

INNOVATIVE METHODS IN RIVER EROSION CONTROL - A CASE STUDY OF EROSION OF BHIRA-PALIA RAILWAY LINE BY SHARDA RIVER IN UP

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ABSTRACT

Erosion of the river banks in India have become recurrent event causing enormous problem for the people and the Government. With the increase of population along the bank of the rivers, the erosion of township, cluster of villages and important communication system, govt. resources are over exploited. Presently a large number of township, villages, human dwellings a number of important installations and line of communications are under sever threat. The impact of erosion is unbearable and non-recoverable and inflicts permanent irreparable loss of disastrous dimensions to human being. As such it is emphasised to adopt scientific approach for erosion control on priority.

The most responsible factor for river bank erosion is the flow of large quantity of silt in the river. Therefore, there is a great need either to check entry of silt into the river or desilt the silt when it has entered into the river. Various techniques are being adopted on case to case basis to stream line the flow taking into account the type and severity of the problem. In this paper a remedial measure adopted to tackle the erosion problem of Bhira-Palia Kalan railway line by the river Sharda in Lakhimpur Khiri district of U.P has been dealt is described briefly as below:

River Sharda (known as Mahakali in Nepal) an important tributary of Ghaghra (Known as Kanali in Nepal) originates Nepal, enters into India in Philibhit district of Uttarakhand. The river bifurcates in two channels before entering into Lakhimpur Kheri district upstream of Vira-Palia Railway bridge. Before 2008 flood, 90 % discharge was passing through left channel and 10% discharge through the right channel upstream of railway bridge no. 98 before entering of entire flow into bridge no. 98. During the severest flood of 2008, the river started flowing with 100% discharge through right channel and flow became parallel to the railway track and then it was entering into the railway bridge 98. As a result it eroded the Malani-Bhira-Palia railway line and the running of trains was stopped for about two months.

The Govt of U.P proposed a scheme of Rs. 37.64 crore for the protection of railway line and river bank along with a pilot channel to divert the flow in its original course.

The scheme was received in GFCC. GFCC suggested for the closure of various channel of the river particularly the main channel flowing parallel to Railway line by the five rows of concrete porcupine, permeable structures for closure of channel by siltation, cutting of pilot channel in its closed original channel which was carrying the flow of the river straightway to bridge no. 98. The total cost of the scheme was reduced to Rs. 10.40 crore. The scheme was implemented before the flood of 2009 in two months.

The performance of the scheme was observed during the flood period of 2009. It was observed that major flow is taking place straight to the bridge no. 98 through the pilot channel and about 30% of the flow with insignificant velocity is passing through the channel of 2008 which is getting silted up and is not having any erosive action on the railway track.

This paper discusses the scientific approach for erosion control in a tactful manner. Such kind of remedial measure is economical, easy to construct with locally available man and material and can be constructed in minimum period.

**COFFERDAM. AN EFFECTIVE TOOL FOR EMERGENT FLOOD
MANAGEMENT WORKS - A CASE STUDY OF KOSI BARRAGE AFFLUX BUND
BREACH CLOSURE
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Abstract

Cofferdam is a watertight temporary structure designed to facilitate construction projects in an area which are normally submerged underwater. A cofferdam is installed in the work area to expose the bed of the body of the water so as to enable construction activities, perform other types of work, enact repairs in dry environment. In some regions of the world, a coffer dam is better known as a caisson.

Although a cofferdam is a temporary structure it must be reliably built to keep water away from the work area and to withstand very high water pressure to insure safety.

A variety of materials are used to construct a cofferdam which is truly a feat of engineering.

Most basic type of cofferdam are of sheet metal which are used for the erection into the bed of the body of water to create a water tightwall. Some cofferdams are built of wood or concrete or earthen dam.

It can be of open end type or enclosed structure. In very deepwater enclosed cofferdams are used for works considering workers safety, while in shallow water an opened cofferdam can be used.

Types of Cofferdam

The type cofferdam for use on land :

- (a) rectangular braced sheet piles.
- (b) cross-braced sheet piles,
- (c) cast-in-place concrete cylinder.
- (d) earthen dam.

The type construction depend on the (i) soil conditions (ii) availability of materials (iii), depth of water and its fluctuations (iv) working conditions.

An important condition in the design of cofferdams is the hydraulic pressure, analysis of seepage conditions, and erosion of the bottom when it is located in rivers.

For the closure of breach in the afflux bund of Kosi barrage it was utmost early requirement to divert the water flowing through the breached section so as to facilitate constructional activities for the construction of embankment along with its protection. There were three channels in the main stream of the river Kosi which were closed by earthen dam and the water reaching to the cofferdam from up stream was diverted through a dug diversion channel/pilot channel to the main Kosi river up stream of the barrage. This process made the breached portion free from water and facilitated to close the breach by earthen embankment before the monsoon of 2009. Had the three cofferdam in the three channels through which water was flowing to the breached section not been constructed across the main course of Kosi river, the closure of breach would not have been possible. Similar kind of measure was taken for the closure of left bank embankment of river Bagmati down stream of the Dheng Railway bridge.

This paper discusses the various types of cofferdams and its application in the closure of breaches in Kosi as well as Bagmati river in the Bihar and several implications encountered during the construction of earthen cofferdam.

