

CHAPTER 8

REMIDIAL MEASURES AND RECOMMENDATIONS

8.1 REMEDIAL MEASURES FOR SAVING RESOURCES.

- 8.1.1 DISSEMINATION OF WARNING
- 8.1.2 THE DISASTER MANAGEMENT CYCLE
- 8.1.3 PREPARING FOR FLOOD
- 8.1.4 FLOOD MANAGEMENT MEASURES
- 8.1.5 FLOODPLAIN MANAGEMENT AND ZONING
- 8.1.6 FLOOD PROOFING
- 8.1.7 FLOOD FORECASTING AND WARNING

8.2 ACTIVITIES OF GO'S AND NGO'S FOR SAVING LIVES AND PROPERTIES FROM FLOODS.

- 8.2.1 IRRIGARION AND WATERWAY DEPARTMENT, KOCH BIHAR
- 8.2.2 CENTRAL WATER COMMISSION, KOCH BIHAR
- 8.2.3 RELIEF AND RESCUE
- 8.2.4 RESCUE MECHANISM IN THE DISTRICT
- 8.2.5 TRIGGER MECHANISM FOR RESCUE IN KOCH BIHAR
- 8.2.6 ROLE OF CIVIL IN DEFENCE ORGANISATION IN FLOOD RESCUE OPERATION
- 8.2.7 ROLE OF DISTRICT POLICE ADMINISTRATIN IN FLOODING SITUATION
- 8.2.8 ROLE OF BSF IN FLOOD SITUATION IN KOCH BIHAR DISTRICT
- 8.2.9 ROLE OF ARMY INFANTRY BATTALION

8.3 RECOMMENDATION FOR MITIGATION OF FLOOD

- 8.3.1 ENGINEERING APPROACHES FOR LIMITATIONS OF FLOODING EFFECTS
- 8.3.2 PROTECTION OF ENDANGERED AREA
- 8.3.3 REDUCING THE DANGER OF THE FLOOD DURING ITS

OCCURRENCE, THE ACTIONS IMPLEMENTED INTO

- 8.4 PREVENTIVE MEASURES FOR HEALTH
- 8.5 FLOOD INSURANCE
- 8.6 RECONSTRUCTION OF ECONOMIC LIFE AND
COMPENSATION
- 8.7 FLOOD RISK MITIGATION

8.1 Remedial measures for saving resources

The floodplain dwellers in the study area have to aware of flood hazard. Floods are annual feature, though its magnitude and frequency differs from different places and different years. Floods inundating croplands are of course, regular events. People of Koch Bihar suffer from flood damages regularly. Damages are primarily to crops and to a lesser degree to animal and houses including life household property.

During flood the government agencies of the flood control board keep alert to help flood victims. Flood warning, if given efficiently in time, may greatly reduce flood damages. Flood zoning map have to be prepared with utmost care particularly by examining the ground reality in details. The flood shelters are few and far between. A well integrated warning system and preparedness may reduce the distress of the affinities community. A decentralized relief system would help to approach the remote areas fast. To save resources flood management and flood proofing including disaster preparedness and response planning, flood forecasting and warning and other non structural measures such as disaster relief, flood fighting including protection of public health and introduction of flood insurance, quick drainage facilities, potable drinking water, sanitary arrangement and education, human dwellings and animal shelters, raised platforms for shelter, storage facilities for food and fodder and other essential commodities and communications. The modernization of flood forecasting system based on telemetry and satellite communication is necessary. Complete immunity from flood is almost impossible and hence preventive measures are required to be perfect to avoid damages to the great extent possible.



Plate 8.1 Zig-zag shaped embankment construction for protection of land from soil erosion at Jorepatki.

8.1.1 Dissemination of warning

Flood warning is disseminated by following means:

1. High priority Telegram
2. Doordarshan
3. All India Radio
4. Bulletins in the press
5. Satellite based disaster warning system
6. Teleprint
7. Telex
8. Telephone
9. Government channel

