FLOOD MANAGEMENT IN BANGLADESH

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1. BACKGROUND

Endowed with water, fertile soil and a favourable climate, Bangladesh has developed a predominantly agrarian economy over the centuries. Though the country is richly blessed with water resources on an annual basis, it faces serious problems as the water availability is characterized by wide seasonal variability, too much during the monsoon and too little during the dry season. There is also spatial variability to contend with. A major difficulty arises, as the country is the lowest riparian to the Ganges water resources, the Brahmaputra and the Meghna river systems (figure 1) and the large majority of the annual runoff enters the country from outside its border. The overabundance of water in the monsoon brings in its trail devastating flood, erosion of land and vagaries of the braided and meandering rivers.

After the country had suffered from unprecedented floods in two consecutive years 1954 and 1955, a flood commission was constituted in December 1955 known as the Krug Mission. This Mission submitted the 'Krug Mission report' in 1957 after a detailed review of the gigantic problems associated with the flooding. Based on the recommendations of the Krug Mission, the East Pakistan Water and Power Development Authority (EPWAPDA) was created in 1959 for the unified and coordinated development of the water and power resources.

The East Pakistan Water and Power Development Authority prepared a Master Plan for water resources development in 1964. This plan marked the beginning of the formulation of an integrated plan for flood control and development of water resources of the country. After the independence of Bangladesh in December 1971, the East Pakistan Water and Power Development Authority was bifurcated into two separate bodies, leading to the creation of the Bangladesh Water Development Board (BWDB) and the Bangladesh Power Development Board (BPDB). This was done with a view to undertake expanded water and power development programmes and speed up the execution of projects. Recently the Government of Bangladesh has restructured the mandate and task of BWDB to strengthen its capacity through National Water Policy 1999, National Water Management Plan 2004 and BWDB act 2000. Accordingly, at present BWDB is the major organization to deal with the flood management and the drainage improvement in the country. Presently the following skilled and supporting professionals are working under BWDB.

Manpower Statement of BWDB

Sl. No.	Category	Manpower	Remarks
1	Engineer	519 752	B.Sc Engineer (WR) Diploma (WR)
2	Water Management	59	WRM

Sl. No.	Category	Manpower	Remarks
3	Administrative	130	
4	Economic	20	
5	Finance Audit & Accounts	61	
6	Land & Revenue	17	
7	Non Cadre (grade-1)	49	
	Sub Total	1607	
8	Other Support Staff	7302	
	Total	8909	Excl. ME & Dredgers