KOSI FLOODS 2008: A CALL FOR COOPERATION

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Abstract

Kosi floods 2008 are yet another call for cooperation. It provides an opportunity to re-look at the framework of existing cooperation, which has primarily been built upon technological solutions viz., building the structures along the river, dams, embankments etc. The element of flood risk reduction goes much beyond the technological elements and some of non-structural elements need to be brought into the realm of cooperation. With the same socio-cultural and economic roots, Kosi basin, a home to the poorest community of the region, requires having cooperation of different kind - contextual, inclusive and more holistic. The Mekong River Commission, build upon the foundation of regional cooperation involving six South East Asian Countries, has addressed considerably the flood risk with the right combination of structural and non-structural measures in the river basin.

The paper intends to identify 'the missing links' in the existing framework of regional cooperation. It presents a framework laying emphasis on the regional cooperation in the form of early warning systems, cross-boundary information sharing, social networking, cooperation to share the river-basin ecosystems and overall a regional strategy for flood risk reduction.

**FLOOD FREQUENCY ESTIMATION FOR A RISK PRONE RIVER IN EAST UTTAR
PRADESH**

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ABSTRACT

Like all other eastern India rivers, Rohini River in east Uttar Pradesh is also prone to recurring and destructing floods during monsoon season. Though there are a number of embankments and other flood control measures in the catchment, river overflows every year devastating the land around and creating damages and loss to lives and property. To achieve effective disaster risk reduction & to enable preparedness for minimizing flood risk, better understanding of physiography and hydro meteorology are essential. Due to fewer hydro meteorological data, sparse network of rainfall and stream flow stations & large scale data on topographic and physiographic data, assessment of runoff and flood volumes are possible only with hydrological models. The present study attempts to predict flood frequencies of the Rohini river catchment using runoff simulation data. Firstly, the rainfall-runoff relationship was established for the river catchment. To generate the future rainfall and simulate the stream flow for the projected rainfall period, we used the ARNO model. The ARNO is a continuous semi-distributed hydrological model widely used recently as a basic tool for several applications such as extreme floods, water master planning & GCM models. The model is a parametric description of main hydrological processes at the catchment scale such as infiltration, evapo-transpiration, drainage, percolation, routing etc. and can represent catchment as a tree shaped cascade of sub-catchments. Using the available data for the period 1982-2005, runoff simulation was carried out. Model was initially calibrated and validated using the historical data which showed a good agreement between observed and predicted flows (coefficient of determination 0.85, RMSE-83.89 and MAE 54.79). Future flow scenario was generated for the projected period 2007-2099. The simulated runoff was then used to estimate flood frequencies for various return periods using the L-moments method. Though the model has limitation to calibration in ungauged catchments, when long term records of rainfall and runoff are available, model can be calibrated and used for both simulation and real time flood forecasting.

INCORPORATING LOCAL NEEDS AND CAPACITY FOR FLOOD RISK REDUCTION

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Abstract

Risk from any disaster can be attributed to many factors which are both intrinsic and extrinsic to the community. So far, flood risk reduction programmes mainly focus on the physical component of the risk like building of check dams, developing a scientific early warning system, etc. Often the social and cultural component of the risk is neglected. This may lead to failure in choosing the right strategy for flood risk reduction. Ideally, any risk reduction programmes should be holistic in approach and should incorporate the local needs and capacity so that the programme is cost effective and sustainable.

The present paper analyses the local capacity and needs of a flood affected village in the Bahraich district of Uttar Pradesh, India. The paper also suggests how capacity and need can be enhanced and addressed so that risk from the flood is not only reduced but sustainable development is brought about. The village where the study was conducted is a perennially flooded village and the villagers suffer from inundation at least two to three times in a year. The study had mainly used qualitative research techniques like observations, key informant interviews, focus group discussion, etc. for data collection.

Key words: Local Needs, Capacity, Flood, Risk Reduction, Social, Cultural, Sustainable, Uttar Pradesh

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LESSONS LEARNT FROM DISASTER MANAGEMENT OF RECENT DAM / EMBANKMENT BREAK EVENTS IN INDIA

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ABSTRACT

In the backdrop of Orissa super cyclone, Gujarat earthquake and end of International Decade of Natural Disaster Reduction (IDNDR), Govt. of India recognized disaster management as a development issue. A number of important initiatives were taken up to mainstream disaster risk reduction into the process of development. It was realized that "while hazards, both natural or otherwise, are inevitable, the disasters that follow need not be so and the society can be prepared to cope with them effectively whenever they occur" and called for a "multi-pronged strategy for total risk management, comprising prevention, preparedness, response and recovery, on the one hand, and for initiating development efforts aimed towards risk reduction and mitigation, on the other". This paradigm shift led to enactment of Disaster Management Act, 2005 in India. The statutory provisions regarding preparation of a hierarchy of disaster management plans at the National, State and District levels provide an opportunity to prepare holistic plans on disaster management covering the entire disaster management cycle and integrating the macro level policy issues with micro level issues of implementation. This also provides an opportunity of converging resources available from various sources for disaster risk reduction and management in the country.