8.1.2 The disaster management cycle

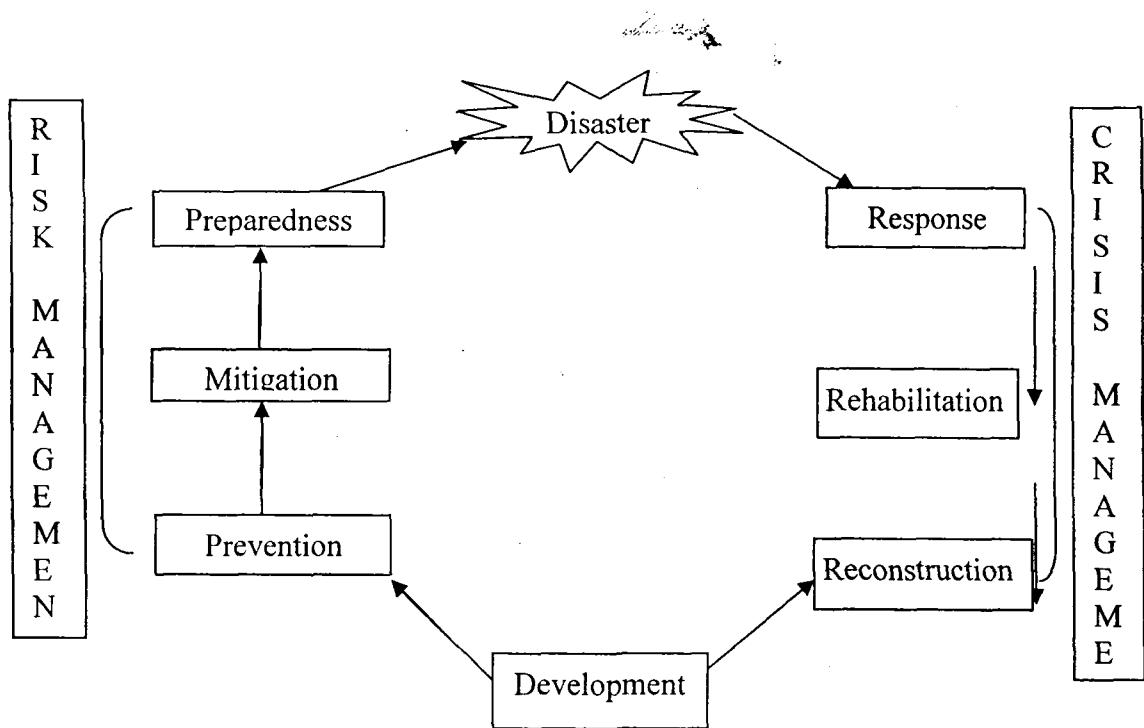


Fig. 8.1 Disaster Management Cycle.

Source: UNDP Disaster Risk Management Programme 2007.

Disaster Management Cycle (Fig. 8.1) consists of the following stages:

a) The Disaster event:

This refers to the real time event of the hazard occurring and affecting elements at risk. The damage is directly proportional to duration of event.

b) Response and Relief:

This refers to the first stage after the calamity. Relief materials like flood, clothing, medicines and other necessities are distributed to bring life to normalcy.

c) Recovery (Rehabilitation and Reconstruction):

It is used to describe the activities that encompass the three overlapping phases of emergency relief, rehabilitation and reconstruction.

d) Development:

It is an ongoing activity for an evolving economy. Long term prevention for disaster measures like construction of embankment against flooding can be taken up as a development plan.

e) Prevention: Reduction of risk in disasters involves activities which reduces the magnitude and intensity of flooding like disaster.

f) Mitigation:

It is a collective activity undertaken in anticipation of occurrence of a potentially disastrous event, including preparedness and long term risk reduction measures.

g) Preparedness:

The Process embraces measures that enable government, community and individuals to respond rapidly to disaster situation to cope with them effectively.

8.1.3 Preparing for floods:

Floods which are natural hazard need not become a disaster, if we are prepared to deal with them. Some preparedness measures that we need to carry at the individual and at the government level are:

Pre Disaster

Individual Preparedness

1. Know the route of the nearest safe shelter.
2. First Aid Kit should be ready with extra medicines for snake bite and diarrhea.
3. Tie up all valuables at the top of the roof.
4. Radio with extra batteries, torch, ropes to be kept ready.
5. Store dry ration, kerosene, biscuits, baby food for at least 7 days.
6. Be ready with water proof bags, polythenes to store clothes and valuables.
7. Identify a highland/ mound for the cattle and have sufficient fodder for them.

8. As soon as you receive warning tune to the local news in the radio / Television for the latest update.
9. Don't spread rumors. Get authentic data and then announce it.
10. Check your emergence kit.

If you have to Evacuate

1. Pack cloths, essential medicines, valuable, personal papers in a water proof bag.
2. Inform the Disaster management Team member to the place that you are shifting to.
3. Raise furniture and appliances to a higher place.
4. Switch off all electrical appliances.
5. Put sandbags in the toilet bowl and cover all sewage backflow.
6. Lock your house and take the route suggested.
7. Don't go into water of unknown depth and current.

Government Preparedness:

1. Update the entire resource inventory.
2. Control room should be functional for 24 hours.
3. Identify all the shelter places where people could be evacuated.
4. Activate all the First Aid and Rescue and Evacuation team.
5. See to it that there is no blockage in the flow of the river.
6. Ascertain the availability of dry food, drinking water and medicines.
7. Ascertain the fodder availability for cattle's.
8. Mobilize boats, vehicles which will help in evacuation and rescue operation and also in the distribution of relief.
9. Provide mobile wireless sets the villages likely to be cut off.
10. Prior storage of grains in the vulnerable pockets.
11. Arrange adequate hand pumps where wells are likely to be inundated.
12. Identify the relief centers.
13. Prepare maps of alternate route, resource available.
14. Communication with army, Police, Railways locality.

During Disaster

Individual

1. Keep food covered. Don't take heavy meals and eat food that is hot.

2. Drink boiled water or put halogen tablets,
3. Use raw tea, rice water, coconut water during diarrhea,
4. Don't let children stay in empty stomach,
5. Avoid entering flood water. Stay away from water which is above knee depth.

