced in India in the year 1958 for the river Yamuna. It now covers most of the flood prone inter-state river basins in the country as indicated below :

i. The Ganga and its tributaries.
ii. The Brahmaputra and its tributaries.
iii. The Barak and its tributary, the Katakhal.
iv. West flowing rivers viz. the Narmada, the Tapti, the Daman-Ganga, the Sabarmati, the Banas, the Mahi.
v. The Krishna, the Tungabhadra, the Bhima.
vi. The Godavari, the Wainganga, the Indravati.
vii. East flowing rivers viz. the Mahanadi, the Subernarekha, the Burha-Balang, the Baitarni, the Rushikuliya and the Vamsadhara.

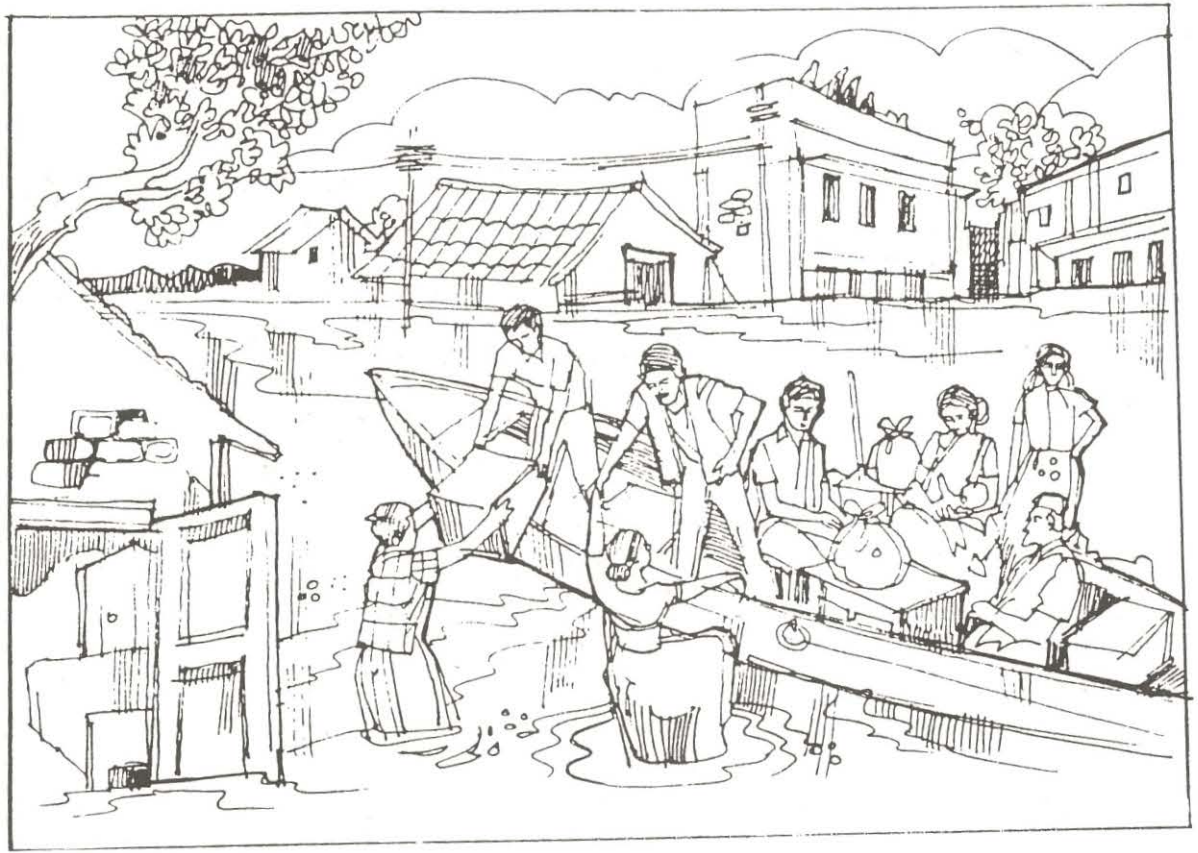
The flood forecasting organisation set up in Central Water Commission is presently responsible for issuing forecasts at 157 stations, of which 132 are for water stage forecast and 25 for inflow forecast used for optimum operation of certain major reservoirs. These 157 stations are located in the 11 flood prone States and 2 Union-Territories as shown in the table :

