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Flood Management

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Abstract: ***Floods have been recurrent phenomena in India. Year to year variations occur are,noted with regard to climate and rainfall pattern along with floods. Even inadequate capacity of the rivers to contain the high water flows coming down from the upper catchment area following heavy rainfall leads to high floods. Doppler Radars are being installed by the Indian Metrological Department (IMD), wherever require for the forecasting warning of flash floods. Lands slides and blockages in rivers are monitored by the Central Water Commission (CWC) / State Disaster Management Authority (SDMA) etc. For flood mitigation the structural measures like constructing of flood embankments / walls, dam storages channel improvement, flood water diversion and catchment area treatment are done for the safety of habitants.***
Keynotes: Flash Floods, Forecasting, Monitoring, Management.

I. INTRODUCTION

Almost every year floods of varying magnitude affect some parts of the country or the other. Different regions of the country have different climates and rainfall patterns and, therefore, while some parts face devastating floods, other parts may, at the same time, experience drought conditions. The monsoon regime is a regular phenomenon. Year-to-year variations occur with regard to the onset of the monsoon, its progress over the Indian landmass, and the amount of rainfall distribution. In some years the variation is quite significant. Nevertheless, there is a fundamental regularity and dependability about the monsoon that sets the seasonal rhythms of life, although it also causes unfortunate losses across much of this part of the world. The annual average precipitation over the country is around 1150 mm. The total volume of water available in the country is around 4000 BCM. The annual runoff through rivers is 1869 BCM. The estimated utilizable water is 1123 BCM, out of which 690 BCM is surface water and 433 BCM is ground water component. The Indian subcontinent receives maximum rainfall during the south-west (SW) monsoon (summer monsoon) for a period of about 100 days, starting from the first week of June to the end of September. Normal area-weighed rainfall over the Indian land mass is 89 cms during this period. The normal annual rainfall varies from less than 600 mms in the north-western part to over 2,500 mms in the north-eastern part. It varies from about 1,200 mms in the north to 2,900 mms in the south.

II. OBJECTIVE

A. To study the forecasting of floods.
B. To study the control of flood damages.
C. To study the flood management measures.

III. METHODOLOGY

Only secondary data like books, research papers, Reports of High level Committees, Govt. Commission's report and websites, Interstate water plan etc., are used for the present research paper

IV. FLOOD PRONE AREA

Inadequate capacity of the rivers to contain within their banks the high water flows comming down from the upper catchment areas following heavy rainfall, leads to flooding. The tendency to occupy the flood plains has been a serious concern over the years. Because of the varying rainfall distribution, many a time, areas which are not traditionally prone to floods also experience severe inundation. Areas with poor drainage facilities get flooded by accumulation of water from heavy rainfall. Excess irrigation water applied to command areas and increase in ground water levels due to seepage from canals and irrigated fields also are factors that accentuate the problem of water-logging. The problem is exacerbated by factors such as silting of the riverbeds, reduction in the carrying capacity of river channels, erosion of beds and banks leading to changes in river courses, obstructions to flow due to landslides, synchronization of floods in the main and tributary rivers and retardation due to tidal effects. According to the estimate of the National Commission on Floods, the area prone to floods in the country is of the order of 400 lakh hectares. It is considered that 80 per cent of it, i.e., 320 lakh hectares can be provided with a reasonable degree of protection. India can be broadly divided into the following four regions for a study of flood hazard.

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V. FLOOD FORECASTING

The flood forecasting (FF) enables us to be forewarned as to when the river is going to use its flood plain, to what extent and for how long. The forecast of a flood may be for the water level (stage forecast), discharge (flow forecast) and area likely to be submerged (inundation forecast) at various points/particular stations at a specific time. A nationwide flood forecasting and warning system covering major inter-state rivers has been established by the Central Water Commission (CWC). The system under CWC is often supplemented by the states that make arrangements for advance warning at other stations strategically important to them. The CWC also extends FF services to such stations at the request of the states concerned. With reliable advance information/warning about impending floods, loss of life and property can be reduced to a considerable extent. People, cattle and valuable assets can be shifted in advance to safer places.

A. Data Collection

Real time hydrological data viz. gauge and discharge and meteorological data, viz. rainfall, are the basic requirements for the formulation of a flood forecast.