Government

1. Carry out rescue and evacuation.
2. Operation of Control Room and provide warning update.
3. Provide relief materials.
4. Mobilizing resources like boat, dry food, temporary shelter.
5. Coordination at various levels and agencies.
6. Mobile health units to be made available.
7. Damage assessment of life, livestock, crop and live hood.

Post Disaster

Individual

1. Listen to the latest bulletin before moving from the shelter place.
2. Use recommended routes to return back.
3. Dry all electrical equipments before using it.
4. Avoid touching any loose wire.
5. Beware of snake bites.
6. Clean the house and disinfect the surrounding by using bleaching powder.

Government

1. Rescue people who are stranded.
2. Restore roads and power supply.
3. Provide safe drinking water.
4. Check outbreak of any epidemics.
5. Mobile health teams to be mobilized.
6. Take the help of the NGOs.
7. Carry out damages assessment.
8. Ensure the adequate, timely and speedy credit is available to the farmers for purchasing agricultural inputs and cattle's.

(Source: UNDP Disaster Risk Management Programme)

8.1.4 Flood management measures

Such measures can be classified into following four major groups:

- A. Attempts to modify the floods.
 - B. Attempts to modify the susceptibility to flood damage.
 - C. Attempts to modify the loss burden; and
 - D. Bearing the loss.
- A. It involves flood protection by physical measures such as
- Construction of embankments.
 - Construction of detention reservoirs.
 - Channel improvements etc.

By these measures, a catchment area can be treated through reduction in flood volumes or pattern of flows or attempts to alter Weather modification.

- B. It involves action designed to reduce the vulnerability of property and other developmental activities in the floodplains to the flood hazard.
- C. Consists of action to modify the incidence of losses, by spreading them over a large segment of community.
- D. Bearing the loss means " living with floods".

These measures are further classified as:

A. Structural Measures

- i) Long term Measures.
- ii) Permanent Structural Measures.

B. Non Structural Measures

- i) Flood plan zoning.
- ii) Flood Forecasting & Warning.
- iii) Flood Proofing.
- iv) Drainage Management.

Structural Measures

The general approach of these measures is to tackle the problem of floods by preventing the flood water from reaching potential centres.

The main thrust of the flood protection programme undertaken in India so far, has been in the nature of taking up structural measures in different states of India. These may be undertaken in this District also. These are:

1. Dams and Reservoirs,
2. Embankments, flood wall,
3. Natural detention basin,

4. Channel improvement,
5. Drainage improvement,
6. Diversion of flood waters.

The update progress up to of construction of these works is as follows:

- 1) Total No. of Embankment 211
- 2) Length of Embankments 440 km
- 3) Length of drainage channels 800 km
- 4) Towns protected 5
- 5) Area protected 470.75 sq. km.

Long Term Measures

1. Strengthening the river embankments with modern technology.
2. Channel improvement.
3. Inter basin transfer.
4. Bank protection and anti erosion works.
5. Village raising or construction of community cum shelter building above high flood level.

Permanent Structural Measures

1. Introduction of watershed management followed by application of rain harvest technology.
2. Improvement of existing reservoir, tanks etc. through village Panchayet utilizing the fund from Rural Development Works, regular inspection and strengthening flood protection embankment and other bunds.
3. For safe disposal of surplus runoff, inspection and overhauling of drainage channels.

Non structural Measures:

The non structural measures which aim at modifying the susceptibility to flood damage and modifying loss burden consists of:

Floodplain management measures like floodplain zoning and flood proofing including disaster preparedness.

Flood forecasting and Warning

Disaster Relief

Flood fighting including Public Health Measures

Flood Insurance etc.

8.1.5 Floodplain management and zoning

The basic concept is to regulate the land use in floodplain zoning in order to restrict the damage potential due to floods of different magnitudes. The floodplain zoning is done by determining the locations and the extent of areas which are affected by floods of different magnitudes or frequencies. These areas have to develop as floodplain zoning due to manage of flood is minimum. Therefore, Floodplain Zoning aims to regulate the indiscriminate and unplanned development in floodplains. It is relevant both for unprotected as well as protected areas. It recognizes the basic fact that the floodplains are essentially the domain of the river, and as such developmental activities in floodplains must be compatible with the flood risk involved.

8.1.6 Flood proofing

Such measures help greatly in the mitigation of disasters to the population in flood prone areas. It is essentially a combination of structural change and emergency action without evacuation. A programme of flood proofing provides the raised platforms for flood shelter for men, cattle and raising the public utility installations above flood levels. Under this programme several villages were raised in the District.



Plate 8.2 An imprint of bank failure and thereby delink of railway communication at Pundibari.

