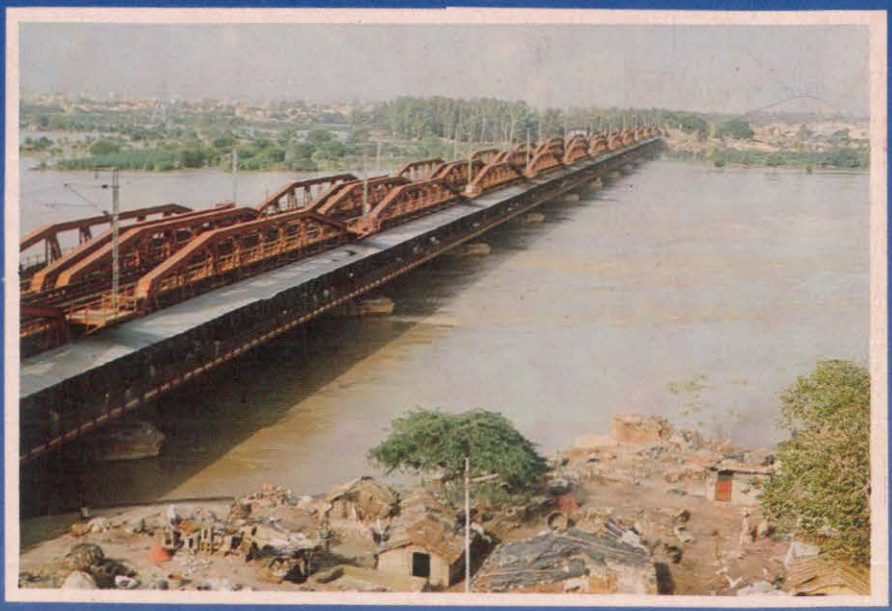
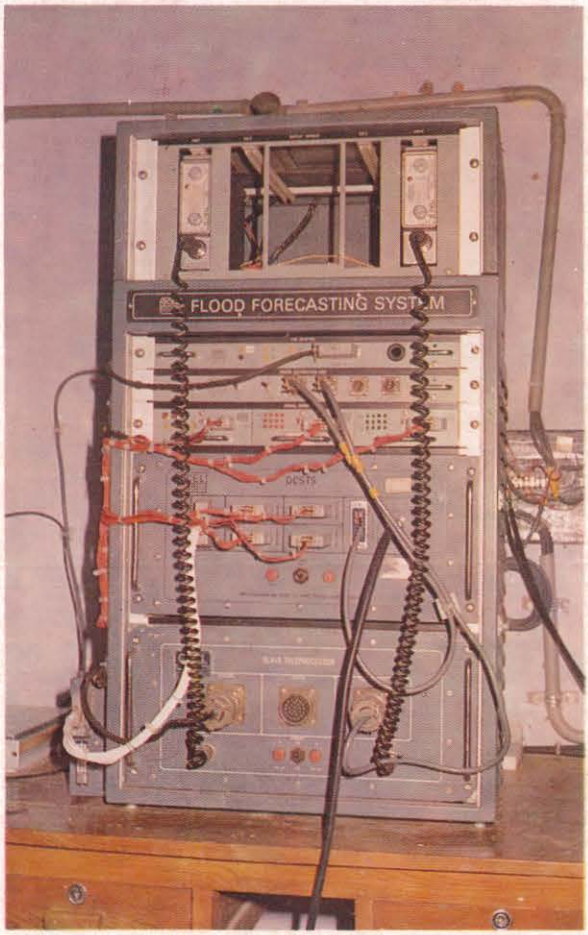
NON-STRUCTURAL ASPECTS OF FLOOD MANAGEMENT IN INDIA



INCID

INDIAN NATIONAL COMMITTEE ON IRRIGATION AND DRAINAGE

(Constituted By Ministry of Water Resources, Govt. of India)



Flood Forecasting Equipment on River Yamuna

Front Cover : River Yamuna in flood at old Delhi Railway Bridge - 1989

Back Cover : Area Flooded by River Tista in North Bengal - 1990

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NON-STRUCTURAL ASPECTS OF FLOOD MANAGEMENT IN INDIA

NEW DELHI.
FEBRUARY, 1993

STATUS REPORT ON NON-STRUCTURAL ASPECTS OF FLOOD MANAGEMENT IN INDIA

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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 are increasingly adopted by many countries including Canada, France, Hungary, The Netherlands, Poland, U.S.A., etc. This document provides an extensive coverage of the Non-structural Aspects of Flood Management in India.

Indian National Committee on Irrigation and Drainage (INCID) through its Working Group on Flood Management had compiled this Status Report to serve as a reference document. The Engineers, Scientists, Administrators and others engaged in Flood Management as also the general public inhabiting the flood prone areas may be benefitted by the report. I would like to congratulate the Working Group Chairman Shri P.C. Jain, Chief Engineer (FM), Central Water Commission and the Convenor Shri M.L. Baweja, Director (FCD), Central Water Commission, for their sustained efforts in bringing out this report. Assistance rendered by Shri R. Rajappa, Managing Director, WAPCOS; Shri A.S. Rao, Member-Secretary, INCID and Chief Consulting Engineer, WAPCOS and Shri N.K. Dikshit, Consultant, WAPCOS is gratefully acknowledged.

MSReddy

(M.S.REDDY)
Chairman, INCID &
Central Water Commission

NEW DELHI
FEBRUARY, 1993

STATUS REPORT ON NON-STRUCTURAL ASPECTS OF FLOOD MANAGEMENT IN INDIA

EXECUTIVE SUMMARY.

1. INTRODUCTION.

India is a vast country with various agro-climatic regions having varied climate and rainfall patterns. Many parts of the country are visited by floods annually. With the rapid increase in population and consequent developmental activities, the flood-plains are being increasingly occupied resulting in more and more flood damage every year despite substantial flood control measures undertaken all along. On an average, the area affected by floods annually is about 7.95 m.ha, of which crop area affected is about 3.7 m.ha. The floods have claimed on an average 1532 human lives and 10,000 heads of cattle every year.

2. FLOOD PROBLEM IN INDIA.

The average annual rainfall in India is about 1150 mm with significant variation in its areal distribution. The South- West monsoon is the principal rainy season which accounts for more than 80% or more of the annual rainfall and most of the floods occur during this season. 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 m.ha. Considering the areas affected under different frequencies of flood viz.25, 50, 100 years or higher, it has been assessed that

the protectable area is 32 m.ha. of which 13 m.ha. have been protected by the end of Seventh Five Year Plan (1985-90).

3. FLOOD MANAGEMENT MEASURES.

Flood Management activities can be grouped under four major categories viz. attempts to modify the flood, attempts to modify the susceptibility to flood damage, attempts to modify the loss burden, and bearing the loss or living with floods. The flood management measures can also be classified broadly as structural and non-structural measures. The activities of 'modifying the flood' are in the nature of physical measures and hence are 'Structural measures'. The remaining three categories mentioned above are 'Non-structural measures'.

4. PAST APPROACH IN INDIA.

The general approach in the past has been to adopt physical measures to prevent the flood water from reaching the potential damage centres. These were either in the shape of flood control or protective works like embankments, detention reservoirs, anti-erosion and bank stabilisation works etc.

For preparation of flood management plans for major flood affected river basins such as Ganga and Brahmaputra, separate Central Organisations like Ganga Flood Control Commission and Brahmaputra Board were set up.

5. At the time of adopting the National Policy on Flood Control in 1954, 6000 km. length of embankments existed in the country. With the launching of the National Policy in 1954, the tempo of construction of structural measures had increased from year to year with the result, the length of embankments

increased to 15,675 km. in 1990, besides improvement of 30,857 km. length of drainage channels. The investment on flood control measures in the various Five Year Plans upto 1990 was about 27,122 million Rupees which provided a reasonable protection to an area of 13.8 m.ha, besides town protection to 854 towns and village raising to 4705 Villages.

6. NEED FOR REVIEW OF STRATEGY.

In order to assess the effectiveness of past measures and to evolve 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 without diluting the structural measures for specific locations. Subsequently, specific problems of the Ganga and the Brahmaputra were reviewed by a High Level Committee. As a result of these reviews, the flood management strategy is evolved aiming at a suitable blend of structural and non-structural measures with emphasis on the latter which provide long-term strategy with time and cost effectiveness to mitigate the flood fury.

7. NON-STRUCTURAL 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 on each of the above measures is briefly brought out in the succeeding paragraphs.

7.1 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 legislation enacted wherever necessary. Accordingly, Central Water Commission (CWC) prepared guidelines for flood plain zoning and also a model bill 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 flood frequencies, CWC 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. As regards enactment of legislation on the lines of model bill circulated by the Central Government, the progress made by States was not encouraging as only one State viz. Manipur had enacted the legislation. The matter is still under consideration in a number of other States and needs to be expedited.

7.2 Flood Proofing.

Flood proofing is essentially a combination of structural change and emergency action, not involving any evacuation. Under the flood proofing programme, several villages were raised in Uttar Pradesh. In West Bengal and Assam land fills were attempted in villages to keep houses above flood level in some areas. In the Eighth Plan (1992-97), flood proofing programme is proposed for the Ganga basin States, more particularly for areas like, North Bihar.

7.3 Disaster Preparedness and Response Planning.

Plans are prepared in advance for disaster mitigation, warning, emergency operations, rehabilitation and recovery. These plans will involve activities such as training, post-disaster evaluation, review and co-ordination of Central, State and local level preparedness programme. The Ministry of Agriculture have brought out a model Action Plan on the subject and circulated to the 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.

7.4. Flood Forecasting and Warning.

Flood Forecasting and Warning Programme was commenced in India in 1958 for the river Yamuna. It now covers most of the flood prone inter-state river basins in the country. 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. The total number of forecasts issued by the above organisation increased from 6964 in 1978 to 8566 in 1990. The percentage of accurate forecasts increased from 82 in 1978 to 95 in 1989.

For improving the quality of forecasts, modernisation of existing network has been taken up with external aid from donor countries such as UNDP, Denmark, etc. Co-operative programme with neighbouring countries such as Nepal and Bhutan has also been taken up to provide better forecasts in these countries and also India, particularly for rivers originating from these countries.

8.0 MODIFYING THE LOSS BURDEN.

8.1 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 event. 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 fund are issued by Ministry of Agriculture which is coordinating the relief programme at the centre.

8.2 Flood Fighting.

This covers building temporary dykes along the rivers; dowel bund 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.

8.3 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 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.

9. INTREGRATED 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/State Agencies, not much progress has been achieved on Flood Plain Zoning. The implementation of this measure requires political will. A

judicious mix of Structural and Non-Structural Aspects would optimise benefits that would accrue from Structural Measures.

10. NATIONAL WATER POLICY.

The National Water Policy (1987) envisages preparation of a master plan for flood control and management for each flood prone river basin. To oversee the implementation of the policy, a National Water Board has been set up in 1990 which reports to the National Water Resources Council.

STATUS REPORT ON NON-STRUCTURAL ASPECTS OF FLOOD MANAGEMENT IN INDIA

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 part is suffering under the effects of 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 since the very inception of his existence, the impact of floods was not, perhaps, felt to the same extent in the past, as it is now felt, due to the much smaller number of people inhabiting the land and lesser pressure of industrial activities and other developmental works on the plains. 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 undertaking substantial flood control measures in the past few decades.

2.0 FLOOD PROBLEM IN INDIA.

2.1 The average annual rainfall in India is about 1150 mm with significant variation in its areal distribution. The annual rainfall along the Western Coast and Western Ghats, the Khasi Hills and over most of the Brahmaputra Valley amounts to more than 2500 mm, the maximum is higher than 11000 mm. The annual rainfall is less than 600 mm in

the Peninsula and in the North-Western region, it is about 500 mm progressively reducing to 150 mm over the extreme west Rajasthan, although freak rainfall does, however, occur even in the driest regions as happened in the LUNI basin of Rajasthan and Saurashtra region of Gujarat.

2.2 The South-West monsoon, June to September, is the principal rainy season for almost the entire country and accounts for 80 percent or more of the annual rainfall. Most of the floods in the Country occur during the monsoon and are generally associated with the following weather situations:

- Tropical storms and depressions.
- Active monsoon conditions, and
- 'Break Monsoon' situations.

The main rainfall belt during the period October to December, is on the east of the Country starting from Assam through the coast of Andhra Pradesh, Orissa, Tamil Nadu and Kerala. Kashmir also experiences some rainfall during this period. Cyclonic storms emanating from the Bay of Bengal strike Tamil Nadu, Andhra Pradesh, Orissa, West Bengal and Assam resulting in heavy rainfall and floods.

2.3 In general, the river systems can be grouped into 4 regions, namely :

i Brahmaputra Region.
ii Ganga Region.
iii North West Region, and
iv Central India and Deccan Region.

2.3.1. Brahmaputra Region.

The main rivers are the Brahmaputra and the Barak and their tributaries covering the States of Assam, North Bengal and North-Eastern States. Excessive rainfall and drainage congestion cause the flood problem in this region.