B. Transmission of Data to the Forecasting Centers

Transmission of data on a real-time basis from the hydrological and hydro meteorological stations to the flood forecasting centers is a vital factor in the FF system. Landline communication i.e., by telephone/telegram was the commonly used mode for data transmission in FF services till the beginning of the 1970s. The communication is mainly by VHF/ HF wireless sets at the data observation/collection sites and at the FF centers. There are over 500 wireless stations of the CWC all over the country for communication of real-time data related to flood forecast.

C. Data Processing and Formulation

Historical data like gauge, discharge and rainfall are utilised for the development of techniques for formulation of forecasts on a real-time basis. Forecasts are formulated at the FF stations by predicting river stage/inflow with time of occurrence. After receipt of the hydrological and meteorological data from field formations, the data is processed in FF centers/control rooms to check its consistency and the data is modified, if any inaccuracy is found, before using in forecast formulation. All the forecasting centres of the CWC have been provided with computer facilities for data processing.

D. Dissemination of Flood Forecasts

The final forecasts are then communicated to the user agencies such as the concerned administrative and engineering authorities of the state/central governments including railways, defence and other agencies connected with flood protection and DM by special messenger/ telegram/wireless/ telephone/fax/e-mail etc. Flood forecasts are also passed on to the All India Radio (AIR), Doordarshan and local newspapers for wide publicity in the affected area.

VI. FLASH FLOODS

Flash floods are characterized by very fast rise and recession of flow of small volume and high discharge, which causes high damages because of suddenness. This occurs in hilly and not too hilly regions and sloping lands where heavy rainfall and thunderstorms or cloudbursts are common. Depression and cyclonic storms in the coastal areas of Orissa, West Bengal, Andhra Pradesh, Karnataka, and Tamil Nadu also cause flash floods. Arunachal Pradesh, Assam, Orissa, Himachal Pradesh, Uttarakhand, the Western Ghats in Maharashtra and Kerala are more vulnerable to flash floods caused by cloud bursts. Sudden release of waters from upstream reservoirs, breaches in landslide dams and embankments on the banks of the rivers leads to disastrous floods. Severe floods in Himachal Pradesh in August 2000 and June 2005, and in Arunachal Pradesh in 2000 are a few examples of flash floods caused by breaches in landslide dams. Floods in Assam, Bihar, Uttar Pradesh, Orissa and Andhra Pradesh are generally caused by breaches in embankments. Incidents of high intensity rainfall over short durations, which cause flash floods even in the area where rains are rare phenomena, are on the rise and the problem needs to be tackled in a scientific manner.

1) Flash floods forecasting and warning systems using Doppler radars are being installed by the India Meteorological Department (IMD) wherever required.
2) As a preventive measure, the inhabitation of low-lying areas along the rivers, nallas and drains will be regulated by the State Governments/State Disaster Management Authorities (SDMAs) / District Disaster Management Authorities (DDMAs).

3) Landslides and blockages in rivers will be monitored by the Central Water Commission (CWC)/National Remote Sensing Agency (NRSA)/State Governments/SDMAs with the help of satellite imageries and in case of their occurrence, warning systems will be set up to reduce losses. If possible, appropriate structural measures to eliminate the damage in case of sudden collapse of the blockages will also be taken up.

VII. FLOOD DAMAGES

More than the loss of life and damage to property, the sense of insecurity and fear in the minds of people living in the flood plains is a cause of great concern. The after effects of floods such as the agony of survivors, spread of epidemics, non availability of drinking water, essential commodities and medicines, loss of the dwellings etc. make floods the most feared among the natural disasters faced by mankind. Heavy flood damages had occurred in the country during the monsoons of the years 1955, 1971, 1973, 1977, 1978, 1980, 1984, 1988, 1989, 1998 and 2004. Highlights of the flood damages are given below:

TABLE 1.1 Damages Caused by Floods

Particulars	Maximum	Average
Area affected (in lakh hectares)	175 (1978)	75.1
Crop area affected (in lakh hectares)	101.5 (1988)	35.1
Population affected (in crores)	7.045 (1978)	3.284
Houses damaged (in lakhs)	35.1 (1978)	12.2
Cattle heads lost	618248 (1979)	94830
Human lives lost	11316 (1977)	1587
Damage to public utilities (in Rs.crores)	5604.46 (1998)	820.67
Total damages (in Rs. crores)	8864.54 (1998)	1805.18