8.1.7 Flood forecasting and warning

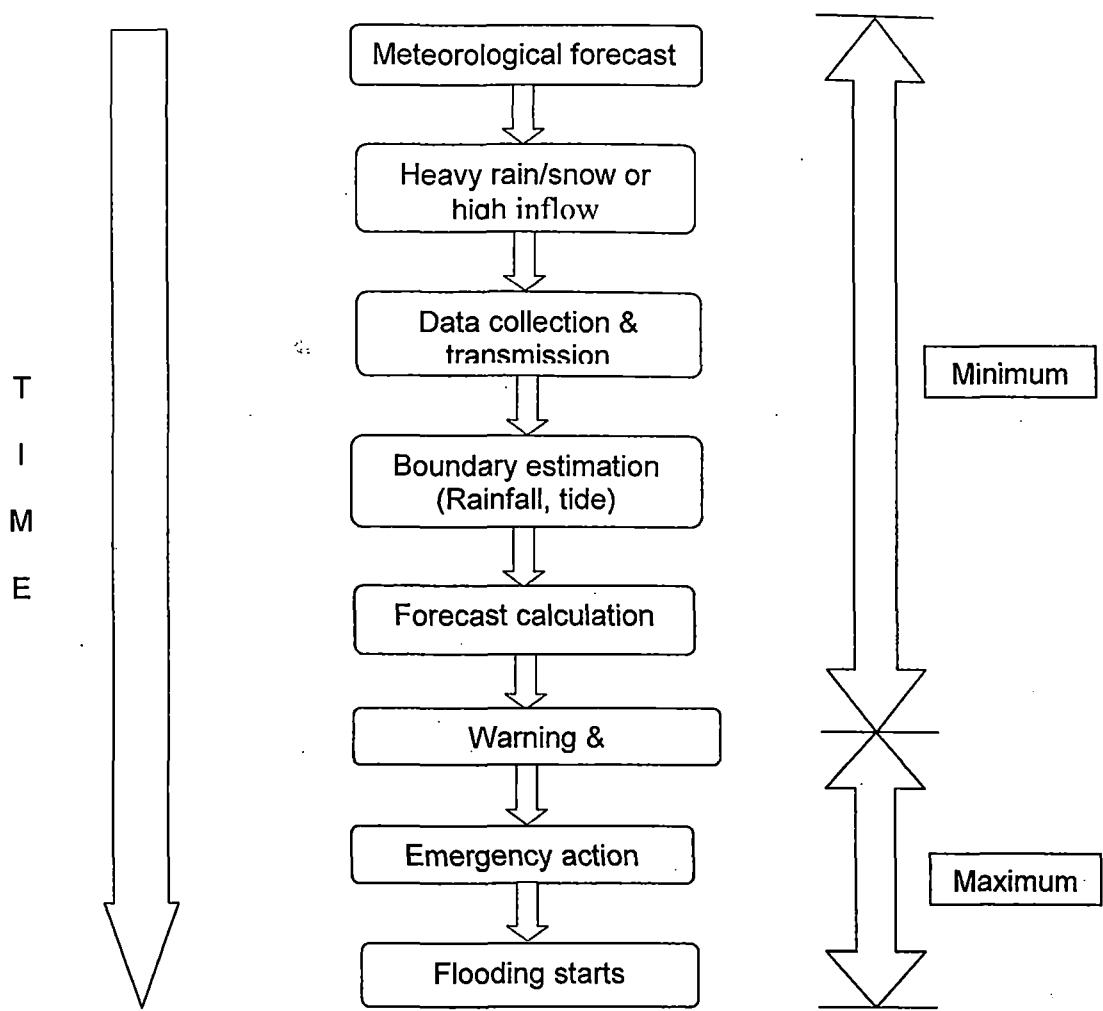


Fig. 8.2 A schematic presentation of the main activities in flood forecasting, warning and dissemination.

(Source: Paudyal, 2003).

Flood forecasting is the prediction of water levels and the extent and depth of flooding in rivers and floodplains. Flood warning is the preparation of forecasts in a meaningful format that can be either numerical or visual. In order to effective, the warning has to be disseminated to the media for broadcasting, and concerned organizations who are prepared to act on the information and provide relief to vulnerable communities (Pudyal 2003).

Figure 8.2 shows a schematic of the main activities of flood forecasting, warning and dissemination in a river basin. The forecasting system should provide a clear overview of the current situation in the catchment areas at a given time and

able to display them using Geographical Information System (GIS). It should be able to provide a forecast of river flows including reservoir inflows, water levels along tributaries as well as in the mainstream.

This programme was first commenced in our country in 1956. It now covers most of flood prone areas of the country. It was set up Central Water Commission (CWC). CWC has established flood monitoring and forecasting stations in different river systems in the District and surrounding District of Jalpaiguri and Assam (Table 8.1).

The Flood forecasting activities and hydrological activities in the District are being issued from different sites are given below in details:

Table 8.1 Flood forecasting activities and hydrological activities in the District Koch Bihar District.