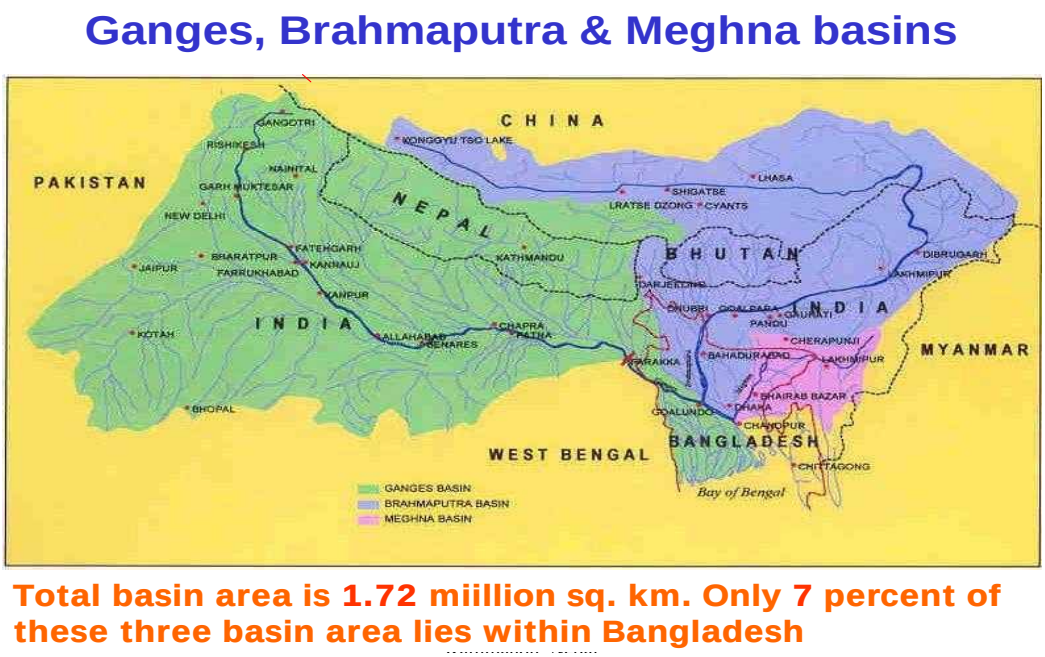

Figure 1 : GBM Basin the flood contributing catchments

Bangladesh Water Development Board (BWDB) has completed 617 water resources projects over the last 45 years. Through various components under these projects, it made a total of 5.39 million hectares of agricultural land free from flood and drainage congestion thereby facilitating the production of an additional food grain of about 7.8 million tons annually. BWDB has constructed a total of 9462 km of embankment including the coastal area. These embankments have provided reasonable security to the beneficiaries from normal flooding in the inner country and from moderate wave action in the coastal area and have enabled the farmers to reap their harvests. These embankments have also created facilities of communication round the year even to remote places of the country. BWDB also undertook huge number of erosion control measures in major and other rivers and thus protected cities, towns, business centre, and border areas. By achieving all these benefits BWDB is contributing in fulfilling the national goals of poverty reduction, self-sufficiency in food and enhancing standard of living.

Each year in Bangladesh about 26,000 sq km, 25% of the country is flooded. Land elevation of 50% of the country is within 5 m of MSL during severe flood. Since the affected area may exceed 68% of the total area of the country. In an average year, 844,000 million cubic metre of water flows into the country during the humid period (May to October) through the three main rivers the Ganges, the **Brahmaputra-Jamuna** and the **Meghna**. Figure 1 and 2 shows the **Ganga Brahmaputra Meghna** (GBM) basins and minimum and maximum inflow distribution through the river system of Bangladesh from GBM basins.

When simultaneous rise in water level occurs in the three river catchments, flood becomes devastating one. Flood of 1998 was the most devastating flood of the last century in the world. It affected about 100,000 sq km areas, which is about 68% of the land area. History of the extreme floods in Bangladesh is shown in the Table 1.

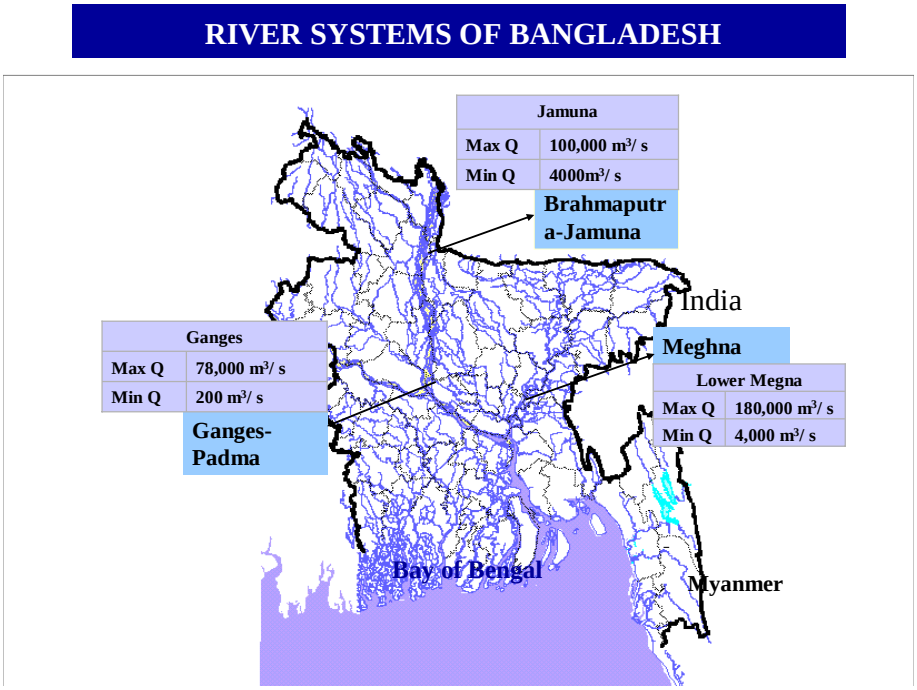

Figure 2: Flow Distributions in Bangladesh from GBM basins

Table 1: Flood affected area and percentage

Year	Affected Area	
	Sq. km	Percentage
1954	> 50,000	34
1955	50,500	34
1974	52,600	36
1987	57,300	39
1988	89,970	61
1998	100,250	68
2004	56,000	38

2. TYPES OF FLOOD AND ITS CAUSES

Almost every year floods occur in Bangladesh. But the intensity and the magnitude of floods vary from year to year. In some years floods occur locally and in others it encompasses vast areas of the country. Floods of 1987, 1988 and 1998 were extensive in aerial extent and colossal in terms of destruction (Mirza, 2003). As much as three fourths of the country was affected in 1998. Floods cause enormous economic loss to the country destroying its infrastructures, standing crops, livestocks and also human lives.

