Flood Detection and Management

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Abstract-This paper aims at the research of a system for flood prevention and reduction along with an idea of recycling the flood water for future use. CWC (Central water commission) India are operating about 878 hydrological and hydro-meteorological sites covering 20 river basins for gauge, discharge, sediment and water quality observation across the country helping GIS (geographical information system) for detection of floods. This paper describes the flood prone areas of India along with the flood prevention and management techniques. Through this paper we want to introduce a new perspective of flood management system which aids to the recycling and reuse of flood water by ground water storage.

Indexing Term- CWC (central water commission), FMS (flood management system), GIS (geographical information system). SAR (Synthetic Aperture Radar), FPZ (flood plain zoning).

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1 INTRODUCTION

BEFORE the existence of human being the earth is a combination of different natural systems which occurred uninterrupted. Events such as volcanic eruptions, earthquakes, landslides are a part of natural systems and these are the example of geophysical events. This continued for millions of years before the human presence transformed not only the natural systems or phenomenon, but also gave the geophysical events of the past a new meaning and term “natural hazards”[1]. If we give a look on all natural disasters then we find that floods are the most extensive and devastating one [2]. When we talk about a flood the most common images that come to mind are disaster and problems. This is the common thinking for floods, but floods also have some beneficial qualities such as bringing fertile clay, flushing away pollutant and contaminants by refreshing underground water banks. Flood is a natural phenomenon and it may also be influenced by manmade activities. Flooding is the most common disaster of nature among all disasters leading to economic losses and deaths [3].In several parts of India floods have been recurrent phenomenon, which causes loss public property and lives and bringing untold misery to the people. Especially to those people who are living in a rural areas. Mass of water defines economic losses and deaths, which produces runoff on land with high flow, which overburdens the natural channel. The major cause for loss of lives crops and properties is occurrence of flood. Flood occurs frequently and causes enormous risk to human life and property [4]. The damage a flood causes can be expressed in terms of social, economic, and environmental costs.Flood damage has been provoked by rapid economic progress [5]. Flood management has traditionally focused on reducing the probability of floods occurring in settled areas (Biharand Uttar Pradesh,). The means of reducing flood probability focuses on modifying the hydraulic characteristics of a threatening body of water by means of engineered solutions, for example the use of dikes, levees, and dams. The alternative means to reduce the risk of flooding is to reduce the damage caused by flooding. In this paper we have discuss some flood proofing technique and ways to improve their throughput.

2. PRADIGM CHANGE

In years past the response around the world to such catastrophes was predictable, more dams, higher levees and sturdier embankments to contain rising waters. These days, however water – management experts are increasing questioning whether traditional remedies make sense; in fact some contend that dams and other barriers do more harm than good. “You can never control floods,” observes Philip William, President of the international Rivers Network, “yes can simply try to reduce the risk’. But are human activities making India more flood-prone? The recent floods in Delhi, Mumbai Kolkata and others metropolises around the country definitely point towards an affirmative answer. Building cities on the world’s worst flood-prone pains – the Indo Gangetic planes – is not new. Cities like Prayag, Kashi and Pataliputra are thousands of years old. But a study of statements in the middle indo- Gangetic plains by the Banaras Hindu University shows that in those days sites were chosen carefully and cities were built with discipline and ingenuity. Major cities were situated near rivers for navigation advantage, but had high banks to withstand floods. Where mistakes were made, the cities, especially along the turbulent northern tributaries of the Ganges, got washed away. The strength of culture in decision making can be overwhelming. For example, in Bangladesh, although the government is aware of the advantages of living with the floods, it still favors the use of flood control. Finally, when considering the implementation of flood management strategies in developing countries it is important to consider that these

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countries often have highly variable environmental conditions. Savenije (1995) comments that developed countries are not more developed because of a higher state of knowledge, but they are developed because of the robust nature of the environment where these societies have formed. [6]

3.RIVERS AND FLOOD PROBLEM

Out of the country's total geographical area of 329 million hectares about 45 million hectares is flood prone. The rivers in India can be broadly divided into the following four regions for a study of flood problem.