Through enactment, society indicates its wishful thinking and provides legal frame work to achieve the objectives. Actual achievement, however, depends on the detailing done or to be done in different possible scenario. One such possible disaster scenario pertains to dam/embankment break situations. Breaching of Parechu landslide dam, Pratapura dam, Jaswant Sagar dam in recent past (2005 onwards) and more recently Narmada Main Canal have given us opportunities to analyse the strength and weaknesses of evolving disaster management systems in the country, which would help us to re-orient ourselves to deal with dam/embankment break scenario more effectively. Accordingly, actual disaster management in these recent dam break situations have been analysed to identify possible areas of strengthening so that the people in the downstream areas be assured of effective & timely action in emergency cases for protection of their lives & properties.

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FLOOD RISK ASSESSMENT & MITIGATION IN HARYANA: A CASE STUDY OF ROHTAK DISTRICT

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ABSTRACT

Natural disasters are now increasingly being questioned about the very naturalness of their origin or occurrences due to recognition of anthropogenic or environmental management of the natural systems in disaster risk reduction. Haryana, an agriculture based state, has not been much rated on the severity of disaster risk or multiplicity of hazards in the official records. However, many of the regions of Haryana are being now reported to have suffered in the past and recent times with complex range of hazards like flooding, elongated water-logging, soil salinity, and drought with scarcity of usable water (drinking and irrigation) in certain regions due to quality constraints. Topographical settings and geo-morphological processes under the regional environmental influence give origin or rise to hazards that may cause disasters if not mitigated at the risk stage itself. River Yamuna and Ghaggar are the primary rivers which bring floods in Haryana. Some of the districts in the south western part have the problem of poor drainage. Rohtak district comes under the flood-prone regions of Haryana. It gets flooded after heavy rainfall due to its bowl-shaped topography. Major floods occurred in the years 1960, 1980, 1988 and 1995 due to the failure of the Drain no. 8 that joins into the river Yamuna. The level of ground water is higher in many parts of the district which contribute to water logging and floods after heavy rainfall. The quality of ground water is bad in many parts of the District. It is saline and cannot be used for agriculture. Canals are the main sources of water in Rohtak and the groundwater remains unexploited. This is a significant reason for higher levels of ground water in those areas. It has been suggested to take measures of using the saline water. Besides this, Haryana receives water from Yamuna, Ghaggar, Markanda, Saraswati, Sahibi, Indoru Rakshi, Dohan and Karoli but only Yamuna is perennial among these. Most of these rivers get activated only in the monsoon. The presence of these rivers makes it prone to floods during the monsoon period. On an average the state of Haryana experiences floods of heavy intensity once in a decade. Floods are attributed to the rivers Yamuna and Ghaggar which are connected to the entire drainage system of the state. Present paper carried out a rapid analysis of the flood risks in Haryana with a Case Study of Rohtak district. Present mitigation and disaster management initiatives have been documented and analysed for adequacy.

Key words: natural phenomenon, drainage, non-structural measures, heavy rainfall, bowl-shaped topography, salinity, mitigation analysis.

FLOOD HAZARD, VULNERABILITY AND RISK ASSESSMENT OF THE NORTH INDIA: ASSESSMENT OF CONCURRENT MITIGATION OPTIONS

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Abstract

A study has been carried out to assess the micro level assessment of Hazard, Vulnerability, Risk and Mitigation Options in relation to the Kosi Flood in year 2008. Such study has not been addressed properly, not due to a single cause. To achieve these objectives of the study, the data collection has been made by the Bihar govt. websites and other national and international sources. The hazard situation is due to accentuation of the catchments characteristics, channel morphology, sediment transport characteristics etc. The vulnerability assessment is a crucial input to understand the probable loss that may occur when hazard would take place. The high degree of vulnerability is more dependent on the economical, educational and flood educational status of the people. Lowering the economical and educational status, the higher the vulnerability will be.

The risk of the area is the prominence of hazard possibilities at the vulnerable points, which is higher in the flood affected areas of the North Bihar. At the same place the mitigation options like preparedness approaches and post disaster learning cell are not able to achieve their real aim and objectives, so the need of time is to strengthen the post disaster responses to make the policies and preparedness plan to reduce such devastating conditions.

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An Experiment Using the High Resolution WRF Model to Predict Heavy Precipitation over India

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Abstract

Prediction of heavy rainfall is one of the many challenging problems in meteorology and its timely warnings is very important for the agencies engaged in disaster preparedness and mitigation. The availability of high computing power, improvement in the quality of observational data over the ocean from satellites and buoys, improved numerical models with better parameterization schemes and also the availability of real-time initial and boundary fields from global models has simplified the job of forecasting centers to run high resolution meso-scale models for research as well as operational use. These products from high resolution meso-scale models are very useful in order to improve the forecasting ability of meteorologists over short time scales.

In the present study the recent heavy rainfall events that occurred during 7th to 11th July, 2008 over parts of Orissa, coastal Andhra Pradesh is investigated using Weather Research and Forecasting (WRF; version 3) meso-scale model at a horizontal resolution of 27 km. Also the sensitivity experiments are conducted with the WRF model to test the impact of microphysical and cumulus parameterization schemes in capturing the extreme heavy rainfall event. Keeping the same cloud microphysics as WSM-3 scheme (Simple ice scheme) the WRF model run was carried out using three cumulus parameterization schemes viz., Kain-Fritsch, Betts-Miller-Janjic and Grell-Devenyi. Another run with WRF model was also carried out with no cumulus scheme. The results of these experiments indicate that although all three cumulus schemes could capture the genesis of the depression reasonably well the Betts-Miller-Janjic scheme was found to be superior during the initial period of the system, whereas, the Kain-Fritsch scheme was found to be superior during the latter part (when the system was intensified). Similarly the heavy rainfall event over Orissa and adjoining areas was well captured in the Kain-Fritsch and Grell-Devenyi schemes with Kain-Fritsch is found to be more consistent. Although the present result is based on one case study more experiments are needed for detailed analysis.

