CHAPTER VII
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FLOOD PROTECTION AND PLANNING

The flood protection and planning involve administrative techniques, engineering techniques, land management application, and flood warning or forecasting. As each situation is different from the other, it needs different approach. In this chapter an attempt is made to study the various protection and planning works undertaken by governmental agencies as well as private ones.

Protection

Flood protection can be done in a number of ways such as by construction or modification of embankments, drainage, improvement, extension of waterways, anti-erosional work, agricultural practices, afforestation, regulating precipitation to certain limit, flood plain zoning, raising the plinths, use of metalled roads, cemented construction of buildings, evacuation, public health, flood insurance, relief and also to bear the loss.

The term 'protection from floods' or 'flood control' means partial control only and that too by
measures which are economically feasible. The objective is to control a flood and aim to minimise the damage it may cause by regulating the flow or by preventing the water to reach to damageable property. The physical control of flood waters may be achieved by construction of embankments, flood walls, dams, reservoirs, detention basins, drainage improvement, river diversion, anti-erosional works and so on. The oldest and the most common and quite economical means of flood protection is the system of embankment, leaving the river more or less in its existing course and without attempting to modify the flood magnitude.¹

The construction of embankment is done on river banks and the direction is parallel to the flow of the rivers i.e. they serve as artificial high banks for the rivers during floods. As these embankments occupy large area due to their shape, sometimes concrete wall is made to save land and this wall is known as dowel wall. But the purpose is same, to prevent the river water from spilling over the countryside. In India great emphasis is laid on construction of embankments. The study region also has the same pattern. About 65 per cent of the total funds allocated for flood control have

been used for construction of embankments. The length of the embankment depends on the severity of flood in a region. The embankment are mostly constructed by flood control board and rarely by big land owners. However, the construction of embankment in flood hazard zone has some merits, as it protects lives and property from getting damaged by flood waters. It has however been found that due to construction of embankments, agricultural fields are debarred from getting fine fertile silt which is brought by flood waters. This reduces the fertility of soil. The construction of embankment also causes inundation and intensifies flood situation in other areas as this flood control method is used as immediate control of flood situation at danger points. On the whole construction of embankments have played a significant role in protecting the flood prone areas in the study region.

Drainage improvement is yet another important flood control measure practised in Uttar Pradesh and other parts of India. This method results largely in increasing the carrying capacity of the channel and this reduces the magnitude of floods. In the study area a good amount of the total funds allocated to flood control are being invested in drainage improvement schemes. But considering the number and length of rivers, their
tributaries and the magnitude of flood problem, the work done in drainage improvement to control floods is inadequate. This method being helpful, should be given more funds and technical knowledge.

Extension of waterways and anti-erosional work is also an important protection methods. The meandering and braided nature of rivers in the study area, more so in eastern Uttar Pradesh has caused serious problems of erosions problems of erosion. The funds allocated in this work are quite inadequate for large area with alarming situation. The anti-erosional work is being done in about one quarter of the sites affected from this problem. But the work of anti-erosion is not satisfactory due to less investment in this field. Untill soil displacement by water erosion on the upper reaches is checked, no basic remedy for floods every year can be found. The sediment it brings along chokes reservoirs affecting the level of river beds by raising them and hence overflowing embankments and dykes. Thus massive extension of waterways and anti-erosion work is needed. So that the water which is hazard at one place can be used through waterways to places where it is needed i.e. where there is inadequate water.

Proper agricultural practices and afforestation is yet an important way of controlling floods which aims
at cutting down and delaying the run-off before it will mix with river channel. If water could be held on the land and not permitted to run-off to the river, floods could be controlled essentially at their source. These methods have the tendency to reduce flood damage as protective effect of vegetation on the soil surface tends to increase the rate of infiltration of water into the soil and reduces erosion. So agriculture is concerned with, the aspect of flood control for cultivated areas in the form of soil protection, type of cropping, rotation of crops, contour ploughing, terrace farming, strip cultivation and so on. The methods for pasture lands are a step towards improvement of pastures and prevention of over-grazing. While farm terracing provide a means of reducing length of slope. The reduction in slope length tends to prevent surface run-off with high velocity and hence erosion is decreased. Similarly contour cultivation also has a tendency to reduce the total run-off. Strip cropping takes advantage of contour cultivation by using alternate strips of high infiltration. Crop rotation also helps as the use of mulches, manure and other soil amendments have a more specific effect on infiltration capacity than any other practice. This is because of the improved structure of soil. It is however noticed that owing to unscientific landuse practices serious problems have been created. To
control the situation awareness should be created among the farmers regarding scientific landuse practices so that the damage caused by floods to crops is minimised.