3.1 Brahmaputra Region

3.2 Ganga Region

3.3 North West Region and

3.4 Central India and Deccan region

Fig 1.1 India Flood Zone

3.1 Brahmaputra River Region

This region consists of the rivers Brahmaputra & Barak and their tributaries covering seven states Assam, Arunachal Pradesh, Meghalaya, Mozoram, Nothern parts of West Bengal, Manipur, Tripura and Nagaland. The catchments of these rivers receive very heavy rainfall ranging from 110 cm. to 635 cm. a year which occurs mostly during the months of May / June to September. As a result, floods in this region are severe and quite frequent. Further, the rocks of the hills, where these rivers originate are fragile and susceptible to erosion thereby causing exceptionally high silt charge in the rivers. In addition, the region is subject to severe and frequent earthquakes which cause numerous landslides in the hills and upset the regime of the rivers. The predominant problems in this region are the flooding caused by spilling of rivers over their banks, drainage congestion and tendency of some of the rivers to change their courses. In recent years, the erosion along the banks of the Brahmaputra has assumed serious proportions.

3.2 Ganga River Region:

The river Ganga and its numerous tributaries, of which important ones are the Yamuna, the Sone, the Ghaghra, the Gandak, the Kosi and the Mahananda, constitute this river region. It covers ten states of Uttaranchal, Uttar Pradesh in its basin area, Jharkand, Bihar, South and Central parts of West Bengal, parts of Haryana, Himachal Pradesh, Rajasthan, Madhya Pradesh and Delhi. The normal annual rainfall in this region varies from 60 cm to 190 cm of which more than 80% occurs during the south west monsoon. The rainfall increases from West to East and from South to North. The flood problem is mostly confined to the areas on the northern bank of the river Ganga. The damage is caused by the northern tributaries of the Ganga by spilling over their banks and changing their courses. Even though the Ganga is a mighty river carrying huge discharges of 57,000 to 85,000 cumec (2 to 3 million cusec), the inundation and erosion problems are confined to relatively few places.

Fig 1.2 Ganga Basin

In general, the flood problem increases from the West to the East and from South to North. In the North Western parts of the region and some eastern parts, there is the problem of drainage congestion. The flooding and erosion problem is serious in the States located in the downstream. In recent years some States which were not traditionally flood prone have also experienced some incidents of heavy floods.

3.3 North West River Region

The main rivers in this region are the Sutlej, the Beas, the

Ravi, the Chenab and the Jhelum, the tributaries of Indus, all flowing from the Himalayas. These carry quite substantial discharge during the monsoon and also large volumes of sediment. They change their courses frequently and leave behind tracts of sandy waste. The region covers the State of Jammu and Kashmir, Punjab and parts of Himachal Pradesh, Haryana and Rajasthan. Compared to the Ganga and the Brahmaputra river region, the flood problem is relatively less in this region.

3.4 Central India and Deccan Region

The important rivers in this region are the Narmada, the Tapi, the Mahanadi, the Godavari, the Krishna and the Cauvery. These rivers have mostly well defined stable courses. They have adequate capacity within the natural banks to carry the flood discharge except in the delta area. The lower reaches of the important rivers on the East Coast have been embanked, thus largely eliminating the flood problem.

4 PRESENT DETECTION AND MANAGEMENT SYSTEM

The detection methods are used for remote sensing the disasters. Geographical information system (GIS) provides spatial data management and analysis .we basically use LANDSAT TM data to estimate soil water content and the use of ERS SAR (synthetic aperture radar images) data to analyse flash floods.The satellites with active sensors are ERS 2, Radarsat 1, SRTM, Envisat (ASAR) and ALOS (Palsar). Recent satellite missions have provided high resolution topography imagery using interferometric synthetic aperture radar (SAR) techniques. SAR continuously emits microwave pulses, when these pulses reflect back towards SAR, it will record the pulses at two different points separated by a baseline distance. With the help of parallax technique we can measure the elevation more precisely. But it has long repeat time and this is the major disadvantage of this technique [7].