Sl. No.	Name of site	River	Nature of site	Nature of working Activities.
A) TOSA BASIN				
1	Hasimara	Torsa	GTS & Rainfall	Hydrological site & base station of Ghugumari forecast site.
2.	Ghugumari Torsa		GTS & WQ	Hydrological site & Forecasting site
B) RAIDAK I BASIN				
3.	Chepan	Raidak I	GTS & Rainfall	Hydrological site & base station of Tufanganj forecast site.
4.	Tufanganj	Raidak I	Gause	Forecasting site.
C) RAIDAK II BASIN/ SANKOSH BASIN				
5.	Barobisha	Raidak II	GTS & Rainfall	Hydrological site & base station of Golokganj forecast site.
6.	Sankosh LRP	Sankosh	GTS	Hydrological site & base station of Golokganj forecast site.
7	Golokganj	Sankosh(Gangadhar)	Gauge	Forecasting site
D) JALDHAKA BASIN				
8	Nagrakata	Jaldhaka	Gauge & Rainfall	Forecasting site & base station of N.H.31 bridge site

9.	N.H. 31 Bridge	Jaldhaka	GTS & Rainfall	Hydrological site & base station for Mathabhanga Forecasting site
10	Mathabhanga	Jaldhaka	GTS,WQ& Rainfall	Hydrological site & forecasting site
E) TISTA BASIN				
11.	Domohoni Bridge	Tista	GTS, WQ & Rainfall	Forecasting site & base station of Mekhliganj R/B Forecasting station
12.	Mekhliganj	Tista	Gause	Forecasting site

Source: CWC, Jalpaiguri.

8.2 Activities of GO's and NGO's for saving lives and properties from floods.

8.2.1 Irrigation and Waterways Department

The Irrigation and Waterways (I & W) Department of Koch Bihar have under jurisdiction 10 Blocks out of 12 Block of the District and remains 2 blocks under the jurisdiction of I & W, Jalpaiguri. There are 30 rivers flowing over the District. Among them 7 are major rivers (Tista, Jaldhaka, Torsa, Raidak I, Raidak II, Kaljani and Sankosh.), 7 are medium size rivers (Gadadhar, Dharla, Sutunga, Mujnai, Saltia, Ghargharia and Dolong) and numerous small size rivers (Bura Dharla, Buri Tista, Upani, Saniajan, Seti, Nenda, Chenakata, Sheuli, Sankhola, Masankura, Upani, Maldah, Giridari etc.) spreads over the District. The total length of these rivers are about 800 km with a total river bank length is 1600 km. Upto 09.07.2010, the I & W Department of Koch Bihar has completed 440km of river bank protection work which are able to protect about 470.75 sq. km of vulnerable land of the District.

Presently, 28% of the river bank in the District remains protected from erosion. Koch Bihar District is a major river erosion prone District. Large amount of fertile agricultural land eroded and washed away every year. Farmers of the District thus are living with distress and misery. I & W Department of the District are entrusted with the task to protect river banks from erosion by executing anti erosion scheme. Anti erosion schemes are initiated as per necessity, demand of the people and availability of fund from the Government.

8.2.2 Central Water Commission, Koch Bihar

Central Water Commission, Koch Bihar is entrusted with the flood forecasting activities and issuing the flood forecasts for selected sites will advance during the

flood season. This Subdivision under Lower Brahmaputra Division. CWC, Jalpaiguri is monitoring the river Torsa, Raidak-I, Raidak-II and Sankosh. There are observation sites situated at Hasimara and Ghugumari over river Torsa at Chepan and Tufanganj over river Raidak-I at Barobisha over River Raidak-II and Sankosh LRP and Golokganj over river Sankosh. Normally over flood season activities starts from 00 hrs. of 15th May and ends on 31st October. During the flood season CWC issues flood forecasts at selected sites such as Ghugumari, Tufanganj, and Golokganj (Assam) and disseminate the hydrological data to the concerned State and central authorities. Divisional Control Room is at Jalpaiguri and Subdivisional Control Room is at Koch Bihar and Barpeta (Assam). These function daily round the clock.



Plate 8.3 Local Schools used as flood shelter during flood period in Fakirerkuti Village.

8.2.3 Relief and rescue

Flood is the main disaster of the District. Every year floods appear but in every 2-3 years large flood comes. So, the District requires elaborate preparedness for mitigation of disaster like flood. Normally in the District, water logging does not take place excepting some areas of Dinhata Subdivision on the banks of river Dharla. In the areas likely to be affected by floods, rescue centers have been identified. Affected people are given shelter in the rescue centers which are normally

Primary Schools or High Schools of the area (Plate 8.2). In the area where flood takes longer duration and people are unable to return to their houses special help specially for food is required. During the flooding time where people are not able to cook due to problem of fire wood then the gruel kitchens have to set up in such areas.

8.2.4 Rescue mechanism in the District

Once the flood warning is received from concern officer as BDO, the message is conveyed in the locality likely to be affected by floods through Gram Pradhan and wide publicity is made through Public Address System. The Primary responsibility for rescue and relief would be that of civil administration in their respective areas (Disaster Management Plan, Koch Bihar, 2007-08). Panchayets would provide necessary help and assistance. Panchayets have to engage in public awareness and rescue operation. BSF in the border area also have to engage in rescue operation. In Balabhat, Gitaldaha, Dhapra, Kuchlibari, etc. speed boat available with BSF may be utilized in rescue operation in flooding situation. Local Army unit is to be ready to provide assistance in extreme emergency. Army can provide rescue parties, boats and bailey bridges if needed.