Flood Forecast Technology for Disaster Preparedness in Bangladesh
Disaster Communication System Abstract
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Throughout Bangladesh's history, floods have ended the lives of millions of people, and deprived those left behind of their livelihoods. Bangladesh's vulnerability lies in its low-lying area combined with a dissecting river system. In response to this lethal predisposition to flood disaster, Bangladesh's Flood Early Warning System has become a critical component in disaster preparedness.

Previously, Bangladesh's flood forecasting system was only able to provide communities with a 72 hour warning in the face of an imminent flood. A host of researchers, institutions, and organizations have been working to save lives, by strengthening the system with an aim of increasing the lead-time of flood forecasting in Bangladesh through the Climate Forecast Applications in Bangladesh (CFAB) program.

CARE's SHOUHARDO program, funded by USA ID, has supported the continuation of CFAB through the development of a three-tiered forecasting technology that has been transferred to Bangladesh institutions such as the Flood Forecasting and Warning Centre and the Bangladesh Meteorological Department.

A major outcome for CFAB includes a short term flood forecast system (1-10 days) that allows time for emergency planning, which in turn will minimize loss of lives and livelihoods, and assist in planning both planting and harvesting patterns."Parallel to this, training is occurring at both community and local government levels in order to maximize the efficacy of the forecasts from this prediction system through mobilization of communities towards counteracting and employing

pre-emptive action prior to the arrival of a flood. Flood information is disseminated via SMS, and flags are hoisted in an easily visible place using different colors to represent the severity of the flood.

CFAB's Flood Early Warning System will have a significant impact upon Bangladesh through its increased capacity in which to predict floods, and the dissemination of flood information to the community - thereby drastically minimizing the damage of the inevitability of natural disasters that Bangladesh faces.

Flood Risk Mitigation and Management Practices in Delhi

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Floods are a recurring phenomenon at national level. Delhi, the capital of India, which is situated on the banks of river Yamuna is also prone to floods. The spread of Delhi was limited to the west bank of river Yamuna in the past. Another river, Sahibi a tributary of Yamuna, used to pass through Delhi and terminates into Yamuna near Wazirabad. Due to unplanned development the Sahibi river has now converted into Najafgarh Drain. The flood prone areas of Delhi are adjacent to these two rivers.

With passage of time, due to increased political and economic activities, the population of Delhi increased exponentially. The unplanned and ill planned development, due to population pressure, has resulted in creation of urban drainage congestions. Local urban drainage congestion like situation occurs very frequently after heavy rainfall of short duration in the city. This is only due to the inadequate/inefficient drainage system, unable to drain out the heavy discharge of short duration.

The flood problem of Delhi can be classified mainly into two categories i.e. flooding due to Yamuna River and/ or Sahibi River and other is due to local urban drainage congestion. Delhi has a long history of substantial damage due to floods. Few of the prominent floods like in the years of 1924, 1947, 1967, 1971, 1975, 1976, 1977, 1978, 1988, 1993, 1995, 1998, 2005 etc. have caused considerable problem for the people and the administration. Among all flood situations, the 1978 flood was one of the worst floods faced by the city in recent times when more than 7 lacs cusec discharge was released from Tajewala Haryana, during which 130 villages and 25 urban colonies were submerged under water due to a breach in the right marginal bund. The left marginal bund was also reached the point of distress. The flood resulted in deaths of 18 people and huge financial loss rendering thousand of peoples homeless in its wake.

The main cause of flood fury in Delhi area is mindless unplanned urbanization in the form of illegal & unauthorized colonies, encroachment on natural drainage system, increased paved / pacca area,

heavy rain fall of short duration, the impact of climate change, heavy discharge into river Yamuna and Sahibi River, lack of local water bodies & lakes and congestion & covering of existing storm water drainage system for reclamation of high value land for other development activities.

Government of Delhi has realized the importance of flood risk mitigation in the state. In its efforts government has established structural and non-structural measures to reduce the impending flood risk in Delhi. Various structural measures adopted in the city include flood protection structures like embankments, regulators on out falling drains into Yamuna, adoption of rain water harvesting system, construction of water recharging channels, desilting of drains to ensure smooth flow during flood seasons. Similarly, large number of non-structural programmes have also been initiated which include sensitization of community, improvement in early warning, improvement in evacuation and search and rescue systems at state level besides others.

The present paper will make an effort to highlight important initiatives taken at state level in Delhi to mitigate the risk due to floods. The data in the paper will be presented in form of tables, charts and sketches.