There are some methods which are used to control the floods and provide some relief to the flood prone areas by decreasing flows of a flood and the flood levels:

(a) A reservoir created across a river and behind the dam.

(b) An improved natural depression which will be regulated if necessary.

(c) With help of diversion of peak flow into a different river basin, where appreciable damage cannot be occur because of diversion.

(d) By creating a parallel water way by passing a particular town or reach of the river prone to flooding.

After all above methods, now we are discussing engineering methods to protect the flood, There is no any provision to reduce the flood flow but they can deal with spilling:

(a) Artificially increase the effective river bank and thereby prevent spilling, it's an Embankment system.

(b) Work involving channel and drainage improvements to decrease the flood water level artificially so as to keep the same, confined within the river banks and thus prevent spilling.

4.1 Reservoirs

Reservoirs can moderate the intensity and timing of the incoming flood. They store the water during periods of high discharges in the river and release it after the critical high flow condition is over, so as to be ready to receive the next wave. Their effectiveness in moderating floods would depend on the reservoir capacity available at that time for absorbing the flood runoff and their proximity to the likely damage centre. The Ghaggar detention basin in Rajasthan is a good example. Depressions available upstream of Srinagar City, on the left bank of river Jhelum, the Mokama Tal area in Bihar and Ottu, Bhindawas, Kotla lakes in Haryana and various beels/haors of Barak basin are some examples of a few natural basins.

4.2 Embankments

Embankments (including ring bounds and town protection works) confine the flood flows and prevent spilling, thereby reducing the damage. These are generally cheap, quick and most popular method of flood protection and have been constructed extensively in the past. These are reported to have given considerable protection at comparatively low costs, particularly in the lower reaches of large rivers. In many places, embankments may be the only feasible method of preventing inundation. Embankments are designed and constructed to afford a degree of protection against floods of a certain frequency and intensity or against the maximum recorded floods till the time of their planning only (in the absence of detailed hydrological data for longer periods) depending upon the location protected and their economic justification. Expenditure has been incurred in the past. Particular mention could be made of the erosion problem of the embankment systems in Assam, Bihar, U.P, Punjab and West Bengal. The embankments, under serious attack by the major rivers and their tributaries, have to be suitably protected by spurs, pitching and other suitable anti-erosion measures. On many embankment systems like the Kosi embankment andPiprasi-Pipraghat embankment on the Gandak in Bihar, the river attack is so severe that the protection measures required to be taken are large and cannot be covered under the normal maintenance works. some embankments have provided positive benefits by ensuring sustained protection against floods and river spills while on the other hand, some embankments have, in certain reaches of the river, aggravated the flood problem by rising river bed levels, decreasing their carrying capacity, causing drainage congestion in the countryside and distorting the levels/gradient of the outfall points.

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Fig 1.3 Kosi river basin

4.3 Channelization of Rivers

Some of the states are proposing channelization of rivers, at least in certain reaches, in the context of tackling the extensive meandering problems of the rivers, activating navigational channels and training these rivers into their original courses. While venturing to channelize rivers, thought must be given in allowing the river certain freedom to flow and right of way to pass its flood waters and silt load within its natural waterway. The dynamic nature of the rivers should be appreciated and preventive measures planned accordingly instead of pinning down the river by channelizing.

4.4 Channel Improvement

The method of improving the channel by improving the hydraulic conditions of the river channels by desalting, dredging, lining etc., to enable the river to carry its discharges at lower levels or within its banks has been often advocated but adopted on a very limited extent because of its high cost and other problems. Dredging operations of the Brahmaputra, which were undertaken in the early seventies on an experimental basis, were discontinued because of their prohibitive cost and limited benefits Dredging in selected locations may perhaps be considered as a component of a package of measures for channel improvement to check the river bank erosion subject to techno economic justification. It may be economically justifiable as a method for channel improvement where navigation is involved. Dredging is sometimes advocated for clearing river mouth or narrow constrictions.