2.3.2. Ganga Region.

The Ganga originates from the Himalayan region and has a large number of tributaries, the important ones being the Yamuna, the Sone, the Ghagra, the Gandak and the Kosi. The flood problem is mainly from Northern tributaries on account of heavy flows and the huge sediment they bring in. Drainage congestion and erosion of river banks add to the flood problem.

2.3.3 North West Region.

The major river is the Indus with its tributaries namely the Jhelum, the Chenab, the Ravi, the Beas and the Sutlej. The Jhelum causes the main flooding problem in the Kashmir Valley. The Ravi causes erosion. Some parts of the region are affected by drainage and waterlogging.

2.3.4 Central India and Deccan Region.

The important rivers are the Narmada, the Tapi, the Mahanadi, the Godavari, the Krishna and the Cauvery. While the region as a whole does not have a serious flood problem, there is occasional flooding in some rivers in the

eastern delta in Orissa due to floods from the Mahanadi and its tributaries. The Tapi and the Narmada experience sometimes high floods. The delta areas of Andhra Pradesh and Tamil Nadu have the usual problem of sediment deposition, raising of flood levels, drainage congestion and synchronisation of river floods with sea tides.

2.4 The total of the unprotected and protected areas flooded in any year, constitutes the area liable to floods. The maximum area damaged in any one year is assumed as the summation of maximum areas damaged in each State in any year. Based on this criteria, it was estimated that an area of 25 million hectares (m ha) as liable to flooding. During the last decade, a number of areas not hitherto considered as liable to floods have been affected. Besides in the area already protected from floods, some area may be flooded due to failure of flood protection works already completed. It was estimated in 1980 by National Flood Commission that the total area liable to floods as 40 m ha taking into consideration the factors mentioned above. This figure would be updated from time to time based on longer series of hydrological data collected.

2.5 Due to topographical and economic factors, protection cannot be provided to all areas subject to flooding. It is also clear that the same degree of protection need not be provided to all areas liable to flooding. Protection is provided on the basis of frequency of flooding and based on this, areas would be categorised as protectable under frequencies of 25, 50, 100 years or of a higher order. Considering these factors, it has been assessed that the protectable area is 32 m ha. A reasonable protection has already been provided to about 13.8 m ha by the end of the Seventh Five Year Plan (1985-90).

DEVELOPMENT BEFORE INDEPENDENCE OF THE COUNTRY (1947).

2.6 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. Centuries ago flood protection embankments were constructed in the Godavari, Krishna and Cauvery deltas in South India, some of which are still existing. In the North India, remnants of ancient embankments particularly in the Indo-Gangetic plain bear testimony to the efforts made in flood control technology over the ages. Early rulers in India paid special attention to the proper maintenance of the embankments which was so vital for sustaining agriculture production. During the latter part of the British Raj, there were impressive lengths of State-owned and private embankments in many States. The records indicate that the flood protection embankments were a common feature in the flood affected States of Bengal, Bihar, Orissa and deltas of Andhra Pradesh.

2.7 At the time of independence (1947), there were 120 km of embankments along the river Damodar and another 3500 km of embankments along various channels in Gangetic Delta of Sunderbans in West Bengal. In Orissa, there were 1209 km of embankments along the Mahanadi, 287 km along the Brahmani and 160 km along the Baitarni. In Bihar, there were 160 km length of embankments along the Gandak river and some stretches along the Ganga and other rivers. In Assam, there were 11 km of embankments along the Brahmaputra and some stretches along its tributaries. Tamil Nadu also had some embankments along the Cauvery river. In 1947, there

were about 5280 km of embankments in the country giving protection to 3 m ha.

2.8 DEVELOPMENT SINCE PLANNED ERA COMMENCED IN 1951.

With the commencement of the First Five Year Plan (1951-56), the traditional approach of constructing embankments was modified in as much as flood protection by moderation through flood space in storage reservoirs was adopted, besides embankments. Simultaneous to the inception of multi-purpose projects in the Damodar and the Mahanadi Valleys, the flood problem of the Kosi in Bihar received attention. During the first three years of the First Plan (1951-54), before adoption of National Policy on flood problem in 1954, a sum of Rs.14 million was spent on flood control programme which resulted in completion of 456 km of embankments along the Ganga, the Buri Gandak and other rivers in Bihar, 60 km along the Brahmaputra and 140 km along the other rivers in Assam.

2.9 NATIONAL POLICY ON FLOOD PROBLEM AND REMEDIES.

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 following outline of the programme of implementation was indicated.

i. 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.

ii. Short-term Phase (from 3rd to 7th year).

a) Embankments.
b) Channel Improvements.

iii. Long-term Phase (from 8th to 12th year).

a) Construction of selected storage reservoirs.
b) Additional embankments wherever necessary.

iv. Beyond Long Term Phase (After 12 years).

a) Other Long Term Measures.

v. Inter-se priority in the programme.

2.10 Although implementation of the programme was the responsibility of State Governments, the policy frame indicated that the Government of India would help the States to implement a systematic plan of flood control. 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 the success of the programme.

2.11. The total investment on the flood control programme during the period of six Five Year Plans and Annual Plans from 1951 to 1985, was Rs. 17,628 million and the area protected from floods was assessed as 13.01 m ha. The investment during Seventh Five Year Plan (1985-90) was about Rs. 9494 million which was a big effort compared to the achievement in the first six Five Year Plans. The additional area protected in the Seventh Plan was 0.79 m ha. The total investment up to the end of Seventh Plan was Rs. 27,122 which provided a reasonable protection to 13.8 m.ha.

FLOOD DAMAGE.

2.12. Flood damage data is collected by Central Water Commission since 1953 annually. The maximum area damaged in any one year or the years is taken as area liable to flood, in any State. On this basis, the area liable to flood is assessed as 34 m ha. In some places, the area protected may also be affected. The National Flood Commission accordingly reassessed the area liable to floods as 40 mha.

2.13. Heavy flood damage had occurred in the country during the wet 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 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 ha was flooded, of which, average crop area affected was of the order of 3.7 million ha. The floods have claimed on an average 1532 human lives and 10,000 heads of cattle every year.

3.0 FLOOD MANAGEMENT MEASURES.

3.1 Flood management activities can be broadly classified into four major groups :

i. Attempts to modify the flood;
ii. Attempts to modify the susceptibility to flood damage;
iii. Attempts to modify the loss burden; and
iv. Bearing the loss.

Attempts to modify the flood involves flood protection by means of physical measures such as construction of embankments, construction of detention reservoirs, channel improvements, etc. Measures taken to treat the catchment area with a view to cause reduction in flood volumes or pattern of flows or attempts to alter 'Precipitation Pattern' through 'Weather modification' are also classified as "attempts to modify the flood."

3.2 Each of the above measures aims to protect an area rather than a particular property and normally involves high capital cost.

3.3 Attempts to modify the "damage susceptibility" involve action designed to reduce the vulnerability of property and other developmental activities in the flood plains to the flood hazard.

3.4 Attempts to "modify the loss burden" consist of actions to modify the incidence of losses, by spreading them over a large segment of the community.

3.5 'Bearing the loss' means 'living with floods'.

3.6 All the measures for flood management adapted under various approaches can also be classified as :

i. Structural measures.
ii. Non-structural measures.

Broadly, all measures taken up under the activity of "Modifying the flood" which are mostly in the nature of physical measures are being treated as 'Structural measures', while those under the other three activities mentioned in para 3.1 are broadly grouped as 'Non-structural measures'.

4.0 PAST APPROACH IN INDIA.

4.1 The general approach to tackle the problem of floods in the past was based on experience and intuition with an emphasis mostly, on physical measures with a view to prevent the flood water from reaching potential 'damage centre'. The past approach in India has been to adopt measures for modifying the floods. These were either in the shape of flood control or protective works like embankments, detention reservoirs, anti-erosion and bank stabilisation works, etc. On the planning side, significant progress was achieved in preparation of the flood management plans for major river systems of Ganga and Brahmaputra.

4.2 The Ganga Flood Control Commission which was set up by Govt. of India in 1972 to, interalia, formulate a comprehensive plan of flood management for Ganga Basin including phased and coordinated programme of implementation, in consultation with the State Governments, prepared such

plans in respect of most of the sub-river systems of Ganga Basin.

4.3 The Brahmaputa Board set up by the Government of India in December, 1981 also charged with the responsibility in respect of Brahmaputra river system, prepared master plans for the main stem and a number of tributaries. The Schemes visualised in these 'Master Plans' have to be implemented in a phased manner and necessary adjustments/modifications/firming up of proposals shall have to be done gradually.

4.4 Watershed management or soil conservation schemes with the aim of conserving soil and water as also to cut down or delay the run-off were also taken up in a few areas during the past two decades.

5.0 STRUCTURAL MEASURES.

5.1 The structural measures in general, executed in the country are briefly discussed below :

i) Embankments.

The flood protection through construction of embankments was an age old tradition in India. Embankments were extensively constructed in the deltas of Cauvery, Godavari, Krishna and Mahanadi rivers. It has been assessed that about 6000 km length of embankments were existing in the country when the National Policy on Flood Control was launched in the year 1954 in the wake of disastrous floods.

Under this planned programme, various structural measures were taken up. The tempo of construction of flood protection works like embankments, reservoirs, etc. was gradually increased under the national programme during the various Five-Year Plans, resulting in the constrcution of 15,675 km. length of embankments and 30,857 km. length of drainage channels upto 1990. The investment in the various Five Year Plans upto the end of VII Plan (1985-90) was of the order of Rs. 27,122 million. These measures provided a reasonable protection to an area of 13.8 m.ha out of an area of 40 m.ha assessed by the National Flood Commission (1980) as 'area prone to floods' with 32 m.ha. area considered as 'protectable'. Besides the area protected, 854 towns were provided with flood protection works and 4705 Villages were raised above flood level upto 1990.

ii) Reservoirs.

A large number of reservoir schemes to harness water resources for irrigation, power, etc. were undertaken in the country during various plan periods. Realising the great potential of reservoirs in impounding floods and regulating the flows downstream for flood moderation, flood control has been sought to be achieved as one of the objectives in multi-purpose dams by providing specific flood cushion. Thus, a few reservoir schemes like a cascade of dams on the Damodar System (DVC) in the eastern part of India, and Rengali Dam in Orissa were provided with in-built provision of flood moderation. In case of other schemes like Hirakud Dam on the Mahanadi in Orissa and Bhakra on river Sutlej, flood moderation was made possible by suitable gate operations.

iii) Soil Conservation Measures.

Watershed management or land treatment approach to the flood management aims at cutting down and delaying the run-off before it gets into the river channel besides reducing the inflow of silt from the catchment. To achieve this objective, a centrally sponsored scheme for integrated watershed management was launched in a few flood prone catchments during the Fifth Plan (Years 1974 to 78). By the end of Seventh Plan, an area of 0.4 m.ha. was stated to be treated, out of the total treatable area of 3.98 m.ha.. Subsequently, 13 more catchments were recommended by the 'Working Group on Soil Conservation' to be taken up during Eighth Plan Period (1992-97). Another programme of soil conservation in the catchment areas of a few river valley projects was also taken-up as a centrally sponsored scheme during the last two decades under which, watersheds were chosen for integrated treatment after prioritisation. This programme is presently continuing. The results obtained from earlier treatments have shown that soil conservation measures result in considerable reduction in silt load. For example in Machkund Project, the reduction was of the order of 40% while in Hirakud it was of the order of 28.3%. As regards flood moderation, it has also been claimed that a moderation of about 14% was achieved in some cases. Detailed assessment of the extent of benefits given by watershed schemes on a 'proto-type' basis from major floods would have to be taken on the schemes already in hand.

5.2 In this context, it may be appropriate to quote the observation of the National Flood Commission which has mentioned in its report that "although useful, the precise role and cost effectiveness of watershed management is yet

to be established as far as its ameliorative value on the flood mitigation problem is concerned."

5.3 It will be observed that the major thrust, so far, in the flood management in India has mostly been in the shape of construction of embankments. However, this has created its own problems. It has been found that in many States, embankments were often aligned very close to the river edge so as to protect as much an area or as many villages as possible. Even though these might have appeared reasonably safe at the time of construction, they invariably come under attack subsequently on account of ever-changing nature of the river course. Now, a substantial portion of annual outlay is spent on protecting these embankments from the river attack, and other anti-erosion and river training works, particularly when these were constructed along aggrading and meandering rivers. Sometimes, spurs constructed to protect a particular reach of the embankment on one bank of the river, caused adverse effects on the opposite bank. The construction of a series of spurs on both the banks of a closely embanked river resulted in decrease of the flow area in river section, there by raising the flood levels. Construction of embankments also caused problems of drainage congestion, behind embankments particularly in high rainfall areas in the North-Eastern States For want of proper drainage relief measures,at many places, the problem of drainage congestion itself became so acute as to cause more distress to the population in the protected area than otherwise. Construction of embankments also caused the flood wave to travel faster, thus reducing the warning time available to areas downstream.