Source: GoI, National Disaster Management Guidelines January 2008

VIII. URBAN FLOODING

Historically, civilizations have developed along river courses. Towns have grown faster on account of increase/influx of population. Owing to lack of regulation/control, there has been considerable encroachment of flood plains. Damages become serious as a result of inadequate capacity of storm water drainage system. The problem of urban flooding has become serious as evidenced by the floods in Mumbai, Bangalore, Chennai, Vadodara, Ahmedabad, Surat, Kolkata, Hyderabad, Visakhapatnam and Vijayawada. The National Disaster Management Authority (NDMA) has, in recognition of the dimensions, this phenomenon has acquired, identified urban flooding as a distinct discipline, in regard to the management of which separate guidelines will be formulated and issued soon.

IX. FLOOD PREVENTION AND MITIGATION

On account of frequent occurrence of floods since time immemorial, people have learnt to live with them. They have generally set up settlements away from frequently flooded areas, which have been used for less important activities such as agriculture, grazing of cattle etc. The crops that can sustain submergence, are grown in the flood prone areas, during monsoon. The crops grown in the areas that were inundated during floods, result in bumper yields. Traditional methods based on locally available resources have been used to minimize the damage during floods. With the increase in population, these areas have been occupied and as a result floods cause huge damage to lives, cattle, property and infrastructure. The FM measures can be categorized into structural and non-structural measures. Structural measures for FM are physical in nature and aim to prevent flood waters from reaching potential damage centers, whereas nonstructural measures strive to keep the people away from flood waters.

X. STRUCTURAL MEASURES FOR FLOOD MANAGEMENT

The main thrust of the flood protection programme undertaken in India so far has been on structural measures,as stated below.

A. Embankments/Banks, Flood Walls

The embankment system in the river restricts the river to its existing course and prevents it from overflowing the banks. Embankments are constructed generally with earth easily available from nearby areas. In developed areas where adequate space is not available or land is very expensive, concrete or masonry floodwalls are constructed.

B. Dams, Reservoirs and Other Storages

Lakes, low lying depressions, tanks, dams and reservoirs store significant proportions of flood water and the stored water can be released subsequently when the flood has receded. The stored water can also be used subsequently for irrigation, power generation, and meeting industrial and drinking water needs. In the case of large multipurpose reservoirs, a proper reservoir regulation schedule can be worked out for optimum benefit from the project as a whole.

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C. Channel Improvement

A channel can be made to carry flood discharge at levels lower than its prevailing high flood level by improving its discharge carrying capacity. Channel improvement aims at increasing the area of flow or the velocity of flow (or both) to increase its carrying capacity.

D. Drainage Improvement

Surface water drainage congestion due to inadequacy of natural or manmade drainage channels results in flooding in many areas. In such cases constructing new channels and/or improving the capacity of existing channels constitute an effective means of flood control. However, the possibility of drainage congestion and flooding in the downstream area is to be kept in mind while formulating such schemes.

E. Diversion of Flood Water

Diverting all or a part of the discharge into a natural or artificially constructed channel, lying within or in some cases outside the flood plains is a useful means of lowering water levels in the river. The diverted water may be taken away from the river without returning it further downstream or it may be returned to the river some distance downstream or to a lake or to the sea.

F. Catchment Area Treatment

Watershed management measures such as developing the vegetative cover i.e. afforestation and conservation of soil cover in conjunction with structural works like check dams, detention basins etc. serve as an effective measure in reducing flood peaks and controlling the suddenness of the runoff. This, however is not very effective during a large flood although, it does help in reducing the siltation of reservoirs and to some extent, silt load in the rivers as well.

G. Coastal Protection Works

The erosion of land by the sea waves in coastal areas is a serious problem. Sea walls/coastal protection works in the form of groynes etc. are constructed to prevent flooding erosion in coastal areas by sea water.

H. Dams and Reservoirs

Dams and reservoirs store water during floods the quantum of which depends on the availability of space in the reservoir thereby reducing the flood peak downstream. The stored water is released from the reservoir for meeting water requirements for irrigation, power generation, and drinking and industrial purposes. The water is also released into the river downstream subject to its safe carrying capacity to make space in the reservoir for accommodating future floods as per the reservoir regulation manual. Reservoirs provide a good long-term solution to the problem of floods. They are more effective for flood control if a designated space is reserved. The National Water Policy 2002 has recommended the provision of an adequate flood cushion in water storage projects and that flood control be given overriding consideration in the reservoir regulation policy.