4.5 Drainage Improvement

Drainage congestion is one of the recurrent phenomenons in India. It is often difficult to distinguish between flood and drainage congestion situations. This problem is rather acute in Andhra Pradesh, Bihar, Haryana, Punjab, Orissa, Uttar Pradesh, Assam and West Bengal, J&K, Gujarat and Tamilnadu. Therefore, improvement of drainage by construction of new channels or improvement in the discharge capacity of the existing drainage system is recommended as an integral part of the flood management program in the country.

4.6 Diversion of Flood Waters

Diversion of flood waters takes a part of the flood discharge to another basin or to the same basin downstream of the problem area or to a depression where it could be stored for subsequent release. This measure can be used to manage unusual floods around cities as in the case of flood spill channel near Srinagar and also in the lower reaches of a river near the sea as in the case of Krishna Godavari drainage scheme. Important schemes under execution or under planning are the supplementary drain in Delhi, the outfall channel in Jammu and Kashmir, the Damodar in the lower reaches in West Bengal, the Thottapally Spillway diversion in Kerala, the Kolleru lake diversion into the sea in Andhra Pradesh, the Kama Pahari drain in Rajasthan and the Hulwaa drain in Uttar Pradesh.

4.7 Watershed Management

The watershed management measures include developing and conserving the vegetative and soil covers and also to undertake structural works like check-dams, detention basins, diversion channels, etc. In the watershed management of upper catchment, land treatment through afforestation and grass land development practices should be supplemented by structural works for retarding the water velocity and arresting silt.

4.8 Administrative / Non-structural Measures

The administrative methods endeavor to mitigate the flood damages by:

(a) Facilitating timely evacuation of the people and shifting of their movable property to safer grounds by having advance warning of incoming flood i.e. flood forecasting, flood warning in case of threatened inundation

(b) Discouraging creation of valuable assets/settlement of the people in the areas subject to frequent flooding i.e. enforcing flood plain zoning regulation providing absolute protection to all flood prone areas against all magnitude of floods is neither practically possible nor economically viable. Such an attempt would involve stupendously high cost for construction and for maintenance. Hence a pragmatic approach in flood management is to provide a reasonable degree of protection against flood damages at economic cost through a combination of structural and non-structural measures.

4.9 Flood Plain Zoning

Central to flood plain management is the concept behind FPZ (flood plain zoning). Demarcating zones or areas which are likely to be affected by floods of different magnitude or frequencies and probability levels, and specify the types of permissible development (the primary development) in these zones are the basic aim of FPZ, so that whenever floods actually occur, the damage or

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disaster can be minimized, if not avoided (these areas construct with the help of temporary blocks). Unluckily, While all generally support this approach in standard, little attention is given to it in actual practice (generally not giving substantial attention to prevent from flood water), leading to increased flood damages.

The damages depend upon depth of flooding, velocity of floodwaters, duration of flooding, sediment load and warning time. Some historical damage assessment procedures have focused on depth of flooding [8-9]. The techniques presented were mapping and analyzing river channel data, interpolation of river cross-sections and integration with surrounding topography. The extent of flooding, soil loss due to erosion and sediment load in basin were mapped and soil erosion was estimated using the universal soil loss equation and revised universal soil loss equation was used to identify the damaged areas [10]. Nawaz and Han 2006 concluded that if the proper storage facility and modernized structures are provided in hill torrent affected areas then not only the flood is controlled but also the drought conditions can be mitigated and the crops yield can be enhanced [11].