6.0 NEED FOR REVIEW OF STRATEGY.

6.1 Although the investment in flood control has increased from year to year in the successive Five-Year plans and more areas have been protected, the flood damage continues to show an increasing trend. Though the increase in monetary value of damaged assets could partially explain the paradox, the major reason for the increase can be attributed to the unregulated developmental activities and occupation of flood plains of the rivers because of population pressure. Of course, lack of adequate maintenance of existing works due to paucity of non-plan allocations is one more reason for increased flood damage. Another reason is due to reporting of damage caused by inadequate drainage for rain water and consequent damage to crops as flood damage, though not caused by floods. The authorities responsible for flood management, however, came to realise the fact that notwithstanding progressively increasing measures of flood protection, it would be futile to expect absolute immunity to flood risk. It was felt that due to financial constraints, it was neither feasible nor even desirable to protect all flood prone areas in the country.

6.2 The problem of floods was receiving increasing attention of the Government especially since 1954 when the National Flood Policy was announced. However, the increase in flood incidence during 1970s had caused concern. It was in this context the National Flood Commission or Rashtriya Barh Ayog (RBA), the first of its kind, was set up in July 1976, by the Government of India, the then Ministry of Energy and Irrigation, to examine and advise on various aspects relating to floods. The Commission headed by Shri Jaisukh Lal Hathi, had a composition of eight more eminent members

and had the benefit of the views of various experts in the field of Water Resources Development. After a detailed study of all the issues for four years, the RBA had submitted its exhaustive Report to the Government in the year 1980 with over 200 recommendations for implementation by the Central and State Governments.

The RBA, inter-alia,laid great stress on proper flood plain management without diluting the importance of structural measures for specific situation. Subsequently, the specific problems of Ganga and Brahmaputra basins were also studied by a high level committee of experts headed by the Secretary, Ministry of Water Resources, Government of India, which submitted reports for tackling the problem of floods in the two major flood prone basins. As a result of these reviews and past experiences, the flood management strategy has to aim at a suitable blend of structural and non-structural measures of flood management with more emphasis on non-structural measures, as these are more time and cost effective, providing a long-term strategy to mitigate the flood fury. The flood management strategy has also to encourage the philosophy of 'living with floods'. For this purpose, there is need for developing suitable varieties of crops which can withstand inundation for some periods. It is very necessary for sustained efforts and persuasion to achieve the desired results.

7.0 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 vacating of the same for use of the river whenever the situation 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 encraochments 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 can be broadly grouped under two categories as follows :

i. Modifying the susceptibility to flood damage.

- Flood Plain Management
- Flood Proofing including Disaster Preparedness and Response Planning
- Flood Forecasting and Warning.

ii. Modifying Loss Burden.

- Disaster Relief.
- Flood Fighting including Public Health Measures.
- Flood Insurance.

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. Other measures particularly the flood plain zoning have to be tackled with more vigour so that a long-term solution to flood problem can be achieved in conjunction with structural measures whereever necessary.

The status of implementation of the various non-structural measures is discussed below :

7.1 Flood Plain Management.

7.1.1 The basic concept of flood plain management is to regulate the land use in the flood plains in order to restrict the damage due to floods, while deriving maximum benefits from the same. This is done by determining the locations and the extent of areas likely to be affected by floods of different magnitudes/frequencies and to develop those areas in such a fashion that the resulting damage is minimum in case the floods do occur. Flood Plain Zoning, therefore aims at disseminating, such 'potential loss' information on a wider basis so as to regulate indiscriminate and unplanned development in flood plains and is relevant both for unprotected as well as protected areas. Flood Plain Zoning recognises the basic fact that the flood plains are essentially the domain of the river, and as such all developmental activities in flood plains must be compatible with the flood risk involved. Heavy encroachment of flood plains has been responsible for increasing trend of damage over the years.

7.1.2 The need for Flood Plain Zoning has received recognition at various fora in the past also. As far back as 1973-74, the Central Water Commission (CWC) had prepared guidelines

for Flood Plain Zoning which were approved by the Central Flood Control Board. Since the implementation of these guidelines needed statutory backing, CWC also prepared a model draft bill which was circulated in 1975 by the then Ministry of Irrigation, Government of India, to all the States advising them for enactment of a suitable legislation. A copy of the model bill is at Annexure - I.

The Rashtriya Barh Ayog (The National Flood Commission), 1980 in its report also recommended that flood plain management measures should be undertaken and a suitable legislation enacted wherever necessary. Subsequently, the National Conference of the States' Irrigation and Water Resources Ministers have endorsed this view and have recommended the enactment of necessary legislation by each State expeditiously along with other related measures. It has also been recommended that pending enactment of legislation, developmental activity in the flood plains should be regulated by administrative measures.

7.1.3 To enable the State Governments to properly demarcate the flooded areas corresponding to different flood frequencies, the CWC initiated a programme through Survey of India for carrying out surveys for preparation of flood risk maps to a scale of 1:15,000 with a contour interval of 25 cm for the areas/reaches, identified in a few flood-prone river basins. The work was taken up in a phased manner as per the priorities indicated by the States. With the available data, the State Governments could then take up preparation of flood risk maps and demarcate areas corresponding to different flood frequencies, for effective implementation of regulations after the enactment of flood-plain zoning legislation. Against an area of about 100,000 sq.km. identified by the

State Governments, survey for about 50,000 sq.km. was completed by Survey of India upto the end of Seventh Plan. The progress on preparation of flood plain zoning/flood risk maps by the State Governments was however, not satisfactory and the programme of surveys had been discontinued during the the Eighth Plan (1992-97). Unfortunately, not much progress was achieved by the State Governments in this respect.

The response from the State Governments towards enactment of flood-plain zoning legislation has also not been encouraging.

Except Manipur State, no other State in the country has enacted a legislation so far, though it is stated to be under active consideration in a few other States. Assam has stated that enactment of flood plain zoning legislation is not envisaged at this stage. Madhya Pradesh is considering physical demarcation of 36 towns affected by floods at least 3 times in the last 30 years. The matter regarding legislation for flood plain zoning is before the State Flood Control Board for consideration. Uttar Pradesh feels that flood plain zoning legislation is not considered necessary at this stage. West Bengal is in correspondence with its Law Department regarding the draft bill on flood plain zoning. Orissa has reported that the formulation Flood Plain Zoning Bill was under consideration of the State Government. The State Government of Tamil Nadu has intimated that they agree in principle to enact a suitable legilsation for flood plain zoning. Delhi Administration have informed that the enactment of Flood Plain Zoning Act is not required as the objective is proposed to be achieved through the existing provision of Delhi Development Act 1957. However, CWC has informed the Ministry of Water Resources that the Delhi Development

Act does not cover the flood aspects and is mainly meant for urbanisation etc. Goa, Daman & Diu have intimated that they are expecting to enact the legislation very soon. Government of Gujarat have not considered it necessary to enact such a legislation in view of the situation prevailing in the State.

7.1.4 The possibility of utilising the satellite imageries for preparation of flood plain management maps is also being explored. For this purpose, the National Remote Sensing Agency (NRSA), Hyderabad is presently busy with a pilot study which aims at demarcating areas actually flooded during selected flood periods in a year. With successive demarcation of such areas for the past few years, the study aims to identify the areas liable to high and low degrees of flooding. Presently the study is proposed to cover only important flood prone basins. The maps prepared by NRSA so far, as a result of this study, show the areas inundated due to floods/drainage congestions separately. However, these maps do not show areas flooded under different frequencies like 1 in 50 or 1 in 100 as required for enforcement of flood plain zoning regulations envisaged under the proposed legislation.

7.1.5 The flood-plain zoning measures as per the guidelines prepared by the Central Water Commission broadly involve :

i. Demarcation of areas liable to floods by preparation of detailed contour plans of such areas to a large scale (preferably 1:15,000) showing contours at a suitable interval.

ii. Fixation of reference river gauges and demarcation of

areas likely to be inundated for different magnitudes of floods i.e. for different flood frequencies like 1 in 25 years, 50 years and 100 years. Similarly demarcation for areas likely to be affected on account of accumulated rain water for different frequencies of rainfall like 5, 10, 25 and 50 years were required to be done.

iii. Delineation of the types of use to which the different zones as demarcated in flood plains could be put to.

7.1.6 For regulating land use in different flood zones, the following priorities in respect of construction of buildings and other utility services have been envisaged :

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.

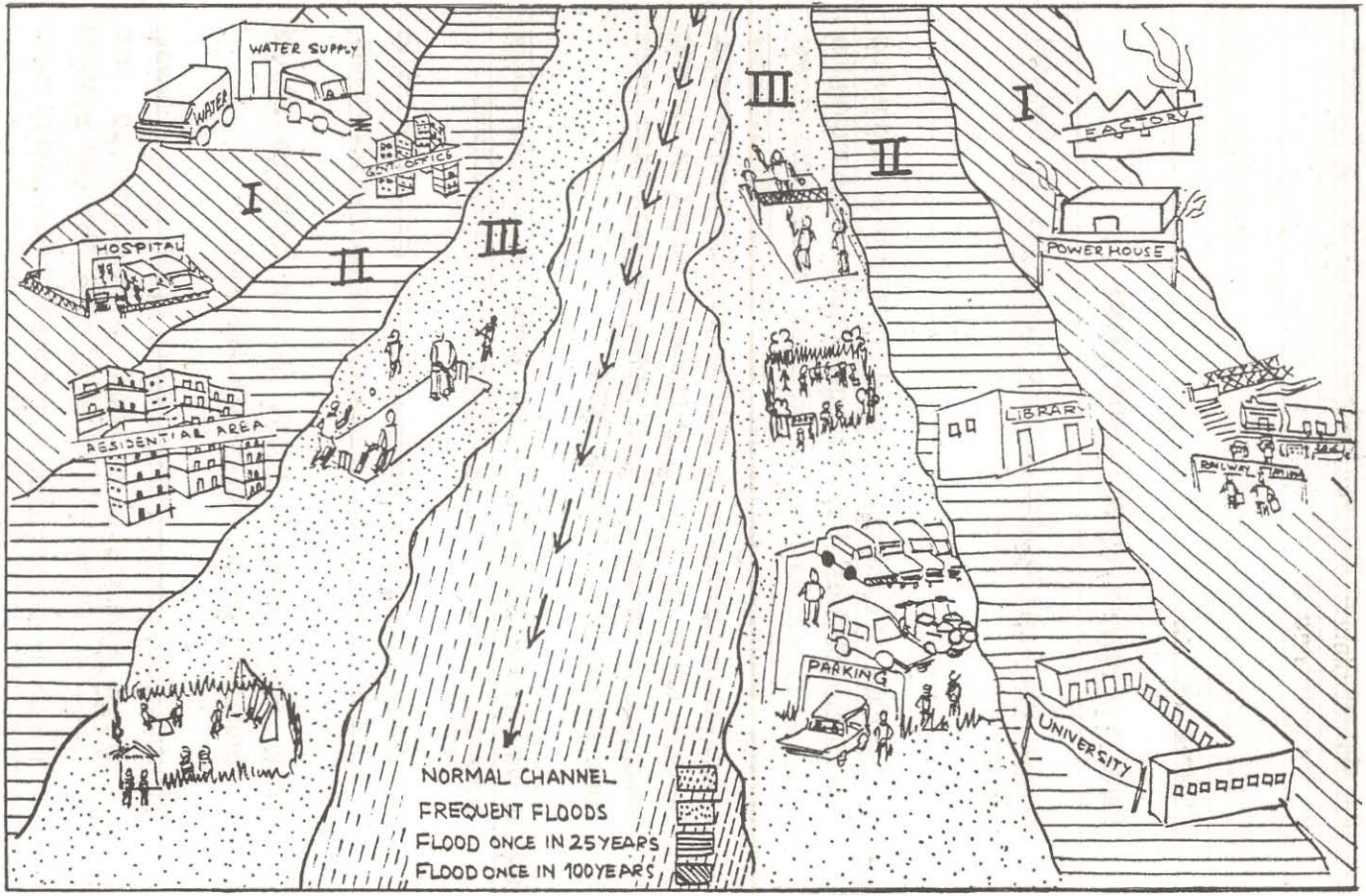
7.1.7 In the case of existing developed areas, it was suggested that the possibilities of protecting/relocation/exchanging the sites of vital installations like electricity sub-stations/power houses, telephone exchanges, etc. should be seriously examined so that they were safe from possible flood damage. Similarly the pump stations of tubewells meant for drinking water supply should be raised above the high flood levels corresponding to a 100-year flood.