Natural floods: About one-fifth to one-third of the country is flooded to varying degrees each year during June through September when about two-thirds of the food grain (mainly rice) are produced. The following natural floods are encountered.

- River flood;
- Rainfall flood;
- Flash flood;
- Tidal flood;
- Storm-surge flood.

Table 2 shows the flooded area of Bangladesh for different return periods.

Table 2 Flooded Area of Bangladesh for Different Return Periods (World Bank, 1998)

Return Period (years)	2	5	10	20	50	100	500	Mean
Flooded areas (%)	20	30	37	43	52	60	70	22

The available flood damage information is not always complete. Flood damage assessments are generally prepared by various organizations, which are often not systematic and well coordinated. Regarding flood damages, there are consequential effects such as reduced employment, industrial production loss, reduced consumer demand, reduced economic activities due to disruption to daily life of poor people etc. When converted into monetary term, it is found that flood damage to infrastructure and property outweighs the damage to crops. But the misery of the people however cannot be translated into economic indices.

The 1988 flood caused over 1517 deaths and damages variously estimated at about $1200 million. The lower death toll in the 1998 flood of less than 1000 and a considerable reduction in livestock deaths (down from 350,000 in 1988 to 26,564 in 1998) reflect improvements in flood preparedness over the intervening period. The 1998 flood forced over a million people out of their homes, damaged 16,000 km of roads and 4,500 km of embankment, and destroyed crops on over 500,000 ha of land.

Flooding in some parts of Bangladesh is caused by a combination of several factors such as:

- Huge flows from the upstream catchments by rainfall and snowmelt and consequent high water levels in the river:
- Runoff generated by heavy local precipitation that cannot drain out due to high stage in the outfall river;

- High tide in the Bay coupled with the wind set up caused by the south-westerly monsoon winds or cyclones that obstruct drainage of the upland discharge;
- Excessive silt load in the rivers due to soil erosion, instability of the river, erosion of the banks and changes in river course:

The intensity or magnitude of flooding depends considerably on the pattern of occurrence and synchronization of the above factors.

3. AFFECTS OF FLOOD

Affects of flood are many. It has both the adverse as well as positive effects. Whether the affects of flood will be positive or negative, depth and duration of the flood depends on the geographical location of the flooded areas. Some of the negative and adverse effects are as follows:

i) Dislocation of normal life;
ii) Damage to the habitat, physical infrastructure and public properties;
iii) Disruption of the communication;
iv) Erosion of the topsoil in the mountain and hilly areas;
v) Excessive siltation in the river beds, reducing the conveyance capacity;
vi) Erosion of river banks to accommodate larger flow volume;
vii) Deterioration of environment due to water logging;
viii) Increase in reproduction of vectors of different water borne diseases;
ix) Deterioration of sanitation; etc.

Some of the positive contribution may also be cited below :

i) Land building in the flood plains due to siltation;
ii) Natural fertilization of the flood plain lands;
iii) Increased recharge of the Groundwater;
iv) Availability of abundant soil moisture during post flood period;
v) Increase in production of fish, etc.

In case of severe floods, the negative effects always outstrip the benefits. But normal flood usually contribute to the positive benefits.

4. FLOOD MANAGEMENT ROLE IN BANGLADESH

The issues of flood management should be considered from different angles of improvement of quality of life, impact on physical environment, socio-economic condition and environmental preservation etc. It is usually found that different methods or techniques are practiced in different parts of the world to tackle the flood problems. All the methods and techniques for flood management can generally be classified into three broad categories and they are as follows:

Structural Measures

In Bangladesh it is being some structural measures such as Flood Embankment, Channel Improvement, River Training, Coastal Embankment etc to combat the flood sufferings. Among these structural measures, construction of embankment is most popular and very old practice in Bangladesh. This is also a very cheap method compared to other structural

measures. With the experience over the last few decades, it was observed that the structural measures do not usually bring only blessings. They also have adverse effect. The adverse effects always do not appear shortly after their construction but become apparent with the elapse of time.