States	No.of Stations
Andhra Pradesh	11
Assam	23
Bihar	36
Gujarat	10
Haryana	1
Karnataka	4
Madhya Pradesh	3
Maharashtra	7
Orissa	11
Uttar Pradesh	33
West Bengal	14
Union-Territories	
Delhi	2
Dadra & Nagar Haveli	2
Total Stations	**157**

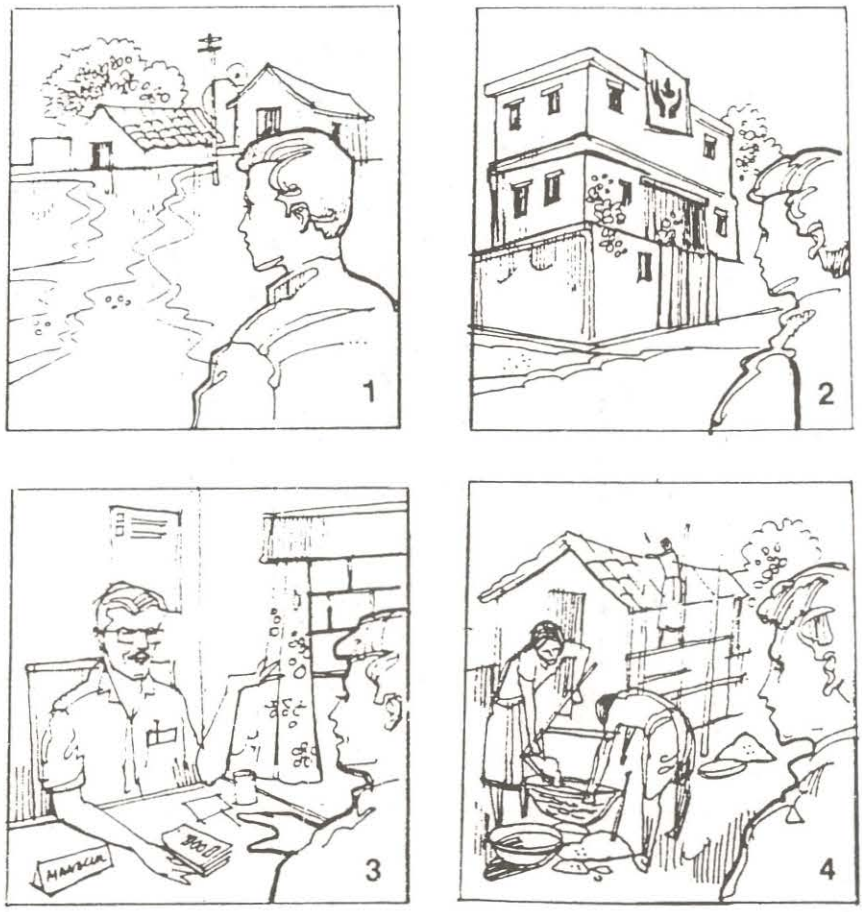
The total number of forecasts issued by the above organisation increased from 6964 in 1978 to 8566 in 1990. The percentage of accurate forecasts also increased from 82 in 1978 to 95 in 1989.

The State Governments and various agencies incharge of Flood Management and Relief Operations are benefitted extremely with the reliable and timely flood forecasts furnished by the Central Water Commission during different flood seasons and conveyed their appreciation for the excellent work being done by that premier organization of national importance. However, States should also develop their own flood forecasting networks to supplement the national networks to be more effective.

For improving the quality of forecasts further, modernisation of existing networks has been taken up with external aid from donor agencies



FLOOD FIGHTING - EVACUATION OF PEOPLE FROM FLOODED ZONE



FLOOD INSURANCE

1. Flood Insured Property damaged by floods.
2. Owner approaches Insurance Office.
3. Insurance Officer settling the claim.
4. Reconstruction of damaged property with the payment received.

like UNDP, DANIDA, USAID, etc. Co-operative programme with the friendly neighbouring countries such as Nepal, Bhutan has also been taken up to provide better forecasts in these countries and also India particularly for rivers originating from these countries.