7.1.8 It was further suggested in the guidelines that for future buildings, the following regulations could be stipulated :

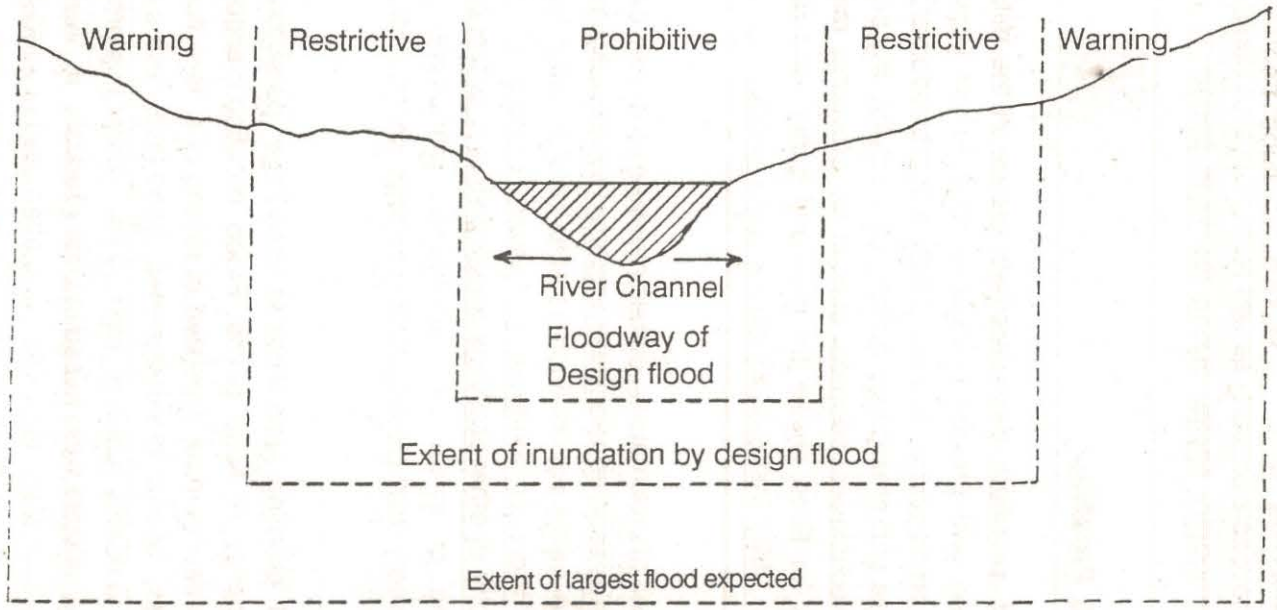
a) Plinth levels of all buildings should be nearly 0.75 m to one metre above the drainage/flood submersion levels.

b) In areas liable to floods, all the buildings should preferably be double/multiple storeyed.

c) Wherever there are single storey buildings, a stairway, should invariably be provided to the roof so that temporary shelter can be taken there. The roof levels of the single storey buildings and the first floor level of multi-



FLOOD PLAIN ZONING



FLOOD PLAIN ZONING

storeyed buildings should be above the flood level corresponding to 1 in 100-year flood frequency, so that moveable property as well as human lives could be given temporary shelter during the flood period.

7.2 Flood Proofing.

7.2.1 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.

7.2.2 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.

7.2.3 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 level 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 even though

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.

Further, it was also found that it was not easily possible to connect raised villages to an all weather road economically. No other flood proofing measure was either taken up or given much importance till recently. During the current Eighth plan, it is proposed to take up flood proofing programme in Ganga basin States more particularly for areas like north Bihar for which some outlays have been provided for 1992-93. It is also envisaged that a Steering Committee shall monitor the progress. The objectives and the scope of the flood proofing programme likely to be undertaken in the near future are as follows :

i. Relieve drainage congestion efficiently by adopting innovations in sluice gates and connected works.

ii. Flood proofing of civic amenities so that adverse impact of the floods on the daily life of the inhabitants is minimised.

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

7.2.4 The scope of the programme proposed to be implemented can be divided into the following categories :

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 food storage facilities in "Block" head-quarters for catering to flood shelters.

b. Providing fodder stroage facilities in "Block" headquarters.

V. Communication links like telephone/wireless/road/rail/ boat.

a. Providing road links from shelters to the Block headquarters.

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 head quarters.

7.2.5 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 by 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.

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

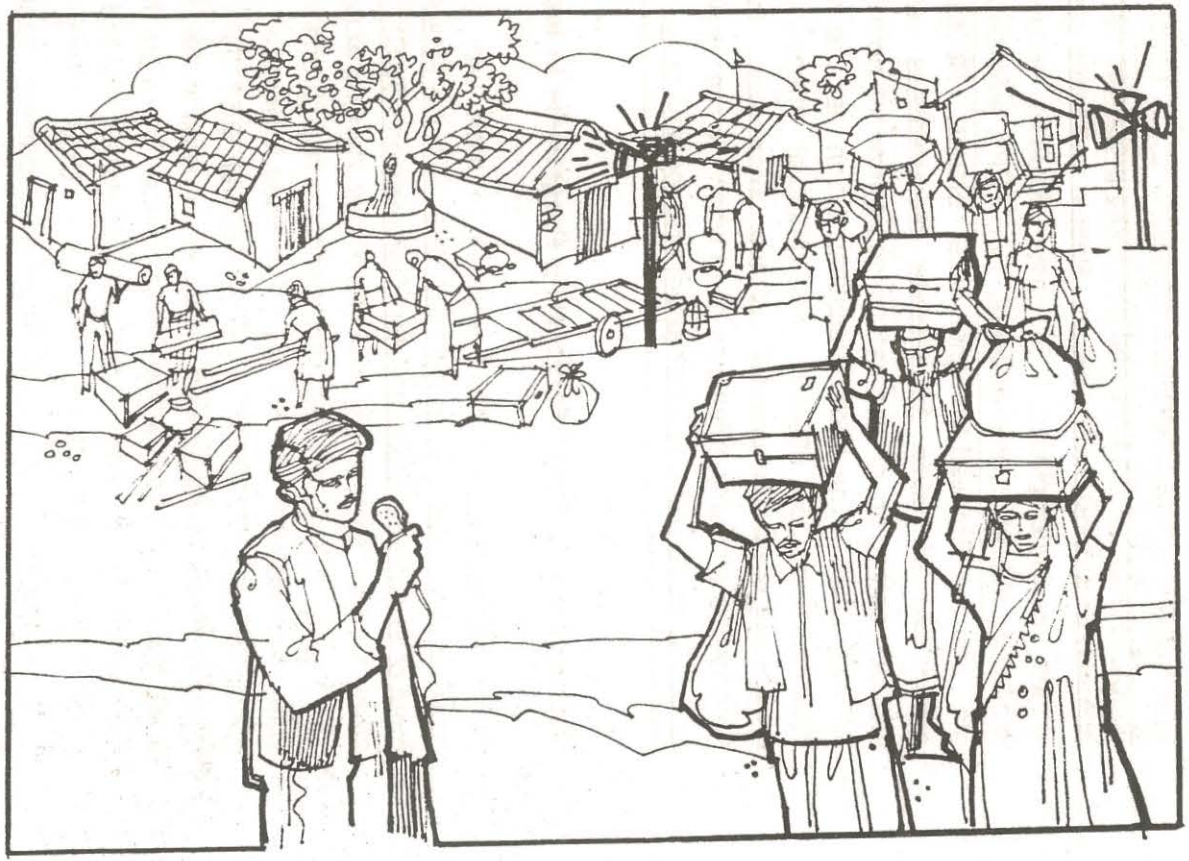
7.2.5.2 With a view to tackle disaster situations effectively, the Ministry of Agriculture have brought out a Model Action Plan and circulated to States and Union Territories. A copy of this is given as Annexure-II. Earlier, the National Planning Commission had also set up a Group on Disaster Preparedness and Management which had recommended in its report of August 1981 that a balanced programme of disaster preparedness should have as its core a National Disaster Control Centre with sub-centres at regional and local levels. There should be a Disaster Management Committee at local level with representatives drawn from Agriculture, Irrigation, Meteorology, Panchayats and Public Works Departments, Police, Civil Defence, etc. The Group also recommended constitution of a National Institute of Disaster Training and Management to look into all aspects of diaster management.

7.3 Flood Forecasting and Flood Warning.

With reliable advance information/warning about impending floods, loss of human lives and moveable properties can be reduced to a considerable extent. Poeple and cattle can be shifted to safer places. Similarly, valuable moveable properties like electronic gadgets, TVs, VCRs, automobiles, etc. can be removed to higher safer places. Necessary action can be taken for disaster preparedness which includes setting up of relief camps, deployment of boats etc. for evacuation. The flood forecasting which is the most important and cost effective non-structural measure for flood loss reduction provides us this information. Flood Forecasting primarily forewarns as to when the river is going to use its flood plain, to what extent and for how long.

7.3.1 Development of Flood Forecasting Programme in India.

Flood forecasting and flood warning in India was commenced in a small way in the year 1958 with the establishment of a unit in the Central Water Commission (CWC), New Delhi, for the flood forecasting of the river Yamuna at Delhi. This has by now grown to cover most of the flood prone interstate river basins in the country. The flood forecasting organisation in CWC works under the overall supervision of Member (River Management), who is assisted in the field work by an extensive network of field units. There are three regional offices at Delhi, Patna and Hyderabad headed by Chief Engineer (Northern Region), Chief Engineer (Eastern Region) and Chief Engineer (Southern Region) respectively. This organisation is presently responsible for issuing forecasts at 157 stations of which 132 stations are for water stage forecast and 25 for inflow forecast used for



FLOOD WARNING

optimum operation of certain major reservoirs. The 62 streams covered by the above flood forecasting network are located in the following major river systems:

i. The Ganga and its tributaries.

ii. The Brahmaputra and its tributaries.

iii. The Barak and its triburary, 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, theBurha-Balang, the Baitarni, the Rushikuliya and the Vamsadhara.

7.3.2 Hydrological and hydrometeorological data from nearly 400 hydrological and 600 hydrometeorological stations respectively in these rivers are being collected, analysed and forecasts issued for the benefit of State Governments and the general public. State-wise, and Union Territory-wise distribution of the flood forecasting stations is given in the following table:

State.	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-TERRITORY.	
Delhi	2
Dadra & Nagar Haveli	2
Total Stations.	**157**

7.3.3 For issuing flood forecasts, the work of observation and collection of hydrological and hydrometeorological data is done by the concerned Divisions of the CWC. Flood Meteorological Offices of India Meteorological Department collect and transmit the meteorological data. The CWC is also responsible for planning of river gauge/discharge network, collection of gauge and discharge data and communication of the data to its Flood Forecasting Divisions. The Flood Meteorological Offices provide information regarding general meteorological situation, rainfall amounts of last 24 hours and heavy rainfall warning for the next 24

hours for different regions and quantitative precipitation forecasts for various river basins to the concerned flood forecasting centres of CWC. The data transmission is done on real-time basis from the hydrological and hydrometeorological stations to the Flood Forecasting Divisions by installing VHF/HF wireless sets at the data collection stations. The various Flood Forecasting Stations are using different forecasting methods, based on availability of hydrological and hydrometeorological data, the basin characteristics, computational facilities available at forecasting centres, warning time required and purpose of forecast. However, some of the common methods being used by various stations are given below :

i. Simple correlation based on stage-discharge data.
ii. Co-axial correlation based on stage, discharge and rainfall data etc.
iii. Routing by Muskingham method.
iv. Successive routing through sub-reaches.
v. Hydrologic models (at selected places).

7.3.4 The final forecasts are transmitted to the concerned administrative and engineering authorities of the States, and other agencies connected with the flood protection and management work, on telephone or by special messenger, etc. On receipt of the flood forecasts, the above agencies disseminate flood warnings to the officers concerned and people likely to be affected, and take necessary measures like strengthening of the flood management, flood fighting, and relief measures and evacuation of people to safer places before they are affected by floods.

7.3.5 Actual Performance of the Flood Forecasting Network.

Table at Annex-III gives the total number of forecasts issued every year, number of forecasts within the permissible limits of accuracy and the percentage of accurate forecasts for the period from 1978 to 1990. It would be seen therefrom that the percentage of accurate forecasts has improved steadily. According to a uniform criterion being followed in the CWC for the evaluation of a flood forecast, the forecast is considered to be reasonably accurate if the actual level falls within $\pm$15 cm of the forecast level. In the case of inflow forecast, a variation of $\pm$20% of cumecs is considered to be acceptable. It would be observed that the percentage of accurate forecasts has steadily improved since 1978 and reached a figure of 95%. During the year 1990, a total number of 8566 forecasts were issued to 11 States and 2 Union Territories of Dadra & Nagar Haveli and Delhi, of which 8071 forecasts were within the accuracy range giving an overall percentage accuracy of 94%. The percentage accuracy ranged from 91 in Andhra Pradesh to 100 in Karnataka. It has been the constant endeavour to improve the forecasting performance even further.

The State Governments and various authorities incharge of Flood Management and Relief Operations are getting 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.

7.3.6 Modernisation of Flood Forecasting Network.

It has been recognised that there is ample scope for improving the quality of forecasts, i.e., increasing the lead time and precision by considering all the parameters required in the formulation of accurate forecasts. To achieve this objective, the techniques of observation of hydrological data and their transmission to the forecasting Divisions has been constantly under review and a few modernisation schemes have been taken up which are in different stages of completion.

i Modernisation of Flood Forecasting System for Delhi on the Yamuna.