To some extent man's behaviour may be controlled so that it reduces the effects of flooding. The removal of forests and the consequent reduction in rate of evapotranspiration significantly increases intensity of flood. Afforestation is one way of reducing surface run off and controlling soil erosion. The rain falling on a forest gets caught up on the surface of leaves, twigs, stems and branches and trickles down to the ground. The force of rain drops is thus retarded at several stages by various tiers of the green canopy. The leaf litter and humus which spread on the floor of a properly maintained forest absorbs in a sponge fashion some of the precipitation. The roots of trees, shrubs, and grasses which penetrate the ground greatly assist in the percolation of water into the soil. Increase in the velocity of run off water enormously enhances its power to carry soil, pebbles and boulders. But the outflow from a forested region is far less rapid, less voluminous and less turbid than that from a bare area. During last few decades there has been occurrence of more serious and

devastating floods than in the past and the reason seems to be excessive destruction of forest cover leading to increased rate of surface runoff. The area under forest are less than the national standards, so to increase the forest area in the state through social forestry was introduced. The schemes of social forestry looks after the plantation of trees and protection of trees. This department has contributed in significant afforestation in the study area.

Precipitation modification is an attempt to redistribute it both in respect of time and space, so that the risk of high flood is reduced in the area. A number of research programmes for determining the possibility to alter the weather in a reliable and consistent manner are underway in various parts of the world. The reduction of a storm may reduce the damage to property in certain areas, but increases it in certain other areas. It may also deprive certain areas of the rainfall upon which they depend for agriculture, industry, domestic water supply etc. It has to be considered whether economically more efficient means of providing the same benefits can be found. Over and above that it also needs to be examined whether the ecological impact of weather modification would be significant and the likely effects that may arise among different regions, states or countries as a result of its adoption. In fact weather
modification may need even international regulation as its effects would extend far beyond the area where the modification takes place.³

Flood plain zoning in various flood prone sites of different river basins is important to identify areas exposed to flooding and determination of inundated land. Flood-prone areas undergo changes continuously with every flood and to understand this remote sensing techniques and aerial photographs are best ways to study. In eastern Uttar Pradesh such studies are being carried out in Rapti and Gandak basins for the purpose of flood plain zoning and land use. Zoning may be used to prevent the unlimited expansion of flood plain use after protection has been provided. In this way zoning becomes an integral part of the flood protection programme. It is found that there is variation in characteristic of flood even within the same flood plain of a river. Some parts of the study region are more hazardous in terms of erosion and inundation and some are only affected during peak floods. The flood plains have been classified on the basis of flood frequency into three zones: High hazard zone, medium hazard zone and low hazard zone.

In the state the Central Water Commission and Revenue Departments are the government agencies for recording the flood frequency. The zone of high frequency accounts for about forty to forty five per cent of the total area. This area gets badly affected by floods nearly every year. This zone is mostly situated in eastern parts of Uttar Pradesh along the river course. The districts of Gorakhpur, Azamgarh, Deoria, Gonda, Basti etc. come under this zone. This also get badly affected by erosion and inundation. Both the lives and property including crops are highly damaged by floods in this zone.

Medium hazard zone accounts for about thirty six per cent of total area of the study region. The frequency of floods is about six to nine per decade. It has an intermediate flooding location i.e. next to high hazard zone. The district of Lucknow, Sitapur, Kanpur, Fatehpur etc. come under this zone. This zone receives damages of medium intensity mainly.