I. Regulation of Reservoirs

Reservoirs in general have a beneficial effect on the flood problems of a basin. Their effectiveness in moderating flood would depend on the capacity available for absorbing flood runoff. Reservoirs can, however, also accentuate the flood problem in the downstream areas if the rules for their regulation are not prepared considering the flow-carrying capacity of the rivers and the safety of the dams. Similarly, if the reservoirs are not operated according to the operation manual and the reservoir is filled at the beginning of the monsoon season for meeting water demands for irrigation, hydropower, drinking and industrial water supply, a large quantity of water may suddenly have to be released to prevent the crossing of Maximum Water Level (MWL) and for ensuring the safety of the dam which may lead to flooding downstream.

J. Dam Safety Aspect

Dam safety programmes will be carried out strictly in accordance with the standards and guidelines laid down by the Dam Safety Orgnisation of the CWC.and Dam safety organization of Government of Maharashtra. Dam Safety Review involves review of design flood, spillway capacity, structural soundness of the dam, spillway and appurtenant works and, if required, taking up of remedial measures in the form of augmenting the capacity of spillway by appropriate works or constructing additional spillways, strengthening of the dam, spillway and appurtenant works and completing the same in a fixed time frame. Pre-monsoon and post-monsoon inspections of dams will be carried out by the experts and subsequent recommendations implemented by the State Governments/SDMAs in a fixed time frame to ensure continued service and safety.

XI. MEDICAL PREPAREDNESS

Floods as a natural disaster have a high potential of precipitating the incidences of mass casualties. There is the risk of drowning and physical trauma along with the threat of diseases associated with contamination of water and the creation of mosquito breeding sites. Direct health effects of a flood may include: drowning; injuries like cuts, sprains, fractures, electric shocks; diarrhea, vector-and rodent-borne diseases like malaria, leptospirosis; skin and eye infections; and psychological stress. The indirect health consequences of floods are usually due to damage caused to health care infrastructure and loss of essential drugs, damage to water and sanitation infrastructure, damage to crops and disruption of food supplies, destruction of property causing lack of shelter that may lead to increased exposure to disease-vectors.

XII. FLOOD DEMARCATION

To tackle flood situations, flood maps indicating three zones should be drawn at multiple levels, for project areas, as well as for watersheds, sub-basins and finally, the entire basin. During the probable flood situation (1st June to 15th Oct every year) all the concerned departments work together round the clock. In order to control encroachments in rivers, marking for prohibited zone (blue lines); restrictive zone (red lines) and caution level zone (green lines) should be done on priority for critical flood prone areas and remaining areas thereafter. Updating of marking should be carried out periodically once in 5 years.

Caution Zone (green colour): This zone shows the extent of water spread resulting from inundation, in case of a dam failure / dam break. This zone assumes the simultaneous occurrence of maximum recorded rainfall in the catchment as well as in the non-intercepted zone, and failure of the dam when the reservoir reached or cross the maximum water level, or a situation of „overtopping" the dam. The use may be permitted with instructions of caution. Restrictive Zone (red colour): This zone indicates the flooding condition during maximum rainfall in the catchment area, or approximately equal to the area inundated by the maximum possible flood which returns / occurs once in 25 years. No permanent structures are to be built in this zone. The use is permitted if protected by fill or plinth raised above likely flood level.

Prohibitive Zone (blue colour): This zone shows the observed floods. This zone should be completely prohibited from any settlements and structures. There is a need to rehabilitate the village settlements at the earliest to avoid any disastrous event in the near future. No building or any development of land or dwelling is permitted.

XIII. CONCLUSION

The Indian sub continent receives maximum rainfall during South West monsoon, starting form first week of June to end of September. The heavy floods are generally expected during this period. The flood forecasting is also possible by collecting Real Time Hydrological Data like rainfall, guest discharged etc. After processing data the final forecasts are communicated to the user agencies like administrative and engineering authorities, so as to intimate or warn the habitants and concerned agencies. The flood mitigation measures are also taken for moderating the floods by constructing dams, widening river channel, constructing flood embankment or walls, catchment area treatment etc. The Central Government is keeping control over the flood management through agencies like Central Water Commission (CWC), National Remote Sensing Agency (NRSA), with due intimation State Disaster Management Authority (SDMA), to minimize or reduce the losses due to floods. Adequate care is also taken to control mass casualties by keeping medical preparedness, in the area of expected heavy floods, by intimating State or District Disaster Management Cells.