A pilot project for the "Improvement of River and Flood Forecasting System in India" was taken up in 1980 as a UNDP aided project on the Yamuna river upto Delhi with Central Water Commission as its executing agency. The Phase-I of the scheme was completed in 1985. Fourteen data collection-cum-reporting stations which are provided with sensors for precipitation, temperature, water level and micro processors and a VHF telecommunication system, besides seven repeater stations have been installed.

A mini-computer, Hewlett Packard 1000 F series system having 1536 KB memory, 132 MB winchester disc storage, thermal printer, graphic plotter, digitizer, display terminal, teleprinter and matrix printer, etc. with a master teleprocessor has also been commissioned at the Central Station located in Sewa Bhawan, R.K.Puram, New Delhi.

The master teleprocessor has been programmed to co-ordinate the activities of remote stations by directing them

to transmit data in a specified sequence and time intervals to store the data on floppy, print the data in a specified format and display the data on CRT, whenever required. The data stored on the floppy is transmitted to the mini-computer through RS-232 interface.

Three computerised hydrological models, viz. SSARR (Stream flow Synthesis and Reservoir Regulation Model), NAM-System 11 FF (Flood Forecasting) Model and NLC (Non-linear Cascade Model) which are continuous models and the HEC-1 F (Flood Hydrograph Package Model of Hydrologic Engineering Centre) which is an event type model, have been transferred to the computer. All these models have updating capabilities and also include rainfall run-off and flood routing routines. These models which are calibrated and are in running mode, are now being tested for real-time operation in flood seasons. New models, viz., CWCFFI & PEM developed in Central Water Commission and being used on pilot basis are being refined for better performance.

As a part of UNDP Pilot Project, an experimental watershed, the Sundli Nala, was selected in the Upper Yamuna basin in Himachal Pradesh for Snow Hydrology Studies. Four years of data have been collected and development of snowmelt run-off model is in progress. The snow hydrology studies are now proposed to be further extended with the assistance from USAID.

During Phase-II of the UNDP Project, improvement of the telemetry system by installing 'Data Collection Platform' (DCP) at the data collection sites for communication of data through satellite INSAT-1B has been taken up. Under Phase-II of this project, 14 DCSTS ('Data Collection, Storage and

Transmission Sub-system') stations were proposed to be installed with suitable interface to the existing sensors and to communicate the data by using the INSAT-1B facility to the earth station at Secunderabad and on to the IMD Headquarters at Lodi Road, New Delhi through a micro-wave link. The data would thereafter be passed on to Central Water Commission Control Room at Delhi through VHF wireless link from IMD Headquarters. The system has suffered a setback as INSAT-1B is not operational for this purpose.

ii Modernisation of Flood Forecasting System for the Damodar Basin.

Under the Danish Hydraulic Institute (DHI)/Central Water Commission collaboration Project, with Damodar river basin as focus project, computerised mathematical models developed in the DHI were transferred and adopted after modification for inflow forecasting and formulation of flood forecasts using indigenous computer. Phase-II of this scheme was successfully completed in 1986 and models have become operational at Maithon and Delhi. The Phase-III of the project has been taken up for refinement, upgrading of the existing model, introduction of sediment transport model and Dambreak model and application of the existing model to another river basin.

iii. Modernisation of Flood Forecasting System for the Godavari Basin.

DHI-CWC collaboration scheme to transfer technology of mathematical modelling developed in the Danish Hydraulic Institute has been extended to the Godavari Basin. MIKE-II

model, an updated version of NAM and System - II F models, is being utilised to develop the forecasting systems for the Godavari.

iv. Modernisation of Flood Forecasting Monitoring System Using FFWNPAS.

For monitoring of flood situation, daily water level is observed at 08.00 hours and forecast is transmitted to CWC headquarters in New Delhi. Based on the compilation of all such data from field Divisions, Dialy Water Level and Flood Forecast Bulletin, in two parts viz. part-I and part-II for stage and inflow forecasting stations respectively, is prepared during the flood season. Stations above danger levels or in high flood situation are high-lighted for quick action, on the cover page of these Bulletins. Since the year 1990, the manual preparation of this bulletin has been replaced by the computerised information system for monitoring daily flood forecasts of CWC's flood forecasting network of stations. The Daily Bulletins are prepared and forecast performance evaluated using a package FFWNPAS developed by NIC Water Resources Information System Group.

This system has been utilised operationally during 1990 monsoon season. Flood Forecasting and Warning Network Performance Appraisal, 1989 was documented using FFWNPAS package. Effectively, the day-to-day operational monitoring of the flood forecasting system has been achieved using PC/AT - 386 in a FOXBASE + XENIX environment. Further improvement in the monitoring system is contemplated using NICNET facilities.

v. Human Resources Development.

All the above improvement schemes have been utilised to provide exposure to senior officers in the new techniques. Several Engineers/Hydrometeorologists have undergone training in India and abroad in hydrological modelling and computer applications in flood forecasting during the course of these projects.

7.3.7 Cooperation Programme with Neighbouring Countries.

It has been possible to secure the active cooperation of neighbouring countries also in the field of flood forecasting and warning.

A comprehensive scheme envisaging collection of hydrometeorological data of rivers flowing from Bhutan to India is under operation, under which during floods, real-time hydrological data is transmitted from sites in upper reaches of Bhutan for formulation of forecasts for stations in India. The hydrological/meteorological data collected from the stations in Bhutan is useful for formulating water related schemes in both the countries.

Similar cooperation is being extended by Nepal also under which it is also proposed to set up a network of Hydro-meteorological stations on rivers originating in Nepal so that the data can be used in formulation of suitable forecasts.

8.0 MODIFYING 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.

8.1 Flood Disaster Relief.

8.1.1 Flood disaster relief is rendered as soon as flood damage occurs. The immediate relief is extended by the local agencies both in Government and Voluntary sector on the basis of assessment made immediately after the occurrence of the event. However, relief programme is initiated on the basis of detailed assessment of the damage made subsequently at District and Tehsil levels and special relief funds available with the State Governments.

8.1.2 The existing policy and arrangements for meeting the relief expenditure at Government level, has been evolved over the years on the basis of recommendations of Finance Commissions. Recognizing the fact that the necessity for relief in the event of floods was always of immediate nature, the State Governments were provided with certain funds for immediate relief known as 'margin money'. This 'margin money' for each state was calculated by averaging the non-plan expenditure booked over the years by the State Government for accommodating the relief expenditure. The Seventh Finance Commission, while fixing the 'margin money' also included the expenditure on public works damaged by natural calamity like floods. As regards expenditure in excess of 'margin money' the central assistance was to be made available as non-plan grant. This non-plan grant was to be given to the extent of 75% of the total approved ceiling of

expenditure in excess of the 'margin money'. The remaining 25% was to be borne by the State. The Seventh Finance Commission also felt that whenever a calamity was of "rare severity", the Central Government could extend assistance to the States concerned even beyond the above stipulation. The Eighth Finance Commission increased the quantum of 'margin money' and suggested that the same should be shared on matching basis between the Centre and the States. The Commission also stipulated that the 'margin money' should cover not only items of direct relief expenditure but also expenditure on repairs and restoration of public assets. The Central assistance was provided on the basis of the spot assessment of flood damage by a inter-ministerial team of experts, subject to availability of funds. The guidelines for relief stipulated that funds could be made available to the extent of restoring the "status quo" and seek plan funds for carrying out improvement, and modernisation.

8.1.3 The Ninth Finance Commission, however, replaced the earlier system by a new one whereby greater autonomy, accountability and responsibility was sought to be placed upon the States and they were to be provided adequate means and wherewithal to carry out the relief functions. Under this scheme, the States were expected to follow the path of self reliance without looking up to the Centre. Under this scheme, a sum of Rs.804 crores was worked out on the basis of actual expenditure for the last 10 years specially earmarked for release on account of natural calamities. The Centre was required to pay 75% (Rs. 603 crores) for the 'Calamity Relief Fund' for all the States. Thus, States were required to deal with natural calamity and manage their affairs without the need for any reference to or authorisation

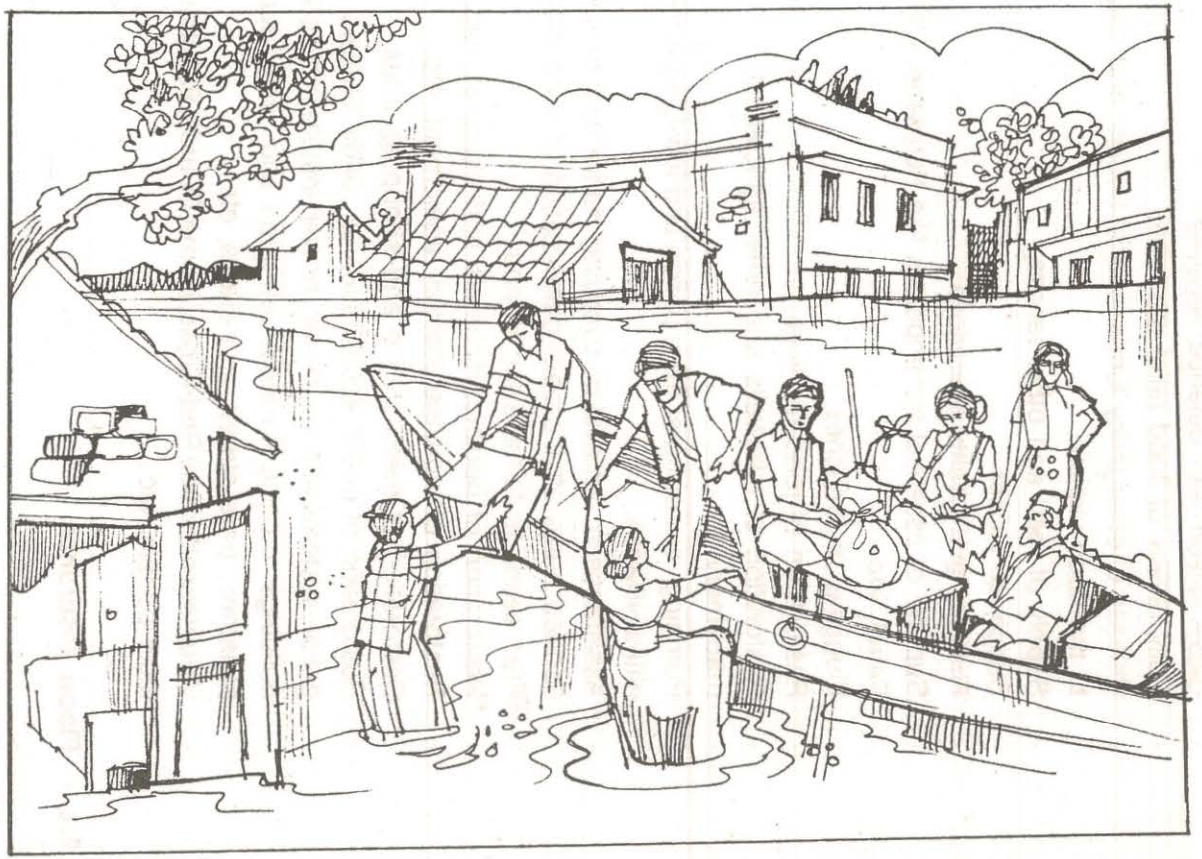
from the Centre within the amounts so provided. Detailed guidelines for the operations and monitoring of the funds were laid down and coordinating functions at the Centre continued to be ensured by Ministry of Agriculture, Government of India.

8.2 Flood Fighting.

8.2.1 Flood Fighting covers building temporary dykes along the river, dowel bunds on the banks, closing small breaches immediately, attending to scour, wave wash, sand boils, etc, evacuating goods and equipments out of the reach of flood zone, protecting equipment with plastic sheets, etc. In respect of flood control works, the measures to be taken are i) Operation of Existing Works, ii) Repair, Strengthening and Raising of Works; and iii) Building Emergency Works. These steps require advance planning of equipment and preparedness to fight floods.

8.2.2 When floods occur, the existing facilities for water supply and sewerage get disrupted affecting the health of the population. The inundation and deterioration of the quality of food grains, the destruction of agricultural crops and health of livestock may lead to famine or atleast nutritional deficiencies. Stagnant water becomes the breeding ground for mosquitoes affecting the public health. Public health operations should ensure availability of supplies and equipment, co-ordination with other organisations engaged in disaster relief and procedure for immediate mobilisation of personnel to eliminate health hazards. Flood fighting measures normally involve :

Strengthening of Central, State and District Flood Control Rooms.