The low hazard zone consists of hilly districts and districts of Bundelkhand region. The zone is affected by floods of high intensity or flash floods. Erosion due to fast run off is on an increase in this zone. The frequency and intensity by which a flood visits this zone is of low profile.
Raising the plinths of villages or houses connecting the places with metalled roads and use of cement for constructional works provide some protection against low and medium floods but it does not protect against high floods much. The duration of flood should be short and velocity low for protecting the area by such methods. The districts of eastern Uttar Pradesh are adopting such methods, but the soils of plinth raised villages are not protected against erosion and are eroded away in the rainy season. Moreover the soil required to raise the plinth is taken from nearby areas wherein the stagnating pools of water make ideal breeding grounds for various bacteria leading to outbreak of disease. Such depressions also create problems for transport and communications. The only point that is good about raised plinth is that even the mud houses are kept safe during floods. But for raising the plinths of villages huge investment of money and labour is needed, which the government should look after. Towns also need due protection from severe floods as it creates water logging and sewage problem. The government is also concerned with town protection but the losses continue to be heavy during peak floods. It is usually seen that dirty water which is flood water plus sewage water is pumped out from cities and towns, which collects nearby. This method has not proved to be sufficient as it has not protect agricultural fields. The use of this method is decreasing due to lower returns.
in the study area.

Flood proofing would be most appropriate when moderate flooding with low stage, low velocity and short duration is experienced and where the traditional type of flood protection is not feasible, and where individuals desire to solve their flood problems without collective action or where collective action is not possible. This includes control of seepage, use of valves, permanent closure of openings like windows, protective covering to machines with plastic sheets etc. These measures will reduce the damage to property in flood prone zones. Although they are emergency methods but are prepared before hand so that they can function during floods.

Strategy for mitigating the losses by means of preparatory, survival and recovery involves emergency measures and redistribution of loss and consists of actions like evacuation, flood fighting, and health. Evacuation is easy as the masses shift from the area where floods are forecasted or when water level starts to rise above normal. Governmental agencies help to evacuate people from danger areas. Flood fighting measures include flood control works, repair of flood control works

and building of emergency works. All these include building of dykes, bunds, closing of small breaches etc. and these measures are done in advance before a flood visit. Then the public health measures are taken as floods leave behind various infections and diseases. This is looked after by Public health department and measures like control of environmental health hazards, emergency restoration of water-supply, waste disposal etc. are taken besides medicine and general check up. The redistribution of losses is a method to provide tax remission and flood insurance. The disaster relief announces financial and other aid. It is done by government of the state and centre. This is to give courage to the occupants besides helping them. Tax remission of individuals is done to reduce financial burden. Flood insurance enables an individual to spread the sudden loss by floods over a larger period of time and then claims are made for insured loss. This helps to keep pace with the flood damage. The last is to simply suffer and bear the losses when they occur. This involves no action but to adjust with flood hazard. But is not being practiced commonly today. So as it is being replaced by other methods, planning and forecasting is required as these early measures of flood control discussed become inadequate due to increase in population and pressure on land.
Planning and Forecasting

It became necessary for the government to take initiative in this matter and conceive and execute schemes where large areas of land and population were involved. For this, some planning becomes necessary. Planning for flood control was visualised in the National Policy, announced in the Parliament in 1954. A programme of flood control was launched at the National level in the same year and it was decided to undertake a countrywide programme of flood control. A central flood control board was constituted under the chairmanship of the then Union Minister of irrigation and power with representatives of the concerned flood prone states. State flood control boards assisted by Technical advisory committee were set up in the flood affected states for assessing the flood problem, laying down policies, approving long range plans and specific schemes and fixing priorities. The government of India, in the ministry of agriculture and irrigation, constituted the Rashtriya Barh Ayog i.e. National Commission on floods by their resolution dated the 2nd July 1976.

In Uttar Pradesh an additional Chief Engineer (Planning) is in charge of overall planning of irrigation and of flood control works. He is assisted by one Superintending Engineer at headquarters for planning and examination and two in the field for investigation and
construction of floods schemes and execution of flood schemes falling in their jurisdictions. Sizeable progress has been made in the flood protection measures since 1954, when the National Flood Control Programme was launched in the country. Government set up a flood forecasting organisation in 1954 to advance warning about impending floods so as to alert agencies concerned with rescue and relief. Central flood forecasting organisation has developed a network of about 149 forecasting stations catering to requirements of most of the flood-prone inter-state rivers. In 1989 alone about 5,500 forecasts were issued during the flood season and 95 per cent of these were within the reasonable degree of accuracy. Working Group on flood management for eight plan has recommended a higher outlay of Rupees 5,060 crores to afford reasonable flood protection to an additional area of 30.9 lakh hectare during Eight Plan Period. Four working groups are to formulate programmes for Eight Plan in irrigation and flood management sector, they are: major and medium irrigation projects, minor irrigation projects and command area development programme. Table IXVIII shows various outlay on flood protection during all the five year plans.