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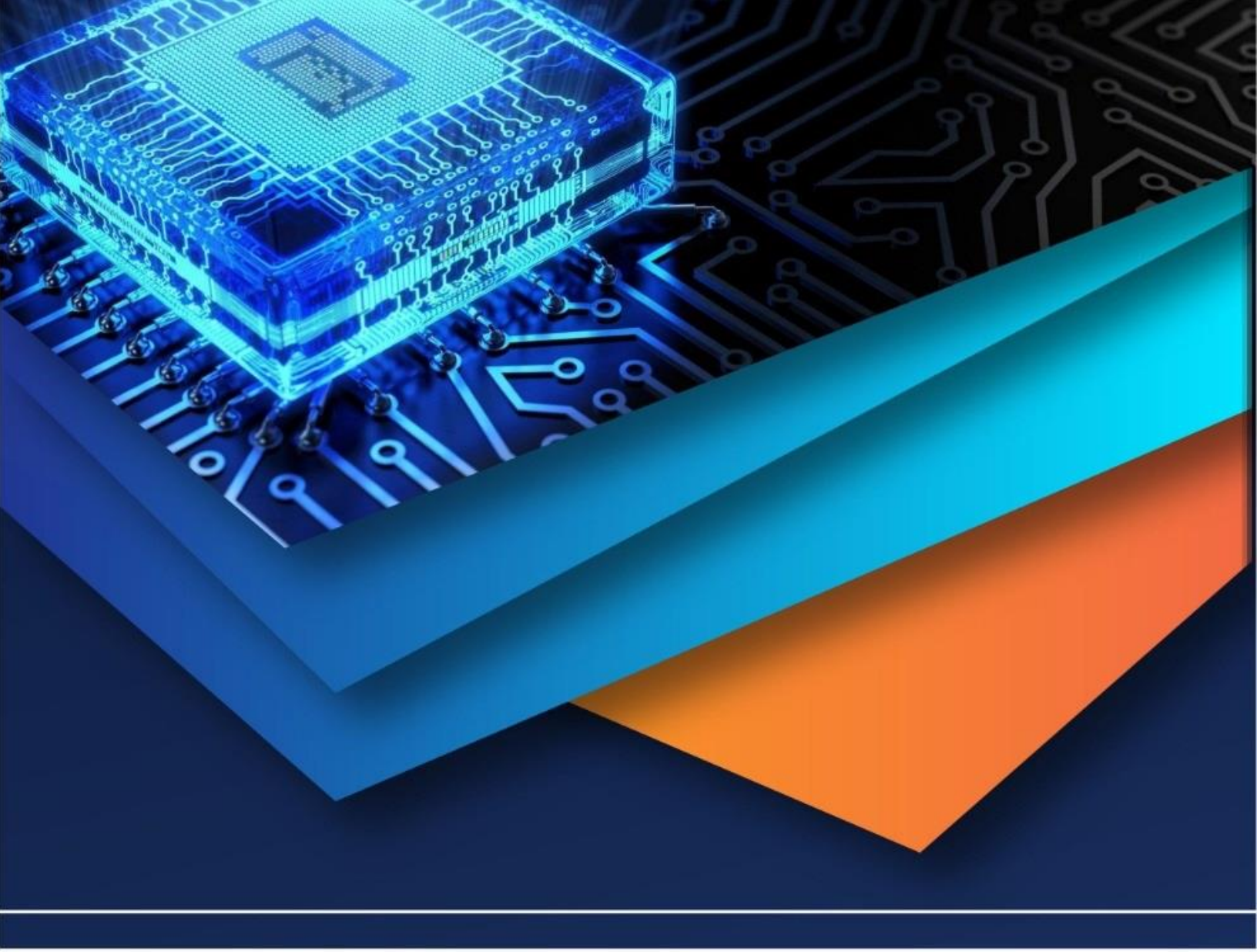

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