FLOOD FIGHTING - EVACUATION OF PEOPLE FROM FLOODED ZONE

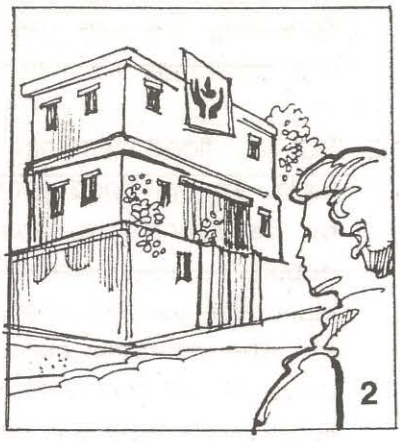
- Evacuation of flood victims.
- Air dropping of food packets.
- Close liaison with defence services.
- Daily review of flood relief measures.
- Release of emergency funds to local bodies and thence to the flood victims.
- Supply of food and other rations.
- Supply of fodder.
- First aid and health operations.
- Supply of essential commodities like Kerosene, Oil and Petrol, etc.
- Plugging of breaches.
- Restoration of road/rail links.
- Restoration of tubewells and other agricultural machinery.
- Pumping out of water from ponds and low-lying areas in cities/villages.
- Assistance in removal of overlying sand layer of certain flooded areas after proper demarcation of such areas.
- Free seeds to farmers for sowing.
- Restoration of poultries/fisheries and piggeries, etc.
- Restoration of industries/factory equipment, etc.
- Restoration of merchandize and shopping areas.
- Restoration of public assets such as roads, bridges, irrigation systems and structures, power installations, public buildings, municipal roads, sewerage and water supply schemes, pave streets and drains, etc.
- Voluntary efforts by Red-Cross, Home-Guards, Panchayats local people, etc.

8.3 Flood Insurance.

8.3.1 Flood insurance has several advantages as a means of modifying loss burden. The insurance does not reduce the

flood loss potential directly, but it provides a mechanism for spreading the loss over the large number of individuals. It is advantageous both to the public and the Government.

8.3.2 So far, flood insurance has not been adopted widely in India. Though flood risk has been included in 'cover' issued by the General Insurance Companies in India, it is more popular in urban areas and big towns where damage due to inundation caused mostly by excessive rainfall is taken care of. The insurance companies have also not been able to arrive at different rates of insurance premium for different flood prone regions in the country. As such, they continue to charge uniform rate irrespective of the fact that property was located in high flood risk area compared to other areas. The insurance companies are faced with a difficult choice. If they levy uniform rates in all areas, the people in flood prone areas would most likely take out the policy which may become too large a burden. If an attempt is made to charge rates proportionate to the flood risk, the premium may work out much more than what the property owner might be willing to pay. Another problem being faced by the insurance companies is, regarding the assembling of basic data for working out a fair and equitable premium for all areas according to flood risk. The insurance cover works successfully for a class of people who are subjected to such risks more or less equally. In case of floods, the risk of loss even in areas liable to flood is not equal. For example, those owning land or property at lower elevation in a flood plain are subject to higher risk both in magnitude as well as in frequency. Therefore, those living at high levels would not be equally willing to obtain insurance cover, at the same rate. It is quite a difficult task to accurately adjust insurance premium. Recently, a study has been taken up for demarcating different flood risk zones in the country for arriving at a suitable criteria for



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.

insurance premium. It may, however, be noted that all these efforts are in respect of properties only and not crops which are more liable to flood damage due to inundation. For this purpose, the Ministry of Agriculture has taken up a pilot scheme for introducing crop insurance. These efforts need further urgent action.

8.3.3 The report presented by the National Flood Commission in March, 1980 contained a total of 207 recommendations covering, inter alia, the aspects of past approach and achievements, effect of developmental works and encroachments, methodology of flood damage assessment, areas needing urgent attention, land use and regulation, cost and benefit criteria and future approach.

The recommendations pertaining to Non-structural aspects of flood management and the actions taken there on, are given in Annexure - IV.

9.0 INTEGRATED APPROACH TO FLOOD-MANAGEMENT.

The main measures of Non-Structural Aspects of Flood Management are (i) Flood Plain Zoning and (ii) Flood Forecasting and Warning. While the issue on Flood Forecasting and Warning is effectively managed by the Central Water Commission and other Central and State Agencies, not much progress has been achieved in respect of the other issue namely the Flood Plain Zoning. Ministry of Water Resources, Government of India had formulated a Model Bill for Flood Plain Zoning and made available copies of the same to all the States for enacting suitable legislations. Except Manipur State, no other State had enacted legislation

for Flood Plain Zoning. As a result, there is no check in indiscriminate occupation of flood plains and consequent exposure to flood damage from year to year. Effective implementation of Non-structural Measures, particularly the Flood Plain Zoning, requires political will to bring in the suitable legislation and for taking administrative actions

The Structural and Non-structural Aspects would provide an integrated approach to the Flood Management Programme. While the 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 both the Structural and Non-structural Aspects would optimise the benefits that would accrue from Structural Measures.

10.0 NATIONAL WATER POLICY.

The National Water Policy adopted by the Country in September, 1987, aims to develop, conserve, utilise and manage the most precious resource of water. The following steps for flood management were included in the National Water Policy.

"There should be a master plan for flood control and management for each flood prone basin. Sound watershed management through extensive soil conservation, catchment area treatment, preservation of forests and increasing forest areas and construction of check dams should be promoted to reduce intensity of floods. 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 the regulation of settlements and economic activity in flood zones, to minimise the loss of life and property on account of floods. While 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 the implementation of the National Water Policy and to provide a strong administrative link, a National Water Board headed by Secretary, Ministry of Water Resources at the official level has been set up by the Government of India in September, 1990 which periodically reports to the National Water Resources Council which has the Prime Minister of India as Chairman, Union Minister of Water Resources as Vice-Chairman and Chief Ministers of the States as Members.

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iv. Morphological studies of river Brahmaputra.

v. Specialised Paper/Studies on Disaster Management, FloodInsurance and Non-Structural Aspects of Flood Control.

ANNEXURE - I

MODEL BILL FOR FLOOD PLAIN ZONING

A BILL

to provide for the zoning of flood plains of rivers in the state of _____ Be it enacted by the legislature of the State of _____ in the Forty _____ Year of the Republic of India as follows :

CHAPTER - I - PRELIMINARY.

1. Short title, extent and commencement.

(1) This Act may be called the _____ Flood Plain Zoning Act.

(2) It extends to the whole State of _____

(3) This section shall come into force at once and the remaining provisions of this Act shall come into force on such date as the State Government may, by notification in the Official Gazette, appoint:

Provided that different dates may be appointed for different provisions of this Act and for different areas or different rivers.

2. Definition.

In this Act, unless the context otherwise requires -

(a) 'Flood plain' includes water channel, flood channel and that area of nearby low land susceptible to flood by inundation;

(b) 'Flood plain zoning' means restricting any human activity in the flood plains of a river where the plains are created by overflow of water from the channels of rivers and streams;

(c) 'Flood zone' means the area which is required to carry the flow of the maximum probable floods;

(d) 'Flood Zoning Authority' in relation to a river, means the authority appointed by the State Government under section 3;

(e) 'Land' includes interest in lands, benefits arising out of lands and things attached to the earth or permanently fastened to anything attached to the earth;

(f) 'Occupier', in respect of any land, means any person who has an interest in the land and cultivates the land himself or by his servants or by hired labour and includes a tenant;

(g) 'Owner' in relation to any land includes any person having interest in such land;

(h) 'Prescribed' means prescribed by rules made by the State Government under this Act;

(i) 'River'includes its tributaries;

(j) 'Water channel' means the channel in which the flows of a river are generally confined.

CHAPTER - II - FLOOD ZONING AUTHORITY AND ITS POWERS.

3. Declaration of flood plain zoning.

(1) Where the State Government considers it necessary or expedient so to do, it may, by notification in the Official Gazette and in the Gazette of every District in which any part of a river flow, declare that flood plain zoning shall be made in the manner hereinafter specified.

(2) The State Government may direct that a survey be made of a river for the purpose of determining the limits within which the provisions of the Act are to be applied and that proper charts and registers be prepared specifying all boundaries and landmarks and any other necessary matter for the purposes of ascertaining such limits.

(3) The State Government may by notification in the Official Gazette, appoint the Collector of the District or such other authority as that Government considers necessary, as the Flood Zoning Authority for the purposes of making a survey of the area as required under sub-section (2) and specify in such notification, the duties to be discharged by such authority.

4. Powers and functions of Flood Zoning Authority.

The Flood Zoning Authority shall exercise the powers and discharge the duties in accordance with the provisions of this Act and the terms and conditions specified in the notification under sub-section (3) of Section 3.

CHAPTER - III - SURVEYS AND DELINEATION OF FLOOD PLAIN AREA.

5. Survey.

(1) The Flood Zoning Authority shall carry out surveys of flood plains of the rivers and determine the nature and the extent of flood plains of the rivers.

(2) The Flood Zoning Authority shall, on the basis of the survey carried out under sub-section (1), establish flood plain zones and delineate the areas which are subject to flooding including classification of land with reference to relative risk of flood plain use intended to safegaurd the health, safety and property of the general public.

(3) The Flood Zoning Authority shall prepare charts and registers indicating the areas delineated under sub-section (2).

6. Power to take up survey.

It shall be lawful for the Flood Zoning Authority or any of the officers generally or specially authorised by it in this behalf.

(a) to enter upon and survey and take levels of any land within its or his jurisdiction;

(b) to mark such levels, boundaries and lines by placing marks or boundary stones;

(c) to measure the land;

(d) to do all other acts necessary for the purposes of ascertaining the limits referred to in sub-section (2) of section 3;

(e) where otherwise the survey cannot be completed and the levels taken, to cut down and clear away any part of standing crop, fence or jungle;

Provided that no Flood Zoning Authority or any other officer shall enter into any building or open any enclosed court or garden attached to a dwelling house (unless with the consent of the occupier thereof) without previously giving such occupier atleast seven days notice in writing of its or his intention to do so.

7. Payment of damages.

(1) The Flood Zoning Authority or any other officer generally or specially authorised by it in this behalf, who has entered upon any land under section 5 shall, before leaving, tender compensation to the owner or occupier of such land for any damage which may have been caused and in case of dispute as to the sufficiency of the amount so tendered, the Flood Zoning Authority or such officer shall refer the matter to the _____ for his decision.

(2) The decision of the officer under sub-section (1) shall be final and no suit shall lie in a civil court to have it set aside or modified.

CHAPTER - IV - NOTIFICATION OF LIMITS OF FLOOD PLAINS.

8. Declaration of intention of State Govt. to demarcate flood plain areas.

The State Government may, on the basis of a report from the Flood Zoning Authority or otherwise, by notification in the Official Gazette, declare its intention to demarcate the Flood Plain areas and either prohibit or restrict the use of land therein.

9. Public Notices.

(1) The Flood Zoning Authority shall, on the issue of notification under section 8, cause public notice of the substance of such notification to be given at convenient places in the area.

(2) The Flood Zoning Authority shall also give notices individually to the owners of the lands situated in the area.

(3) The Flood Zoning Authority shall exhibit records, charts, maps, registers and such other documents showing the river channel, flood channel and the flood plain area, specifying the nature and extent to which the use of limits of the area is either prohibited or restricted, in the office for inspection by the general public at the timings specified therein.

10. Objections.

(1) Any person who desires to raise any objection to the limits and either the prohibitions or restrictions specified in the public notice referred to in section 9, may, within a period of sixty days from the date of publication of the notification in the official gazette, forward to the Flood Zoning Authority a statement in writing setting forth his objections.

(2) After the expiry of the period aforesaid, the Flood Zoning Authority shall issue a notice in the manner prescribed and consider the objections after giving the party concerned a reasonable opportunity of being heard in the matter.

(3) The Flood Zoning Authority shall forward to the State Government its or his proposals together with the records referred to in sub-section (3) of section 9.

11. Decision of the State Government.

(1) The State Government shall, after considering the report of the Flood Zoning Authority, order such alterations in the limits of the area as it considers necessary.

(2) The decision of the State Government shall be final.

(3) The State Government shall, by notification in the official Gazette, declare that the provisions of this Act shall apply to the said river with boundaries and limits as specified.

(4) The areas delineated and approved by the State Government shall be deemed to be the flood plain and the limits shall, where necessary, be marked either by boundary stones or other suitable marks.

(5) The Flood Zoning Authority shall maintain the charts and registers of such areas so delineated and such charts and registers shall form part of the permanent records of the office.

(6) The charts and registers maintained under sub-section (5) shall be furnished to the Collector of the District in which any part of the river is situated and shall be open for inspection by the general public at such times as may be prescribed.

CHAPTER - V - PROHIBITION OR RESTRICTION OF THE USE OF THE FLOOD PLAINS.

12. Powers to prohibit obstruction, etc. flood plain area

(1) Where the State Governments is satisfied that it is necessary to do so in the interest of public health, safety, or property in the

interest of reducing the inconvenience to the general public or that it is necessary to prohibit or restrict the activities in the flood plain, that Government may, by notification in the Official Gazette, specify the area where such prohibition or restriction is to be enforced and the nature and extent of such prohibition or restriction.

Provided that no notification under sub-section shall be issued after the expiry of six months from the date of publication of notification under section 8.

(2) Upon the publication of a notification under sub-section (1) notwithstanding anything contained in any law, custom, agreement or instrument for the time being in force, the prohibition or restriction specified in such notification shall prevail.

(3) No person shall undertake any activity within the prohibited area or restricted area except with the previous permission of the Flood Zoning Authority.