PROBLEM OF URBAN FLOODS IN THE DEVELOPING CITIES OF DEVELOPING WORLD

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ABSTRACT

Water is essence of human life and exists in several forms in our planet and each form has its own features and importance. One of them is rain water, rain water which is important for agriculture, also recharges underground water and maintains the volume of water in different sources of water. This rainwater often leads to catastrophic results in form of floods like what is happening in Bihar, Assam and several places of the country. Floods in the 21st Century have taken a new form a new type, primarily restricted to the developing and improperly planned urban areas, termed as urban floods. One of the best examples of this phenomena and the devastating effect it can have is that of India's commercial capital Mumbai. Which every year suffers badly during monsoon because of urban floods, together with number of other developing towns in the country and developing world.

The present paper deals with the nuances of this problem. It discusses in detail about the problem, the paper explains about what can be called as urban floods. It uses figures to make us understand how small rain drops get easily converted into millions of liters of water whose proper and safe discharge is necessary. The paper focuses on the various causes of urban floods. In the next part it discusses the harmful effects of urban floods on life of that urban area, on humans and on environment as a whole. The third part of the paper deals with the central

theme, the main idea behind the paper, the prominent cause of urban floods, i.e. overlooking of natural watersheds by our planners and policy makers while undertaking developmental activities- It explains how macro/micro watersheds are the key to understand the problem of urban floods and how by providing due consideration to macro/micro watershed can act as an ailment to the Herculean problem of urban floods. In the end the paper contains the plan of action, suggestions and the necessary steps which ought to be taken for curing this problem.

PHUTSE GLACIER LAKE OUT BURST FLOOD LADAKH RANGE, LEH LADAKH JAMMU AND KASHMIR

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Global surface temperature of the earth has been on the rise since the end of the Little Ice (15th-18th centuries). Increased developmental activities in recent times have accelerated the global warming. Glaciers by and large have responded by retreating at a rate that ranges from a few meters to several meters per year. Rapid recession of glaciers is resulting in the formulation and increase in the size of glacial lakes, increasing the threat of glacial lake outburst floods (GLOFs). Ladakh Range and Karakoram Range of mountains in Ladakh District has witnesses several GLOFs in past but very few have been documented, except the bursting of glacial lake formed by the blocking of Shyok River by the surging Chong Kumdan glacier in 1930s. This is one of the best-documented and monitored GLOF of Ladakh.

Occurrences of GLOFs in Ladakh Range have not received due attention of scientific community. GLOFs have been recorded as flash floods in district revenue records. It is only on closer examination and detailed field investigations many of the flash floods are typical cases of GLOFs. In the recent past flash floods have been attributed to cloud bursts, there are field evidences, which clearly indicated that some of these were in fact GLOFs. There is a need to differentiate between the two, especially when the occurrences of cloudbursts have increased in the recent past in the region.

On closer examination of satellite imageries of Ladakh it is observed that there are number of small glaciers and ice fields in catchments of every small stream flowing down the slopes of Ladakh range which may or may not join Indus or Shyok river depending upon the amount of water in the stream (Tokpo in Ladakhi). The significant feature associated with most of these glaciers is the development of recessional terminal moraines and glacial lakes that are either drained in pasts or are in processes of formation. In the past recessional glacial lake formation was larger and the magnitude of floods in Tokpos was also much more than at present when the size of the glaciers were much larger. This is clearly evident by the size of boulder spread over the alluvial fans of these tokpos. Breached terminal moraines bear witness to the bursting of recessional lakes in the head waters of many valleys of Ladakh range.

Preliminary examinations of flash floods in Leh and Phayang Tokpo in August 2006 were carried out in the summer of 2007-2009 by authors. In course of fieldwork it was observed that

the floods in Leh and Phayang Tokpo were due to the bursting of recessional glacial lakes. Phuste glacial lake in the headwaters of Leh Valley, breached in August 2006. Field evidences indicate that the breaching of moraine dam occurred with the melting of ice core. Increase in the summer precipitation substantially contributed to increase in the water level of the lake and subsequent bursting of the lake. The increase of atmospheric temperature played a major role of formation of lake by way of enhanced surface melting of glacier over a height of 5000 masl. An important factor, which has not been given its due importance, is the melting of the permafrost with the increase in global temperature. This is not only destabilizing the mountain slopes but also contributing to increase of melt water flow into glacial lakes.

There is an urgent need for the preparation of inventory of the glacial lakes of Ladakh and to identify potentially dangerous glacial lakes. Developing a monitoring and early warning system to forewarn the dangers of GLOF in advance to the people living down stream.

Glacial melt water has been the source of sustenance for the people of Ladakh since the time of early settlers in Ladakh. Glaciers have already receded to such an extent that it would be difficult in coming days to meet the basic need of water for the people of Ladakh. Depleting glacial melt water would also have its impact on the ground water reserves. Therefore it is suggested that methods be evolved for controlled breaching/drainage of recession lakes. Thereby impounded glacial lake water is utilized as sustainable source of water for the people of Ladakh rather than being a cause of destruction.

DATA INTEGRATION FOR ADAPTATION TO SEA LEVEL RISE, STORM SURGES, AND EROSION

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Computer models have been developed that predict water levels due to storm surges and sea level rise. These facilitate the creation of flood risk maps and flood depth maps, and allow the modeling of different flood risks, based upon generated water level probabilities and a high-resolution digital elevation model (DEM) of the topography. The end result of applying these tools and processes is an understanding of coastal zone changes or events which pose a threat, and identification of the various steps that could be taken to avoid or ameliorate the effects of such changes or events.