### TABLE - LXVIII

Plan outlay for flood protection in Uttar Pradesh

<table>
<thead>
<tr>
<th>Plans</th>
<th>Period</th>
<th>Outlay on flood protection Rs Crores</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Plan</td>
<td>1951-56</td>
<td>13.3</td>
</tr>
<tr>
<td>Second Plan</td>
<td>1956-61</td>
<td>49.2</td>
</tr>
<tr>
<td>Third Plan</td>
<td>1961-66</td>
<td>86.0</td>
</tr>
<tr>
<td>Annual Plan</td>
<td>1966-69</td>
<td>43.6</td>
</tr>
<tr>
<td>Fourth Plan</td>
<td>1969-74</td>
<td>171.8</td>
</tr>
<tr>
<td>Fifth Plan</td>
<td>1974-80</td>
<td>604.9</td>
</tr>
<tr>
<td>Sixth Plan</td>
<td>1980-85</td>
<td>778.6</td>
</tr>
<tr>
<td>Seventh Plan</td>
<td>1985-90</td>
<td>947.4</td>
</tr>
<tr>
<td>Eight Plan</td>
<td>1990-96</td>
<td>5,060</td>
</tr>
</tbody>
</table>

Governments has also constituted an Environmental monitoring committee to oversee the implementation of environmental safeguards at the stage of clearance of irrigation, multi-purpose and flood control projects. It will prepare and submit an annual report on the status of environmental management of different projects in various river basins and will monitor the ecology of project areas, irrigation command areas and catchment areas.
Flood forecasting services have been set up in India to issue advance warnings about impending floods, so as to alert the agencies concerned with rescue and relief operations, to organise themselves and to put into action the flood fighting and maintenance organisation to gear up their activities for emergency. The central flood forecasting organisation with headquarters at Patna and Hyderabad have developed a network of flood forecasting stations under 22 divisions catering to the requirement of most of the flood-prone rivers in the country. The warning issued by the control rooms under these divisions have been extremely useful for flood fighting and relief operations. As damage to moveable property, loss of human and cattle lives can be reduced considerably if timely forecasting for flood occurrence is done. Flood forecasting is given significance to areas which are unprotected and also in already protected areas. So flood forecasting is given attention as an important component of flood protection measures. The system of flood forecasting in India comprises of four phases: observation and collection of operation data, transmission of data to forecasting centres, formulation of forecast and issue of forecast.

The observation of operational data is undertaken by the central water commission and the Indian
 meteorological department. The central water commission plans river gauge or discharge network, collects the data from centre and state governments. The Indian meteorological department provides information regarding general meteorological situation which gives rise to floods. The data from rain-gauge network is collected and the required rainfall data is conveyed through quick transmission system. The hydrometeorological data is transmitted to flood forecasting centre by the Indian meteorological departments which are at Bombay, Calcutta, Nagpur and New Delhi. The Indian meteorological department has also started flood meteorological offices at Hyderabad, Surat, Delhi, Lucknow, Guahati and Patna for collection and transmission of hydro-meteorological data. Now Radio Reporting Rain Gauge has been made available to obtain data from remote rain gauge stations in real time mode. This will help in automating data from upper catchments of flood prone rivers. Wireless sets and telex connections are now being used by flood forecasting organisations. The rainfall and river stages data are used for flood forecasting analysis.

The study region being the part of great Ganga basin has its flood forecasting system controlled by the main flood-forecasting division of the Ganga basin. The main office of the flood forecasting division is located
at Lucknow. It collects data, requisite information such as river discharge, rainfall data, and water level data from various stations. Initially all the district headquarters collect all the information and then communicate it to the control room through telecommunication system. After the analysis of these data, formulation, processing and analysis of data on the basis of previous experiences, the control room makes the forecast about the possibilities of flood. Further, the essential forecasts are transmitted to the flood plain occupants through proper channel i.e. district headquarters to town, tehsil, block and village. Although the flood forecast is directly transmitted to the occupants through radio, Television and press, but is done mostly in case of flash flood or peak floods which is not sufficient. The forecast should be well before time of any flood, except that it cannot be in the case of flash floods, so that the occupants adjust accordingly in enough time space between forecast and occurrence of flood hazard.