8.2.5 Trigger mechanism for rescue in Koch Bihar

This is another name for Standard Operation Procedure (SOP) which is current in the military, and is primarily meant to reduce response time to a minimum. In order to lay down SOPs for different intensity of disasters the concept of L0, L1, L2 and L3 has been mooted (Disaster Management Plan, Koch Bihar, 2007-08).

L0 or ordinary level is to denote the normal times when the disaster management system should be maintaining a close watch over the state of preparedness. Mock drill and management plan for each year is required at this level.

L1 or Level one is the starting point of flood situation, when reported from any corner would set into motion, without formal order from any corner some basic initial management response steps alerting all concerned bodies according to predetermined procedure.

L2 or Level two- An L1 type of disaster develop into L2 level overtime necessitating total attention of the District administration. The mitigation, relief and rescue activities are also going with this level.

L3 or Level three- An L2 type of disaster may be developed over time into an L3 type of disaster. When this level of disaster persists, some basic initial management response steps, predetermined for flood management have to set into motion without formal orders from any corner. The corresponding mitigation, relief and rescue activities would also be going with this level.

These four types of level have to determine for each type of disaster by corresponding managers at the District, State and Central level. Along with these actions that need to follow as well, the various authorities that need to be alerted and activated also need to be predetermined. The Primary responsibility for rescue and relief would be that of civil administration in their respective areas. Panchayets would provide necessary help and assistance.

8.2.6 Role of civil defense organisarion in flood rescue operation

Koch Bihar Civil Defense Organisation performs duties effectively in flooding situation in the District. A reserve force of 30 nos. of C.D. Volunteers is ready in the District Flood office from June to August every year. They have a special training on rescue and First-Aid. They exhibit mock drill in *Sagardighi* on rescue operation in every year (Disaster Management Plan, Koch Bihar, 2006-07).

8.2.7 Role of district police administration in flooding situation

Koch Bihar Police administration plays an important role in flooding situation of the District (Disaster Management Plan, Koch Bihar, 2007-08). They established 6 flood warning R.T. Sets in different 5 locations in the District: 1) Hanskhawa, 2) Giladanga, 3) Adabarighat, 4) Balarampur, 5) Ksheti Fulbari and in 6) Rampur by the West Bengal Police Telecom to convey the water level of the rivers and flood situation report to the District Control Room at every stage. Local Police also collect the flood report from BDOs. They also help in rescue operation with boat and vehicle if needed. They look after law and order situation problem of which sometimes arises during flood and takes steps to guard the affected villages for protection from pilferage and robbery as villagers leave their houses with belonging to take shelter in safe place.

8.2.8 Role of BSF in flood situation in Koch Bihar District

Koch Bihar District has a long (274 km) of international boundary with Bangladesh. There are many BSF camps and BOPs (Border Out Post) for defense

purpose along the southern boundary of the District. These camps and BOPs affects due to flooding each year.

Table 8.2 Flood likely to be affected BOPs in Koch Bihar.

Sl. No.	Border Out Posts	Battalion No.
1	Lotefela	182
2	Chengmari	182
3	Krishnapur	182
4	Balabhut	182
5	Jhaukuthi	182
6	Madhya Balabhut	182
7	Gitaldaha	15
8	Madnakura	15
9	Panchadojhi	15
10	Narayanganj	15
11	Singimari	15
12	South Chamta	06
13	Sitai	06
14	Goutam	13
15	Mahishmuri	13
16	Sangarbari	13
17	Paglarjhar	13
18	Tilak	13
19	Tetulchar	13
20	Satgachhi	91
21	Buraburi	91
22	Ratanpur	91
23	Panishala	91
24	Fulkadabri	91

Source: DIG BSF, Koch Bihar.

Villages nearby BOPs likely to be affected by flooding.

The villages viz. Lotefela, Chengmari Krishnapur Balabhut, Jaukhuti, Gitaldaha, Panchadojhi, Narayanganj, Singimari, Madnakura, Mirapara, Tilak, Mahismuri Gautam Tetulchera, etc. likely to be affected during flood. BSF of Koch Bihar District has two rescue teams with swimmers and speed boats which are

stayed during flood period at Chengmari and Madhya Balabhat. All commandants have been directed to identify their most flood prone villages and have to prepare contingency plan for rescue of flood victims from their respective area of responsibilities. They evacuate flood victims to the nearer rescue centers. BSF also help to the villagers with, vehicle, Life Savings Jackets, Tarpaulins, food, medicine, cloths etc. to the flood victims.

8.2.9 Role of army infantry battalion

The Army sets up two control room for monitoring the flood situation for the District. One control room set up at Koch Bihar Army Head Quarter and another at Binnaguri. The Koch Bihar Army Head Quarter looks after the flood situation of Koch Bihar Sadar, Tufanganj, and Dinhata Subdivision. The Binnaguri Army Head Quarter looks after the flood situation of Mekhliganj and Mathabhanga Subdivision. Each control room have column with components of infantry troops, medical and engineering. The Army is always ready to assist the civil administration during flood hazard at short notice. The Army helps to the civil administration in

- 1) Rescue Operation,
- 2) First Aids
- 3) Medical Facilities,
- 4) Sanitation,
- 5) Emergency Feeding,
- 6) Rehabilitation,
- 7) Restoration of essential services and
- 8) With Army Helicopter.