We have successfully integrated water level probabilities with topography and demography to indicate and illustrate the likelihood of flood extent and potential damage. Animations and graphs are generated as a user interface to better understand flood hazards and better manage risk. On the erosion side, historic imagery is analyzed using accurate measurements to determine rates of erosion, which allows us to focus on sections of shoreline historically most prone to erosion. More work is being done on determining future erosion risk based on natural processes.

This paper summarizes the research described above, and describes further research which will enhance the Coastal DSS by

- taking into account dynamic processes that result in wave run-up, overtopping, and wave damage,
- including the contribution of rivers and precipitation to the total flood probabilities in coastal estuarine regions; and
- enabling analyses in data-poor areas.

Many areas have insufficient historic tide gauge data to enable rigorous statistical analyses. This research will suggest means of determining the range of acceptable parameter values for sensitivity analysis, e.g. what are upper/lower limits, what other constraints might be applied to the parameter values (can any of these constraints be discovered/expressed statistically).

PROBABILISTIC FLOOD HAZARD MODELING OF EMBANKMENT BREACHING IN THE BRAHMAPUTRA RIVER

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Every year floods in Brahmaputra River pose natural disasters; leading to tremendous loss of properties and human lives in its floodplain. In order to mitigate floods, series of embankments were constructed to protect vulnerable areas. Because of continuous changing of morphology in the main river and its tributaries, the embankments are now very prone to breaching during flood seasons. In this study, probabilistic flood hazard modeling approach for embankment breaching is formulated for a large flood prone area with limited available hydraulic and topographic dataset. Firstly, frequency analysis of historical daily stage dataset at a nearby river gauging station was carried out to compute flood discharges of various return periods. The flood return periods range from 2 years to 20 years. Secondly, a two-dimensional hydrodynamic river model, which numerically solves depth-integrated Navier-Stokes equations to obtain depth and velocity fields within the chosen domain (river and floodplain) was considered to obtain spatial variation of the inundation depth and velocity. The model was initially calibrated with flood inundation at Matmora embankment breaching, located in Lakhimpur district, Assam, for 2008 year high flood period. Satellite imageries of pre- and post- breaching conditions were used to derive embankment breaching parameters such as breaching length, embankment extent, and morphologic condition of the river. The flood inundation was mapped from satellite imagery of September, 2008. It was found that simulated flood inundation of about 195 km² closely matched with the mapped one (225 km²). Thirdly, the calibrated model with input flood discharge of various return periods were simulated to obtain probability-of-inundation and maximum velocity at each computational cell. Flood hazard maps were prepared using spatial analysis of simulated inundation depth and maximum scalar velocity, based on depth-velocity hazard curves. Besides this, location of the breaching is considered as a random variable.

The probabilistic flood hazard maps for the Brahmaputra dyke of 51 km long was generated and can be used to plan appropriate cost-effective flood mitigation schemes at both pre and post breaching scenarios.

REMOVING OF ORGANIC POLLUTANTS IN THE RIVERS AFTER FLOODS

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Over many centuries flood have caused famine and epidemics in Armenia. In this year (2009) were terrifying flooding done to a national economy huge harm.

The concentrations of organic pollutants - particularly petrol products, phenol, aromatics, dyes, pesticides in wastewater are increased rapidly by negative influence on human welfare development.

Organics cannot be removed by conventional gravity separation technology. One of the best rapid methods for wastewater treatment from organic pollutants is an application of inorganic and organic adsorbents. Current treatment processes usually involve also biological degradation or chemical oxidation of the waste organics.

In this presentation the results of researches on application of natural Armenian zeolites & agricultural residues as sorbents of organics are presented. We have considered, that by this way it is possible to solve some ecological problem for our country: wastewater treatment, agricultural residues application, technological useful & cheap process use for country ecosystem security.

A method of sorption treatment is offered here, using natural zeolite and agricultural residues. The advantages of zeolites in comparison with other sorbents are: the large reserves in Armenia, a unique complex of technological properties - sorptional and molecular-sieving - as well as their natural origin, possibilities for their modification in various directions, regeneration and utilization. The efficiency and mechanism of sorption - filtering parameters, length of contact liquid and solid phases ratio and other factors - have been studied. The same investigation carry out for agricultural by products and activated carbons from them.

The service provider treating floodwaters must take into account the following:

1. If the onsite wastewater treatment system has electrical components, the ability to restart the system will depend on the flood elevation.
2. If the floodwater only covers the tanks and the components in the tanks, it is possible to

restart the system without further evaluation.

3. If the floodwater covers components located on the ground surface (air pumps, panels), the system should be inspected to determine whether it is safe to restart the electrical service and use the system.

Additionally, sorption materials can be placed on the floodplain, e.g., in ponds with mobile walls filled by adsorbents, and removed after the flood. There would be a primary treatment system and a secondary treatment where the containers filled with zeolite or agricultural by products and activated carbons from them are established.