Structural cum Non-Structural Measures

They are engineering constructions, improvement or change in agronomic practices and watershed management. These options are now being practiced in Bangladesh to modify the flood and to combat the adverse effects of flood. It is found that some of this method is very cheap compared to other methods. Adoption of change in agronomic practices or watershed management requires very high level of community participation. Community awareness campaign is very important in this regard.

Non-Structural

This option consists of the Flood Plain Zoning & Management; Policies for infrastructure Planning and Development in the flood plains; Flood Proofing; Disaster Preparedness & Response Planning and Flood Forecasting and Warning.

Due to increased population pressure it is a typical scenario in Bangladesh that the human habitat is extending more and more towards flood plains, which are vulnerable to recurrent flood. Moreover, more lands of the flood plains are being occupied and converted to habitat and agricultural lands, which were mostly, back swamp. Flood plains are generally regarded as the extended portion of the main river channel. During high flows, the flood plains often act as temporary detention basin as well as conveying excess water to the downstream. Due to increasing occupation of the flood plains for the reason mentioned above, the areas for temporary detention basin as well as conveyance of the flood flow is seriously restricted. As a result, the recurrence of flood is increased along with the flood damage. Flood plain zoning and management is the effective means of regulating habitat construction and agricultural use with minimum interference to the natural condition prevailing in the flood plains.

Due to a swell in population in the flood plains, the governments are bound to undertake more and more development projects in the flood plains. With experiences of construction of different infrastructure in the flood plains, it is often seen that flood vulnerability increases. It is now strongly felt that appropriate policy formulation is needed for infrastructure planning and development in the flood plains to avoid adverse environmental impacts and to lessen the flood vulnerability. Policy formulation should be on the basis of scientific study and research. Bangladesh Government has already finalized Flood Management Strategy in 1995, National Water Policy in 1998 and National Water Management Plan in 2004.

Flood proofing is a measure, which has been found to have less adverse effects. In most of the flood prone areas in Bangladesh, the people used to flood proofing technique in such a way that people build their houses on the built-up earthen mounds. This is being in practice for centuries. Community participation and awareness are very important in the flood proofing measures.

Many of the damages of the floods can be reduced to a great extent through a proper Disaster Preparedness and Response Planning, which is unfortunately lacking in most of

the LDC's (**L**east **D**eveloping **C**ountries) and the **D**eveloping **C**ountries. With the increased awareness on this issue, Disaster Preparedness and Response Planning in many countries are being improved. For the Disaster Preparedness regarding the flood, the most important tool is the Flood Forecasting and Warning System. If the flood depth and duration can be forecasted well in advance, the vulnerable communities can be altered beforehand. This will again help the disaster managers and the communities to formulate their own strategies to cope up with the flood. With the current advancement in the information technology and hydrological and hydraulic sciences, it is possible to provide most accurate advance warning. It is now found that if advance warning is not sufficient, the dissemination of information to the people in the flood prone areas is no less important. In this regard assessment of response of the people to the flood warning is very important element in response planning. Disaster Preparedness programme cannot be made successful without proper response planning.

Flood Forecasting and Warning Process in Bangladesh

Flood forecasting and Warning Centre (FFWC) of Bangladesh Water Development (BWDB) was established as a permanent entity in 1972. Since its inception UNDP (**U**nited **N**ations **D**evelopment **P**rogramme) and WMO (**W**orld **M**eteorological **O**rganization) supported different activities of FF&WC through different projects till 1992.

During the period 1991-1995 the centre again received assistance from DANIDA through a component of the Flood Action Plan (FAP), to improve and expand the flood forecasting and warning services. Currently DANIDA assisted project "Consolidation and strengthening of flood forecasting and warning services" was implemented for the period Jan'2000 to Dec.'2004. The project has started functioning since mid January 2000.

During early period till 1990, the centre used to forecast flood by Co-axial correlation, gauge to gauge relation and Muskingum-Cunge Routing Model**.** From 1991 onwards the forecasting activities at FFWC have been based on the flood modelling technology developed by the Danish Hydraulic Institute (DHI) with the support service from the Surface Water Modelling Centre (SWMC-presently IWM) in Dhaka. Today the forecasting and warning services are carried out by the expertise/staffs of FFWC using the MIKE 11 and FLOOD WATCH modelling systems.