8.3 Recommendation for mitigation of flood

To mitigate flood, the national program of flood control was initiated in 1954 and problems related to flood control then began. At the time of floods the governments have to renders help in cash and kind. The help may be primarily in the form of loans or reduction from previous loan during the flood and soon after. Food, clothing, and blankets have also been supplied at the time of emerging.

Total flood control in the District is neither possible nor desirable. The people of the District have no alternative than to live with flood. The proactive planning for the flood prone areas is absolutely essential. Flood hazard mitigation involves measures to reduce the effects of disaster causing phenomena. All actions to reduce

the impact of disaster that can be taken prior to its occurrence including preparedness and long term risk reduction measures. It also includes the planning and implementation of measures to reduce the risk or manmade hazard and the process of planning for effective response to disaster. Disaster mitigation includes scientific analysis of risk assessment, social, economic, legal and technical processes in the development of mitigation measures and administration and political processes in application of these measures. Flood hazard mitigation plan for the Koch Bihar District is discussed here.

Particular attention may be drawn to some of the recommendation generally applicable in evolving plans for flood control. These are emphasis on

1. Collection of data on rainfall with wide network of rain gauge stations, river discharge and silt observation, topographical survey, river surveys including longitudinal and cross sections,
2. Proper land management and soil conservation measures in the catchments area for reducing silt supply to the river channels, and
3. To deal flood problems not only with the engineering work required but also to deal with other measures such as floodplain zoning, flood forecasting and flood warning, levy of flood cess for financing flood control schemes.

To control flooding following are needed:

- 1) Floodplain zoning and its management, which should include regulation of manmade activities in the floodplain zones,
- 2) Prevention to unauthorized river bed cultivation,
- 3) To build up data base for evaluating performance of existing and future flood control works,
- 4) Reporting of basin wise damages,
- 5) To launce special flood prone area programme, similar to drought prone area programme,
- 6) To integrate master plan for flood control in a basin with that for optimum utilization of land and water resources.



Plate 8.4 Bamboo being used as immediate protection of embankments from flood at Sitalkuchi.

8.3.1 Engineering approaches for limitations of flooding effects

Flooding can be limited by the use of engineering approaches. They are-

- a) **Channel modification:** Channelization is undertaken to reduce flood hazards and to allow development on the floodplain. Channelization can enlarge cross sectional areas and thus higher discharge can be held within the channel. It also increases water velocity and thus reduces drainage time. Most of the rivers of the District have become shallower and narrow due to heavy siltation during flooding, as a result, little rainfall creates overflow in most places. Thus river channel enlargement can reduce destruction of flooding in the District.
- b) **Dams:** Dams can be used to hold water back so that discharge downstream can be regulated at a desired rate. Human constructed dams have spill ways that can be opened to reduce the level of water in the reservoir behind the dam. Thus the water level can be lowered and released later at a controlled discharge.

- c) **Retention ponds:** The District has many small and large ponds, *khals*, *bills* and ox-bow-lakes. Retention of these water containers serves a similar purpose to dams. Water can be trapped in retention of water containers and then released at a controlled discharge to prevent flooding downstream.
- d) **Flood ways:** Floodways are areas that can be built to provide an outlet to a stream and its flood into an area that has been designated as a floodway. In the floodways areas no construction is allowed. Only the land is used for agricultural or recreational purposes when there is no threat of flood, but which provide an outlet for flood waters during periods of high discharge.
- e) **Levees and dikes:** These are structural built alongside the channel to increase the stage at which the stream floods.
- f) **Embankments:** Embankment is a ridge with earth or rock to contain flood water. Embankments vary in nature and function under variety of situation. Flood control embankment is one of several types of embankments (Plate 8.4). This type of embankment is built to prevent flooding of low lying areas. This type of embankment is constructed along the river bank and at some distance from the river to retain floodwater.



Plate 8.5 Construction of embankment is in progress in Ashokbari.



Plate 8.6 Boulder spurs along embankments for flood protection along The River Torsa-Kaljani at Deocharai, Tufanganj I.

8.3.2 Protection of endangered area

Protection of endangered area can be carried out by applying two basic types of methods- active and passive. Active methods are based upon lowering the basin level during the high flow thus ensuring protection of the endangered area. Passive methods are based upon the construction of permanent protection structures such as embankments, canals, grouting curtains, pump stations, etc. So, protection can be based upon either active or passive methods or the combination thereof. The area can be partly protected by the construction of protective structures for floods of shorter return periods or by lowering the basin level for floods of longer return periods.