5 RELATED WORK

With particular reference to the use of some already existed methods of flood management systems like Dry Dams , Diversion canals, Self closing flood barrier (SCFB, The project being implemented in Belgium Italy, Ireland,Netherlands, Thailand, Australia, Russia and other united states), Aqua fence(founded and patented by Norwegian engineers in 1992) and Flap gates(founded by KYOTO UNIVERSITY and machinery maker HITACHI ZOSEN CORP. which can be used in sea walls) we have modeled slightly different technique for flood management. Floods have always been a recurrentphenomenon in India and causes huge damage to human lives and their properties.Flood waters have even inundated the areas which were never flooded before due to monsoons or sometimes due to the improper drainage systems (silt gets deposited with the landslides due to the heavy rainfall).

Floods are one of the natural disasters which bring us the damage to many lives and our belongings. We cannot completely avoid the losses, but they can be minimized by some of our preventive methods and latest technologies.

This paper focusses not only on the reasons, affects and preventive measures taken during floods but also over the use of flood water in an efficient way.

We have considered natural ground water recycling with the help of flood water. It may help us to retain drinking water as in our country during summers shortage of drinking water occurs. This model has not neglected the post effects of floods but eventually prepared a new prevention and management technique considering all possible factors of damage.

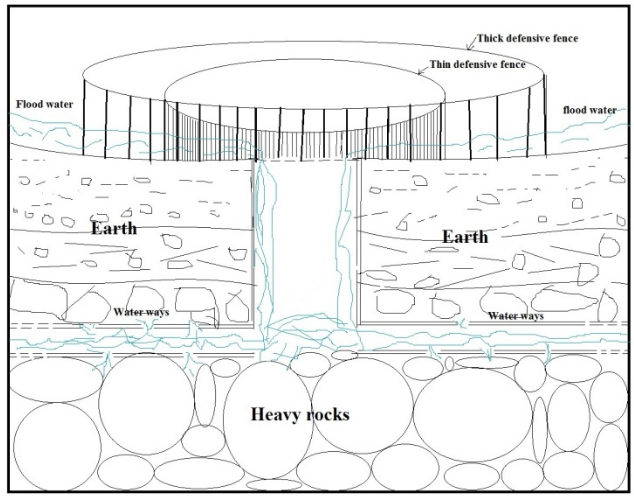

Fig 1.4 Sink hole for flood water drainage

We have created a pictorial view of our idea. There is a sink hole which can be used as a prime parameter for flood management system. The depth of thishole will be around 600 m to 700 m (into the earth surface). As we can see in fig 1.4, water can come into the hole from any direction, hence we have covered this hole by a defensive steel wire net(covering all the sides as well as the top of the hole as cap over a bottle) , which is providing safety around the hole. The material used could be similar to the one used in flap gates or in aqua fences. The cylindrical net structure prevents the hole from blockage which may happen by the sediments collected during floods. The silt gets deposited and raises the level of river bed whichalso causes the floods to happen so our model could comprise a technique which will remove the silt automatically using electromechanical techniques, as a real time response.

Fig 1.5 Slit removal from River bed

After this we have created an underground water recycling mechanism. As we can see in fig 1.4 the flood water is flowing into the hole and settles down at the bottom of it. This stored water will help to increase in underground water level. This can be effectively used to

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overcome the problem of ground water reduction which could be the considerable issue in next few decades.

This water is stored in the layers of earth naturally like retaining walls (dams, reservoir retention ponds to hold extra water) which then flows naturally through water ways. This will be a tunnel made up of the concrete with some small holes distributed symmetrically. The excess water flows through this water way which can be fed to the detention basins(small reservoirs connected to water ways) or can bedirectly fed to a drought affected land. These detention basins also let to reduce the magnitude of downstream flooding.

The water flowing out of the waterway holes will eventually enters a saturated zone where all of the pores, cracks, and spaces between rock particles are saturated with water. This area describes the term ground water. Large amount of water can be stored into the ground. This ground water can be called as "aquifer," which is usually used to describe water-bearing formations capable of yielding enough water to supply people demands.Theaquifer actas a huge storehouse of Earth's water. Thus this retain water can be extracted to meet the human demands like the shallow aquifers are tapped with wells containing fresh water for irrigation purpose.

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