MASTER PLAN FOR PREVENTION OF FLOOD DISASTER IN GORGANROOD RIVER BASIN, IRAN

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Abstract

Flood events in last two decades in Iran had significant damages on economy, environment, natural resources and human life. The Gorganrood river basin in northern Iran is one of areas that experiences number of flood events every year. In important flood events of August 2001 and August 2002 on this area more than 200000 people affected and two villages were complete destroyed and more than 400 people died. In this paper the master plan for prevention and mitigation of flood disaster on the study area is presented. The master plan considers the non-structural methods such as floodplain management and emergency activities together with structural ones such as reservoir dams and river improvement. The main results of application of master plan here is to identify the optimal combination of different methods that aiming to flood disaster control and mitigation. On the basis of master plan, the optimum methods for flood disaster control in Gorganrood river basin includes floodplain zoning, flood insurance, public education, flood warning systems and construction of reservoir dams.

COUPLING CLIMATE CHANGE ADAPTATION AND DISASTER RISK REDUCTION: EMERGING TRENDS IN SOUTH ASIA

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Abstract

Two thirds of the disasters the South Asian region experiences are of climate related and there have been phenomenal increase in their frequency, severity and unpredictability in the recent times. The societal vulnerabilities are aggravating from stresses on water availability, agriculture and environment. The fourth assessment of Intergovernmental Panel on Climate Change (IPCC) highlights increasing severity and frequency of storms, high rainfalls, floods;- drought and heat waves. With climate sensitive agrarian economies, climate change mitigation and adaptation are among the common priorities along with the disaster risk reduction for all the countries such as Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka of South Asian region.

The integration of the climate change mitigation/ adaptation efforts with disaster risk reduction is therefore quite crucial. Although, efforts to bring together stakeholders in climate change and disaster management have begun to create an opportunity for integration, challenges however lie not only in harmonizing diverse institutional structures, distinct sectoral planning & policies etc but also in communication between the communities of practice at global, regional and national levels. The recent years have just seen a beginning of this trend indicating the communities of climate change and disaster management talking to each other and coming closer, the integration however continues to be a challenge especially in South Asian region. The present paper intends capturing the images of such trends from semi-arid regions of India and Pakistan; flood-plains of Bangladesh and Nepal; and Coastal regions of India and Sri Lanka.

AN ASSESSMENT OF INCREASE OF VULNERABILITY OF THE STATE OF WEST BENGAL DUE TO FLOOD

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Abstract

The State of West Bengal is in the Eastern region of India, situated between N 21°30' & 27° 30' and E 85° 30' & 89°45'. The state has 19 Districts covering 65 Subdivisions, 341 Blocks, 333 Panchayat Samities, 126 Municipalities, 3354 Gram Panchayats, 40782 Mauzas, 37945 inhabited villages, 375 towns and 463 Police Stations. Total rainfall in a year is 28418.2 mm in

the state. 78% of the total rainfall takes place from June to September. 26 major rivers and 100 rivulets made the river system of West Bengal, which fall under four categories.

The population of the state is 80 million of which 72% live in rural areas. The population density increased from 615 to 903 per square Km from 1981 to 1991. Increasing economic activity and increased distribution of habitation have reduced the drainage area and traditional wetlands of the state, especially for the monsoonal rainwater. In addition to this, siltation, embankment erosion due to various reasons increased the flood vulnerability in the state.

Vulnerability is defined as the internal weakness of a system from external threats. In the perspective of disasters, vulnerability is determined by the conditions created by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards.

The main objective of this paper is to assess the increasing vulnerability of the major part of the state due to flood. This study presents the increasing vulnerability of flood up to block level. Pattern of rainfall and discharge of water through the drainage basins are the two main parameters studied for assessing the flood vulnerability in the state.

The study presented in this paper was undertaken during the development of the State Disaster Management Plan of West Bengal, 2008-2009, by the Centre for Distributed Computing, Jadavpur University.

"FLOOD WARNING-DECISION SUPPORT SYSTEM DESIGN FOR URBAN FLASH FLOOD MITIGATION CASE STUDY: NORTHERN TEHRAN BASIN"

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Abstracts

Flood is amongst the most commonplace and devastating natural disasters. Existing data shows that the frequency of flood events has arisen severely from 90's mostly due to climate change together with increase in human-nature interference.

There has been found more advantages of combined use of non-structural and structural flood management criteria rather than solely use of them. Amongst non-structural approaches, flood warning criterion has been recognized very essential in loss reduction in urban areas. With respect to the rapid growing and development of information management systems, there is of benefit to incorporate them in flood warning system's (FWD) configuration which aims in advances in flood preparation, response and also recovery.

Decision support system (DSS) is categorized as a knowledge-base system that aids decision makers in adopting efficient decisions facing with disastrous situations. A DSS consists of several elements and layers compound of different models which totally convert data into relevant information.

The combined set-up of FWS and DSS collects the related data of prediction including meteorological, precipitation, water level and river flow by monitoring the related parameters. The set of real-time data would be used in threat recognition that consequently results in adoption of any emergency action in response to flood impacts.

Urban flash floods happen rapidly and cause severe damages to the facilities and social structures in a very short time. On July 1987 the 26th a devastating flood happened to north of Tehran. The number of victims was nearly 300 and a large amount of losses was happened to different stakeholders.

The frequent happening of such flash floods during the last century has led the urban authorities to study flood management strategies for northern Tehran basin. This paper focuses on designing elements and parameters of a practical DSS-FW system for the mentioned basin. The outcomes of the study show that meteorological prediction together with organizational setup plays a vital role in emergency management of the study region.