Provided that where a person makes an application to the Flood Zoning Authority for permission under this sub-section to undertake any activity and the Flood Zoning Authority does not, within a period of ninety days from the date of receipt of such application, communicate to the person that permission applied for has been refused, it shall be presumed that the Flood Zoning Authority has granted such permission.

13. Penalty.

If any person commences or carries on or attempts to carry on any activity in the area specified in the notification under sub-section (1) of section 12 contrary to the terms and conditions specified in such notification, he shall be punishable.

(a) With fine which may extend to five hundred rupees or in default, of payment of fine, to simple imprisonment for a term which may extend to two months; and

(b) With further fine which may extend to one hundred rupees for each day after the conviction under clause (a).

14. Power to Compound.

(1) Subject to such conditions as may be prescribed, any officer authorised by the State Government by a general or special order in this behalf may, either before or after the institution of proceedings under this Act accept from the person who has committed or is reasonably suspected of having committed an offence, a sum of money not exceeding _____ rupees.

(2) On the payment of such sum of money, such person shall be discharged and no further proceedings shall be taken against him in respect of such offence.

15. Appeal.

(1) Any person aggrieved by any decision of the Flood Zoning Authority may refer an appeal to the prescribed authority within a period of ninety days from the date on which such decision was communicated to him;

Provided that the prescribed authority may entertain the appeal after the expiry of the said period of ninety days if it is satisfied that the appellant was prevented by sufficient cause from filing the appeal in time.

(2) The prescribed authority may, after giving a reasonable opportunity to the appellant of being heard in the matter, make such orders as it deems fit and the decision thereof shall be final.

16. Revision.

(1) Where no appeal has been preferred under section 15, the State Government may, for the purpose of examining the legality, propriety or correctness of any inquiry or proceedings of the Flood Zoning Authority, call for the records of any inquiry or proceedings of the Flood Zoning Authority and make such order in the case as it thinks fit;

Provided that no such record shall be called after the expiry of six months from the date of such order.

(2) No order of the Flood Zoning Authority shall be varied by the State Government so as to prejudicially affect any person without giving such person a reasonable opportunity of being heard in the matter.

CHAPTER - VI - COMPENSATION.

17. Payment of compensation.

(1) Where any permission to undertake any activity in the flood plain has been refused to any person or whereas a result of prohibition or restriction imposed on any person under this Act, such person suffers any damage, he shall be entitled to the payment of compensation not exceeding the difference between the value of the land as determined under section 23 or section 24 of the Land Acquisition Act, 1894 and the value which it would have, had the permission for carrying on any (Central

Act 1 of 1894) activity had been granted or the prohibition or restriction had not been imposed.

(2) In determining the amount of compensation under sub-section (1), any restriction to which the land is subjected to under any other law for the time being in force in regard to the right of the person claiming compensation to carry on any activity on the land or otherwise to the use of the land shall be taken into consideration.

18. Determining the compensation and apportionment by consent

(1) The person to whom the compensation under section 17 is to be paid and the apportionment of such amount among the persons interested therein shall be determined by agreement between the Flood Zoning Authority and the person or persons claiming interest therein.

(2) In default of any such agreement, the Flood Zoning Authority shall, after holding such enquiry as it considers necessary, make an award determining :

(a) the amount of compensation to be paid under section 17 and

(b) the apportionment, if any, of such compensation among persons known or believed to be interested therein;

Provided that where the amount of compensation exceeds Ten thousand rupees, no award shall be made without the previous approval of the State Government or such other officer as the State Government may authorise in this behalf.

19. Compensation not admissible.

(1) No compensation shall be awarded.

(a) If and in so far as the land is subject substantially similar restriction in force under some other law in force on the date on which the restrictions were imposed by or under this Act; or

(b) if compensation in respect of the same restrictions imposed by or under this Act or substantially similar restrictions in force under some other law has already been paid in respect of the land to the claimant or any predecessor in interest of the claim; or

(c) for removal of any encroachment.

(2) If any person has unauthorisedly undertaken any activity, then any increase in the value of land from such activity shall not be taken into account in estimating the value of land.

20. Application against award.

(1) Any person aggrieved by the award of the Flood Zoning Authority under sub-section (2) of section 18 may, by an application in writing, apply to the State Government or such other officer as the State Government may authorise in this behalf.

(2) Any application under sub-section (1) shall be made in such form and in such manner as may be prescribed and shall be made within forty five days from the date of communication of the award.

(3) The application under this section shall be disposed of in such manner as may be prescribed.

21. Procedure & powers authorities in deciding applications.

(1) An application under section shall be deemed to be proceedings within the meaning of section 141 of the code of Civil Procedure, 1908 and in the trial thereof, the authorities empowered to decide reference may exercise on the powers of civil court. (Central Act 5 of 1908).

(2) The scope of inquiry shall be restricted to the consideration of the matter referred to the State Govt. or such other officer as the State Govt. may authorise in this behalf.

22. Decision enforceable as decree of civil court.

The decision under section 21 shall be enforceable as a decree of civil court.

23. Payment under award.

On the determination of the compensation under section (1) of section 18, or on the making of an award under sub-section(2) of section 18 or if an application is made under section 20 against such award after decision of the authority, the compensation shall be paid by Flood Zoning Authority and the provisions of section 31 to 35 (both inclusive) of the Land Acquisition Act, 1894, shall apply to such payment (Central Act 1 of1894).

CHAPTER - VII - POWER TO REMOVE OBSTRUCTIONS AFTER PROHIBITION.

24. Power to remove obstructions.

(1) The Flood Zoning Authority may, in accordance with the provisions of this Act, within such time as may be specified by it direct any owner or occupier of land to do any act or to remove any unauthorised obstruction within such time as may be specified by it and such owner or occupier shall do such act or remove the obstruction.

(2) If the owner or occupier fails to comply with the order of the Flood Zoning Authority within time specified under sub-section (1), the Flood Zoning Authority may cause the act to be performed or cause the obstruction to be removed.

(3) All expenses incurred by the Flood Zoning Authority under this section shall be recovered from such owner or occupier as arrears of land revenue.

CHAPTER - VIII - MISCELLANEOUS.

25. Preventing Flood Zoning Authority from doing an act to bean offence.

Any person who prevents the Flood Zoning Authority in discharging any act imposed on such Authority by or under this Act, shall be deemed to have committed an offence under section 186 of the Penal Code. (Central Act 45 of 1860).

26. Flood Zoning Authority and other Officers to be public servants.

The Flood Zoning Authority and other officers and employees authorised under this Act shall be deemed to be public servants within the meaning of section 21 of the Indian Penal Code. (Central Act 45 of 1860)

27. Protection of action taken in good faith.

(1) No suit, prosecution or other legal proceeding shall lie against the State Govt. or any authority or person exercising any power or performing any duty under this Act for anything which is in good faith done or intended to be done in pursuance of this Act or order made thereunder.

(2) No suit or other legal proceeding shall lie against the State Govt. for any damage caused or likely to be caused for anything which is in good faith done or intended to be done in persuance of this act or any rule or order made thereunder.

28. Recovery of fine.

All fines imposed under this Act shall be recovered in the manner provided in the Code of Criminal Procedure, 1898. (Central Act 5 of 1890).

29. Power of Court.

A civil court shall have jurisdiction to settle, decide deal with any question which is by or under this Act required to be settled, decided or dealt with by the Flood Zoning Authority or such other officer authorised by the State Govt.in this behalf.

30. Power to make rules.

(1) The State Government may, by notification in the Official Gazette, make rules to carry out the purposes of this Act.

(2) In particular and without prejudice to the generally of the foregoing provisions, such rules may provide for.

(a) the manner in which charts and records shall be maintained.

(b) the form and manner in which application under section 20 shall be made and the manner in which such appliction shall be disposed of;

(c) any other matter which has to be, or may be, prescribed.

(3) Every rule made under this Act shall be laid, as soon as may be after it is made, before each House of the State Legislature while it is in session for a total period of fourteen days which may be comprised in one session or two or successive sessions and if before the expiry of the session immediately following the session or the successive sessions aforesaid both Houses agree that the rule should not be made, the rule shall, thereafter, have effect only in such modified form or be of no effect, as the case may be, so, however, that any such modification or annulment shall be without prejudice to the validity of anything previously done under that rule.

Annexure - II

MODEL ACTION PLAN (QUESTIONNAIRE) OF DISASTER PREPAREDNESS FOR FLOODS

AT THE STATE LEVEL :

1. Has a nodal agency for Disaster Management for (a) Disaster Preparedness and (b) Disaster Relief and Rehabilitation been set up?

2. Has the Coordination Committee on Natural Calamities met during the year? Are the Departments of Irrigation, Flood Control, Public Health, Civil Defence, Home Guard, Food, Transport, Information and Publicity represented in the Committee? Are the I.G.Police, the local sub-area Commander of the Army, a Senior Air Force Officer from the Air Force formation of the area, the Regional Director, India Meteorological Department, Regional Manager, Food Corporation of India, a Senior Officer of the All India Radio and the Secretary of the State Social Welfare Board Members of the Committee? Does the Committee have a Senior Officer as Member-Secretary? Is the Committee meeting periodically before monsoon and more frequently or daily during a calamity?

3. How many important Disaster Management Voluntary Organisations like the Red Cross have been associated with the Committee?

4. Does the Committee meet at least one month before the on-set of the monsoon each year? Are the District Officers of flood-prone districts asked to attend the meetings or place their problems before the Co-ordination Committee?

5. Is there a separate operations Control Centre? Is it equipped with an adequate number of telephones and wireless sets? Is there arrangement to man it round the clock? Is a roster of duties kept ready to put in operation at a short notice?

6. Have all flood prone blocks, talukas, tehsils been identified?

7. Have steps been taken to see that all such blocks/talukas/ tehsils can be contacted over telephones/W.T.sets in the event of floods?

8. Where are the flood warning signals received? Are they attended to immediately? Are A.I.R. and Doordarshan Stations instructed to issue flood warnings in simple and intelligible language of the area? Are Panchayats given receiving sets?

9. Are stores of relief articles and essential medicines arranged and verified before monsoon to check up if there are adequate stocks of tents, boats, tarpaulins, blankets, ropes, bleaching powder, vaccines (anti-cholera & anti-typhoid vaccines and anti-snake venom serum), water purification tablets and insecticides (for anti-fly and anti-mosquito measures), basic field sanitary engineering equipments, heavy duty pump sets (for drainage) and hand pump sets for drinking water? Have local Army Commanders been told of equipment etc. needed in case of floods?

10. Are routes chalked out in advance for despatch of relief goods to flood affected districts and sub-divisions or for evacuating the vulnerable population?

11. Has the operation of reservoirs been coordinated for providing flood cushion? Have the reservoir engineers been asked to be in constant touch with district authorities before releasing the water likely to inundate Villages?

12. Is it ensured that during flood season there will be no transfers and that leave vacancies are filled and nobody leaves the post unless a substitute is available?

13. Have the local A.I.R. and Doordarshan Station Directors been requested to broadcast/telecast educational and informative talks on disaster preparedness for public and to issue flood warnings round the clock?

14. Are the telephones of the Committee Members periodically checked by the Telecommunications Department to ensure their year round trouble-free functioning?

AT THE DISTRICT AND SUB-DIVISION LEVEL :

1. Have the flood-prone blocks, talukas, tehsils and villages been identified?

2. Is there a responsible officer in charge of relief and anti-disaster operations? Is he familiar with the field conditions of the flood-prone areas? Is there clear division of responsibility for flood relief among the officers and staff?

3. Is there an Operation Control Centre? Is there a roster of duties to man it round the clock?

4. Is a log-book maintained to keep data about rise or fall of flood waters at regular intervals of the rivers in spate.

5. Is there a Coordination Committee for Relief? Are the district level officers of the Departments of Health, Irrigation, P.W.D., Telephone and Police represented on it? Does it meet at least three weeks before the onset of monsoon? Are the S.D.Os and B.D.Os

of flood prone areas invariably asked to attend the meeting? Are voluntary relief organisations of repute and standing and the District branch of Indian Red Cross associated with the Committee?

6. How is the flood warning communicated down the line? Is there adequate arrangement for publicity through mobile units and micro-phones in the flood prone sub-divisions and blocks to issue the warnings?

7. Has the Deputy Controller of Civil Defence trained the Civil Defence Wardens in this matter?

8. Has the Deputy Controller of Civil Defence received any training in disaster preparedness?

9. Have the Home Guards been given any training in disaster preparedness and community preparedness for floods, as well as in rescue/relief/first aid? How are they kept in readiness for being mobilised at a short notice?

10. Are all the flood-prone blocks connected with telephones and all flood prone police stations provided with W.T.sets? Can W.T. sets/telephones be provided to lower levels of administration?

11. Who is responsible for disseminating the flood warnings at the village level? Has the village head and/or the head of the Gram Panchayat been given the responsibility? Do they have transistor/radio sets? If not, can they be provided with such sets at Government cost?

12. Has the Officer-in-charge of relief inspected the district/ sub-divisional relief stores after the occurrence of the last floods?