5. LIMITED ISSUES IN FLOOD MANAGEMENT

Structural

Financial Constraint
Political Commitment
Integration of the problems with overall socio economic aspects

Structural cum Non-Structural

Participation of stakeholders
Lacking of institutional capacity
Coordination

Non-Structural

Constrained of hydrological and meteorological data of upper riparian countries
Technical limitation for forecasting of flash flood
Limitations of dissemination of the flood message to the public

6. MANAGEMENT IN THE FUTURE

Overall, the incidence of flood and erosion events is likely to increase rather than decrease in the future, and little can be done within Bangladesh to prevent them from happening. This is recognized in the National Water Policy, which underlines the importance of implementing effective non-structural measures to reduce the impact on people of material losses and damage, and suggests changes in agriculture and land use practices, flood preparedness and disaster management. Some flood control measures (structural) that have to be taken at the existing ones are to be strengthened, at least to protect the country from worsening situation i.e. to maintain the present day situation. Proposals for creation of reservoir in Nepal may be considered, which will reduce flood situation as well as improve low water flow or drought situation. The polders in coastal areas may have to be strengthened and raised. The country should focus on the non-structural measures in an integrated way.

General options for non-structural measures are:
- Zoning;
- Warning systems;
- Hazard preparedness;
- Improved communications;
- Relief and rehabilitation.

Future improvement possibilities are:
- Financing (loan, insurance etc. for the affected people);
- Workable institutional arrangements;
- Risks and uncertainties;
- Regionality;
- Integrated approach for the improvement.

Total confinement of flood is neither possible nor feasible. We have to live with flooding. During flood, both structural and non-structural measures are important simultaneously.

In order to reduce the flood impact as well as to control the flood and protect drainage infrastructures and to take appropriate mitigation measures, the following conclusions are made:
- “Rationalising of Existing FCD Infrastructure” need to be taken.
- Effective regional cooperation and river basin management with sharing data

- Flood risks zones should be designated and appropriate measures should be taken to provide protection for life, property, infrastructure and agriculture in such zones
- Safe conveyance of the large cross-boundary flows through the major rivers to the Bay of Bengal should be ensured by channelizing and stabilizing these rivers with appropriates measures.
- Excavation and desilting of rivers, khals, offtakes of distributaries etc. should be undertaken for quick drainage of floodwater.
- The rivers, khals and floodways should be kept free from encroachment for free flood flows.
- Full flood protection and proper drainage for the urban areas should be provided.
- Required fund should be ensured for the maintenance of flood management and drainage infrastructures, so that the annual maintenance works are to be started in time
- A revolving fund may be made available to BWDB for emergency flood fighting with appropriate authority.
- Integrated planning, design and construction of all rural roads, highways and railway embankments with the provision of unimpeded drainage should be ensured.
- Adequate on-the-spot security for the personnel engaged in flood fighting should be provided.
- Water Act should be enacted to regulate all water management activities, which includes flood management.
- Improved flood forecasting system and establishment of a reliable and comprehensive flood warning system with adequate lead times and at the same time evolving techniques for dissemination of information to the community level is required.

REFERENCES

1. Bangladesh National Committee of the International Commission on Irrigation and Drainage, 1992. History of Irrigation Flood Control and Drainage in Bangladesh. ICID, Dhaka, Bangladesh.
2. Bangladesh Water and Flood Management Strategy, 1995. Government of the People's Republic of Bangladesh.
3. National Water Policy, 1999, Ministry of Water Resources, Government of the People Republic of Bangladesh.
4. National Water Management Plan (NWMP), Water Resources Planning Organization (WARPO), Government of the People's Republic of Bangladesh 2004.
5. "1998 Flood Damage Assessment of Water Sector Infrastructure", Dhaka, Government of Bangladesh (GOB).
6. Report of Task Force Committee on Flood Management, IEB, October, 1998.
7. The World Bank and Bangladesh Centre for Advanced Studies, 1998. Bangladesh 2020: A Long-run Perspective Study, University Press Limited, Dhaka, Bangladesh

8. H.S.M, Faruque and Ali, M.L, 2005. Climate Change and Water Resources Management in Bangladesh and Climate Change and Water Resources in South Asia, A.A. Balkema publishers, UK, 2005.
9. Ali, M.L, 2005. “Flood Protection Measures and Impacts of Climate Change in the Coastal Zone of Bangladesh”, International Symposium on Floods in Coastal Cities under Climate Change Conditions, Asian Institute of Technology Conference Center (AITCC), a Research Project sponsored by the Asia-Pacific Network for Global Change Research (APN), Bangkok, Thailand, 2005.
10. Choudhury, G. A, 2004. Impacts Of Flood On Flood Control And Drainage Infrastructures And Mitigation Measures, Workshop on Options for Flood Risk and Damage Reduction in Bangladesh, Dhaka, Bangladesh.