Key word: Urban Flash Floods, Flood Management Criteria, Flood Warning System, Information Management System, Decision Support System

FLOODING PROCESSES IN SMALL-SCALE DRAINAGE BASINS

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ABSTRACT

We use the island of Jamaica as an example to show that destructive flooding in small-scale drainage basins is generally dominated by sediment flows. High risk locations are relatively flat debris fans formed by accumulation of landslide debris at the mouth of water courses. These sites are increasingly being used for housing development.

Sediments sources include storm-induced landslides, loose sediment on slopes derived from old slope failures, and sediment available in the water courses. Plentiful sediment supply is maintained by debris flows that have occurred in the past and are likely to continue into the future. Rainfall thresholds that may mobilize sediment-water floods need not be associated with hurricane rainfall. It is not uncommon to observe the entire spectrum of flow behaviours in a single channel including stream flow- hypo concentrated flow-debris flow. In a majority of cases it is the sediment deposition rather than water that is the cause of destruction.

It appears that sediment flows are generally recorded and treated as water floods and most mitigation is designed to contain water floods. This is unfortunate because mitigation strategies for sediment flows are significantly different than those for water floods.

STRUCTURAL AND NON-STRUCTURAL MEASURES OF FLOOD MANAGEMENT

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ABSTRACT

Floods are among the most destructive acts of nature. World-wide, flood damages to agriculture, houses and public utilities amount to billions of dollars each year in addition to the loss of precious human and cattle lives. India is no exception as far as floods are concerned. Severe floods occur almost every year in one part of the country or the other causing tremendous loss of life, large scale damage to property and untold misery to millions of people. A huge amount of money is spent every year in providing relief to the flood ravaged areas. As per the assessment made by the Rastriya Barb Ayog (National Flood Commission) in their report of 1980, the total flood prone area in our country is 40m ha out of which an area of about 32m.ha. is considered as protectable.

The huge losses sustained from floods throughout the World have stimulated actions to deal with flood problem as a priority issue. Both structural and non-structural measures have been undertaken to tackle the problem.

It was initially believed that the way to reduce flood damages was to manage the rivers through structural measures and moderate the floods. Structural measures, as the name implies, are those which involve construction of structures like dams, embankments, drainage channels, etc. However, after spending large amounts of money on flood management works, it was realized that this approach did not work very well. The emphasis then shifted to non-structural measures. The importance of flood plains and flood plain management was also realized over a period of time. It has now been established that the proper way to flood management is to adopt a judicious combination of structural and non-structural methods.

The paper describes the flood problem in India and various structural and non-structural measures adopted for flood management, along with their benefits and constraints & deficiencies.

Dam Break Flood Simulation for Analysis of Risk Management and Damage Estimation

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Abstract

There has been a significant increase in the water related disasters during the last century, affecting a large number of people mostly in developing countries. It causes significant environmental and economical losses. One of major challenges to overcome for economic development of North East India is management and planning against the devastating flood. This damage will be more destructive when a dam which is constructed for flood control, itself falls suddenly. Several dams are proposed in this region primarily to harness the hydro power, facilitate irrigation and to achieve flood control. In most of the developing countries downstream of the dam is also thickly populated and hence if the reservoir fails, sudden flood flows down the battier comes in contact with the habitual area with towns, villages, roads, railways, paddy fields, forests wild lives. The outcome of such occurrence will be a great danger to human and wild life causing significant economical and environmental damages. So to formulate suitable flood hazards mitigation measures in this region of India, prior knowledge of the flood movement is essential which can be acquired through simulation model to understand the dam break hydraulics for such real complex flood plain topography. Therefore, objective of the study is to predict, analyze the risk, manage dam break flood with the estimation of the damages. The model developed here has been applied, to simulate the flood due to the hypothetical failure of the proposed dam in the river Dibang, a major Himalayan tributary of the river Brahmaputra. With the help of the simulation model the flood prone areas are mapped and the intensity of the flood wave along the Dibang river flood plain has been found out. The various important factors such as maximum probable depth of flood maximum probable velocity and time of peak arrival are obtained for the sections downstairs. The inundation of the important places downstream the dam comprising of villages, roads, dense forest etc. has been analyzed. The necessary disaster management plan and damage estimation for the flood due to instantaneous failure of the Dibang dam have been proposed here.

Flood Hazard Modeling and Flood Risk Assessment for a River Basin

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Abstract

In recent years the number and scale of water related disasters, flood in particular has been increasing. The losses from floods often offset years of hard-won social and economic development. The problem is further expected to be aggravated with the phenomena of climate change. Therefore, mitigation and managing of flood hazards has become a priority for alleviating poverty, ensuring socio economic progress, preserving our eco-systems and ensuring the gains of development. The paper presents procedure for flood hazard modeling and flood risk assessment for a river basin. It describes estimation of floods for different return periods for the various stream flow gauging sites of the river reach using the L-moments approach as well as development of the rating employing least squares techniques. It presents modeling of flood inundation for various return periods as well as the depths of flooding using the HEC-RAS package. It discusses simulation of flood inundations for various levels of hydrologic risk associated with the flooding of the river reach.