8.3.3 Reducing the danger of the flood during its occurrence, the actions implemented into:

1. **The emergency phase:** This phase is included the save and rescue efforts, first-aid, medical assistance, repairing of transport and communication
2. **The Transitional Phase:** This phase is included the efforts executed to accelerate the rehabilitation of the people back to their previous state of life

such as reconstruction damaged building, restoring the function of the kitchen in houses, and curing certain diseases.

3. **The Reconstruction Phase:** This phase occurs when there are reconstruction efforts that need a long time to complete. The rehabilitation of houses, roads, and so on sometimes may take years to complete.

8.4 Preventive measures for health

During floods health problems in the District are very important especially during the first 72 hours. During this period it must make sure that there are no endemic or contagious diseases which call for preventive actions like immunization, registering the sick and isolating to prevent the spread of the disease. Water borne diseases like Diarrhoea, typhoid, infective Hepatitis & Dysentery are common phenomena during and post flood. Therefore emphasis should be given on safe water, personal hygiene and public education including sanitary arrangement to the concern people for prevention the epidemic. Different types of diseases and measures for prevention have been given in table 8.2. The disinfection of drinking water sources have to be done immediately. Random surveillance and IEC activities should be continued for early detection and early treatment.



Plate 8.7 Protection of road by using bamboo in Satgachhi Village.

Table 8.3 Types of diseases and measures for preventions.

Sl. No.	Diseases	Prevention
1	Typhus and paratyphus	Waste and urine disposal
2	Food poisoning	Uncontaminated drinking water
3	Water poisoning	Food preparation
4	Cholera	Mosquito or fly control
5	Schistomioses	Diseases surveillance
6	Leptosirosis	Isolation and mass vaccination
7	Malaria	Isolation and diseases treatment
8	TBC	Vaccination
9	Influenza	Isolation

Source: Flood contingency plan for Koch Bihar Districts (Health), 2007.

8.5 Flood Insurance

Insurance can be effective way of spreading damages over several years. However in flood prone areas premiums are likely to be high. Proclamation of land liable to flooding can have a twofold effect upon insurance (Thompson and Rippon 1985).

Firstly, premiums may rise or special clauses may apply to those within the proclaimed area, and

Secondly, people outside the proclaimed area may drop out the insurance scheme, reducing available funds. It has several advantages as means for modifying the loss burden. Although it is being provided to cover the 'Flood Risk' yet on a limited and selected scale. This is mainly because of intricacy in the matter of fixing premium and possibility of payment of claims frequently to accurately flood prone areas. As the District has half of the area flood prone and more than 1/4th people live in the flood prone areas (Table 6.10), the Flood insurance can help and protect them from flooding burden.



Plate 8.8 Protection of agricultural field from flood water at Changrabandha, Mekhliganj.

8.6 Reconstruction of economic life and compensation

Closely allied to insurance schemes are government compensation schemes. The flood can disrupt the occupation of the people as during flood the victims cannot go to work and must assist their families, or the location of their work is missing as their agricultural fields are submerged by flood water. The people who suffer most are those who work as rice field labour, labour, fishermen, or own a small market. The loss of time to work results in worse conditions for their families. The best method to assess the loss is to estimate the income that was lost due to the flood. For example in China the reconstruction phase consists of reconstruction of factories and not houses. China considers it better to provide job opportunities that will help the people to rebuild their houses in the end.

In general, value of lands decline due to flood occurrences. Not many people would like to live in flooded areas. This is why mitigation is generally temporary unless provided with sufficient compensation.



Plate 8.9 Embankment being constructed along the River Jaldhaka-Mansai.



Plate 8.10 Trees planted along embankment under Social Forestry Scheme along the River Jaldhaka-Mansai near Khaterbari.

8.7 Flood risk mitigation

Disaster like flood in the District is inevitable. But with the use of modern science and technology, occurrences of floods can be predicted. And thus intensity of danger of the floods can be minimized to prepare of plan against floods.

The aim of planning or mitigation against flood is to reduce human suffering caused by flood and increase the sense of security of flood victims. Mitigation against flood is measured by the reduction of flood risks through various action alternatives. Such as, constructing flood-proof houses, selecting plants that are resistant to flood, and determining house hold activities that are not hazardous.

To avoid food problems and to reduce the losses, some non-technical things such as behaviour and habits of the people are much useful, especially where the mitigation efforts will end. Some non-technical things related to mitigation of floods are:

- a. Community habit, especially concerning waste (solid and liquid) disposal.
- b. Organizational activities to identify the people, who are vulnerable to floods, such as children, old people, the disabled and the pregnant woman.
- c. Identify the most important items to carry during flood.
- d. Community knowledge of flood orientation and the direction of its occurrence, so, that the people may plan the development of their houses and residential areas accordingly.
- e. Determining locations safe from the flood and work to improve location.
- f. Seek help in making building flood resistant.

The development of floodplain management strategy is to be of paramount importance in order to ensure long term effective use of floodplain areas. The main emphasis lays on structural and non structural measures, most strategies will allow a combination of both. The structural measures can provide local flood relief in the short term. But to ensure a floodplain's long term use, the preferred strategy should towards the non structural options. In particular the judicial use of planning controls combined with a zoning of the floodplain is seen as being the most helpful long term option.