13. In particular, has he checked the stockpile of:

    1. Clothing (including children's garments, durries/mats).

    2. Tents, tarpaulins, CGI sheets and other material for providing temporary shelters.

    3. Boats, both country and power-driven and life jackets.

    4. Mobile water tankers, canvas water tanks, drums and jerry-cans for transporting drinking water and buckets.

    5. Sand bags for repair of flood protection embankments.

    6. Basic field sanitary engineering equipment.

14. Has the Chief Medical Officer likewise checked up the stocks and expiry dates of essential medicines, vaccines, disinfectants, first-aid kits at the district/sub-divisional medical store and kept the Primary Health Centres in flood prone areas well supplied with the following?

    a) Disinfectants such as bleaching powder, chlorine liquid, water purifying tablets, phenyl/creosote, horrocks test apparatus and chloroscopes (for ensuring premissible quantity of free chlorine) for supplying safe and potable drinking water.

    b) Essential medicines for mobile teams and dispensaries in the evacuee camps such as anti-diarrhoea, anti-biotic, chemotherapeutic and anti-malaria drugs, pyretic, analgesic and anti-allergic drugs, chlorosol, I.V.fluids with infusion sets, paediatric formulations for treatment of gastro-enteritis and respiratory infections in children.

c) First aid kits containing splints (including Thomas splints), tourniquets, dressing and assorted bandages, anti-septic cream, scissors and safety pins.

15. Have flood shelters (schools, community centres, etc.) been identified? Are these pucca buildings situated on riased ground above the normal level of flood water? What steps have been taken to make people aware of these shelters? Has the list of such shelters been published in the local newspapers and displayed in the Block, Taluka and Tehsil Offices?

16. Are these shelters easily accessible? Is it contemplated to use the Food for Work Programme for constructing link roads? Do these shelters/buildings have adequate space in and around them for storage of fodder and for keeping cattle?

17. Are the shelters provided with sources of drinking water? If not, what action is being taken to locate water sources - tubewells and wells near the shelters on priority basis?

18. What are the sanitary arrangements for these evacuation camps? Have the local officers incharge of these evacuee camps been told to construct the following?

    a) Deep trench latrines,

    b) Temporary urinals with soakage pits and

    c) Incinerators for burning dry refuse.

19. Has the District Manager, FCI checked up if sufficient stocks of food grains are in position in the flood-prone areas of the district before the monsoon starts?

20. Has the Officer incharge of civil supplies ensured that the dealers keep sufficient stocks of essential articles like wheat flour, rice, pulses, edible oil, salt, kerosene, charcoal, milk powder, baby food, matches, candles and lanterns before the start of flood season?

21. Have the wholesale consumers' cooperative societies been requested to keep in readiness stocks of aforesaid articles at the branch/primary level?

22. Have suitable sites for probable helipads on riased grounds in the flood-prone areas identified? Have these been indicated on the district and thana maps?

23. Has the meeting of the Transport Operators been called by the Chairman of the Regional Transport Authority to negotiate with the former, the placement of private vehicles at reasonable rates for evacuation of floods victims and movement of relief goods?

24. Have the Collectors/S.D.Os convened a meeting of the ferry-owners and cooperative societies of fishermen to ascertain the availability of country boats with boatmen at reasonable rates in the event of an emergency? A few country boats may be converted into improvised ambulance boats by providing them with 1 to 2 stretchers.

25. Have the people staying in low lying areas which are inundated in every flood been alerted first about the flood warning? Have the alternative sites which can be allotted to such families been identified? Have attempts been made to persuade such families to shift their dwellings to such safer locations?

26. Has the concerned Block identified and kept in readiness a shelf of projects of relief works which can be launched when the flood waters recede?

27. Have the villages that remain water-logged for a long time been identified?

28. Is there a list of people who cannot be provided with gainful work but may have to be fed free at Government cost for sometime? Have the Panchayats been associated in gratuitous relief work?

29. Have the people in flood prone villages been trained in relief and rescue work? Have volunteers been grouped for patrolling of embankments round the clock in times of flood warnings and trained to identify vulnerable places where the embankments are likely to give way?

30. Are the exercises to test the disaster preparedness plan conducted at block/taluka/tehsil levels?

Annexure - III

COMPARATIVE FLOOD FORECAST PERFORMANCE FROM 1978 TO 31.10.1990

Year	Total No.of Forecasts Issued	No.of Forecasts within +/-15 cm/+/-20% cumecs of deviation from actual	Percentage of forecasts within +/-15cm/+/-20% cumecs of deviation from actual	Remarks
1978	6964	5741	82.4	Excluding inflow forecasts
1979	4353	3531	81.1	
1980	5175	4485	86.7	
1981	5185	4460	86.0	
1982	4224	3721	88.1	
1983	5058	4377	86.5	
1984	5191	4676	90.1	
1985	6181	5668	91.7	
1986	4787	4409	92.1	
1987	5813	5525	95.1	
1988	6982	6554	93.9	
1989	5536	5262	95.1	
1990	8566	8071	94.2	

Annexure - IV

RECOMMENDATIONS OF NATIONAL FLOOD COMMISSION (RASHTRIYA BARH AYOG), 1980 REGARDING NON-STRUCTURAL ASPECTS OF FLOOD MANAGEMENT WITH ACTIONS TAKEN THERE ON.

1. RECOMMENDATION NO. 49.

FLOOD PLAIN MANAGEMENT MEASURES SHOULD BE UNDERTAKEN WHEREVER NECESSARY LEGISLATION EXISTS AND SUITABLE LEGISLATION ENACTED IN OTHER STATES.

FOLLOW - UP ACTION.

The State Governments have generally been lukewarm in getting the necessary legislation passed for introducing Flood Plain Zoning regulations in the flood prone areas. Manipur is the only State which has got the Bill for Flood Plain Zoning passed. Andhra Pradesh has prepared a Flood Plain Zoning Bill which has been approved by the State TAC but legislation is yet to be passed. Simultaneously, the State has desired that the Centre should undertake the surveys of flood prone areas in the State on priority basis. The other States are being persued to take early action in the matter. The basic requirement for introducing the zoning regulations is the flood risk maps. To prepare the maps of flood prone areas, surveys have been undertaken by the Central Water Commission, through the Survey of India. An area of about 50,000 sq.km. in the entire country has been surveyed upto March, 1990. Survey maps of certain reaches of the Jhelum, the Sutlej, the Yamuna, the Ganga and tributaries of the Brahmaputra have been supplied to the State Governments for preparing flood risk maps. The Central Water Commission has

also proposed to set up a Flood Plain Management unit to exclusively coordinate this work and take up pilot zones for preparing zoning maps and regulation details. State-wise information is given below :

In **Assam** enactment of flood plain zoning legislation is not envisaged at present.

In **Madhya Pradesh** physical demarcation of 36 towns affected by floods at least three times in the last 30 years is being taken up by the Government. Regarding legislation for flood plain zoning, the matter is before the State Flood Control Board (SFCB) for consideration.

In **Uttar Pradesh**, enactment of legislation is not considered necessary at this stage.

In **West Bengal** the draft bill on flood plain zoning is under correspondence with State's law Department.

Orissa has reported that the formulation of Flood Plain Zoning Bill was under consideration of the State Government. The State Government of **Tamil Nadu** has intimated that they agree in principle to enact a suitable legilsation for flood plain zoning. **Delhi** Administration have informed that the enactment of flood plain zoning Act is not required as the objective is proposed to be achieved through the existing provision of Delhi Development Act 1957. However, CWC has informed the Ministry of Water Resources that the Delhi Development Act does not cover the flood aspects and is mainly meant for urbanisation etc. **Goa, Daman & Diu** have intimated that they are expecting to enact the legislation very soon. Government of **Gujarat** have not considered it necessary to enact such a legislation in view of the situation prevailing in the State.

2. **RECOMMENDATION NO 84.**

AFFORESTATION AND SOIL CONSERVATION MEASURES ARE RECOMMENDED AS A USEFUL COMPLEMENT TO OTHER MEASURES AND SHOULD BE TAKEN UP SPECIALLY IN THE WATERSHEDS OF RIVERS WITH HEAVY SILT CHARGE.

FOLLOW UP ACTION.

Afforestation and soil conservation measures have been intensified during the Sixth Plan on the basis of the recommendations of the Working Group on Integrated Action Plan for Watershed Management and Flood Control. CWC would further coordinate with the Department of Agriculture in intensifying this activity, both in India and adjoining Countries of Nepal and Bhutan where the flood prone rivers originate. The Project Implementing Committee at National level and Zonal Committees at zonal level have been constituted to monitor the progress. CWC are represented on both the Committees at appropriate level.

3. **RECOMMENDATION NO 92.**

MEASURES ATTEMPTING TO MODIFY THE SUSCEPTIBILITY OF LIFE AND PROPERTY TO FLOOD DAMAGE SHOULD BE ADOPTED TO MUCH MORE INCREASING DEGREE THAN HERETOFORE .

FOLLOW UP ACTION.

Manipur is the only State which has completely implemented the recommendation. Efforts are also being made by Andhra Pradesh, Assam, Haryana and Uttar Pradesh to implement the recommendation. Central Government through Central Water

Commission is playing a vital role in the implementation of the recommendation through their network of Hydrological Observation and Flood Forecasting and Warning System. Almost all the States have been covered by the system and have appreciated the same. Particularly, Assam, Uttar Pradesh, Bihar and West Bengal Governments were all praise for the service in the face of heavy floods in 1988. The State-wise information is given below :

In **Assam** rehabilitation and flood relief measures are with Revenue Department.

Madhya Pradesh has noted for future action.

In **Uttar Pradesh** the success in this regard is not certain due to ever increasing population.

In **West Bengal** the recommendation is taken into consideration while preparing flood protection schemes.

4. **RECCOMENDATION NO. 137.**

ARRANGEMENTS SHOULD BE MADE FOR CONNECTING BY TELECOMMUNICATION LINKS, ALL POINTS OF IMPORTANT FLOOD AND DRAINAGE WORKS TO THE HEADQUARTERS OF SUPERIOR ENGINEERING OFFICERS AND THE CONTROL ROOM OF STATE HEADQUARTERS.

FOLLOW-UP ACTION.

Andhra Pradesh has stated that satisfactory arrangements exist in the State for monitoring the floods during the flood season.

In **Assam** the important points and control rooms are connected by telelink during the flood season.

In **Madhya Pradesh** the recommendation is accepted and noted.

In **Uttar Pradesh** the recommendation is accepted. Important sensitive places are connected by Police Wireless network.

In **West Bengal** the flood prone areas are generally connected by telelink in flood seasons.

Information is awaited from other States.

5. **RECOMMENDATION NO. 154.**

THE CENTRAL GOVERNMENT SHOULD PREPARE A MODEL BILL DEALING WITH ALL ASPECTS OF FLOOD CONTROL TO SERVE AS A GUIDE FOR THE STATE GOVERNMENTS.

FOLLOW UP ACTION.

Entry 24 as referred to 19.9 of the report of the Union List does not pertain to flood management aspects and as such is not of relevance as far as legislation regarding taking over the management of flood management and related aspects on inter-state rivers is concerned. The Ministry of Water Resources has initiated action for the purpose of regulation of development of inter-state rivers. Ministry of Water Resources (the then M/O Irrigation) circulated a Model Bill on Flood Plain Zoning to all the State Governments and Union Territories in 1975 urging them for enactment of a suitable legislation for flood plain management after modifying the bill to suit the local conditions. (Copy at

Annexure - I). The CWC have been persuing with the State Governments for an early action on the enactment of legislation from time to time. At the Seventh Conference of the State Irrigation Ministers held in December, 1982, it was urged upon the States to undertake the work of preparation of flood risk maps on priority basis and reiterated its earlier resolutions for taking necessary action for enactment of legislation on the lines of the model bill for flood plain zoning circulated by the Centre. Manipur enacted the legislation in September, 1978 and enforced the same by a notification with effect from 1st December, 1985. The State-wise position is given under Recommendation No.49 in this Annexure.

The National Conference of State Irrigation and Water Resources Ministers held in July 1986 considered that it is necessary to regulate the development in the flood plains to minimise the incidence of flood damage and loss of lives in future. The conference, thereofre, recommended that following steps be taken urgently :

i. The work of preparation of contour plans on requisite large scale maps of flood plains should be expedited and completed early by the Survey of India, for which the States may indicate the priority areas to the CWC. Thereafter, physical demarcation of flood affected areas of various frequencies be made and widely publicised by the States.

ii. Legislation of flood plain zoning as required in each State be enacted by all the flood prone States expeditiously.

iii. Pending enactment of legislation, developmental activities in the flood plains should be regulated by administrative measures on the basis of guidelines already circulated by the Government of India.

iv. In the flood plains, suitable crop management practices may be developed with a view to minimising the adverse effects of floods on crop production.

All States should take early steps to enact the legislation on flood plain zoning. Pending enactment, the recommendations of National Conference of State Irrigation and Water Resources Ministers mentioned above may be followed. The progress on the implementation and follow up action on the recommendations made by the State Governments may be periodically reported to CWC.

Flood Forecasting station at Paonta Saheb on River Yamuna

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