6.0 MODIFYING THE LOSS BURDEN.

Under the approach which envisages a strategy to assist the individual and the community in the preparatory, survival and recovery after floods, the following measures are usually taken:

i. Flood Disaster Relief.
ii. Flood Fighting including Public Health Measures.
iii. Flood Insurance.

6.1 Flood Disaster Relief.

The relief is extended by the local agencies both in the Government and Voluntary sectors on the basis of assessment made immediately after the occurrence of the disaster. However, relief programme is initiated on the basis of detailed assessment of damage made at the District and Tehsil Level and the funds available with State Governments. On the basis of recommendation of Ninth Finance Commission, funds were released to States for the Calamity Relief Fund and the States were free to utilise the funds to deal with the natural calamity without any reference to the Centre. Detailed guidelines for operation of the funds are issued by Ministry of Agriculture which coordinates the relief programmes at the centre.

6.2 Flood Fighting.

This covers building temporary dykes, along the rivers, dowel bunds on the banks, closing small breaches immediately, attending to scour, wave wash, sand boils, evacuating goods and equipments out of the flood zone, protecting equipments with plastic cover, etc. It also

includes public health measures to prevent health hazards, restoration of water supply and sewerage facilities. These steps require advance planning of equipment and preparedness to fight floods. Co-ordination of efforts with voluntary organisations such as Red Cross; Home Guards; Panchayats and local people etc. is also necessary.

6.3 Flood Insurance.

Flood insurance has several advantages as a means of modifying the loss burden. So far, it has not been widely adopted in India. It is more popular in certain urban areas and big towns where damage due to inundation caused mostly by excessive rainfall is covered by Insurance Policies. Recently a study has been taken up for demarcating flood risk zones in the country for arriving at a suitable criteria for working out the insurance premium. The Ministry of Agriculture has taken up a pilot scheme for crop insurance in the flood affected areas.

7.0 INTEGRATED APPROACH TO FLOOD MANAGEMENT.

Flood Plain Zoning and Flood Forecasting and Warning constitute the main Non-Structural Measures. While Flood Forecasting and Warning is being effectively managed by the Central Water Commission and other Central and State Agencies, not much progress has been achieved on Flood Plain Zoning. The implementation of this measure requires political will. The Structural and Non-Structural Aspects would provide an integrated approach to the Flood Management Programme. While Structural Aspects would keep the floods away from the people, the Non-Structural Aspects are aimed at keeping the people away from the floods. Therefore, a judicious mix of Structural and Non-Structural Aspects would optimise benefits that would accrue from Structural Measures.

8.0 NATIONAL WATER POLICY.

The National Water Policy adopted by the Country in 1987 envisages preparation of a master plan for flood control and management for

each flood prone river basin. It stipulates sound watershed management through extensive soil conservation, catchment area treatment, preservation of forests and increasing forest areas and construction of check dams. Adequate flood cushion should be provided in water storage projects wherever feasible to facilitate better flood management. An extensive network of flood forecasting stations should be established for timely warning to the settlements of flood plains, alongwith regulation of settlements and economic activity in flood zones to minimise the loss of life and property on account of floods. While the physical flood protection works like embankments and dykes will continue to be necessary, the emphasis should be on Non-Structural measures for minimisation of losses, such as flood plain zoning so as to reduce the recurring expenditure on flood relief. To oversee implementation of the policy, a National Water Board has been set up in 1990 which reports to the National Water Resources Council.

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What National Water Policy Says:

National Water Policy (1987) emphasises establishment of extensive network of flood forecasting stations for timely warning to the settlements of flood plains alongwith the regulation of settlements and economic activity in flood zones, to minimise the loss of life and property on account of floods. The policy further lays emphasis on non-structural measures such as flood plain zoning so as to reduce the recurring expenditure on flood relief.

Implementation of this policy needs enactment of suitable legislation by the States for which a model bill for flood plain zoning has already been circulated by the Central Government in the Seventies.

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