AN ASSESMENT OF WATER RELATED DISASTERS AND ITS MANAGEMENT IN PAKISTAN

SUMMARY

Pakistan is vulnerable to disaster risks from a range of natural hazards. The high priority hazards in terms of the scale and frequency of occurrence and the impact include earthquakes, droughts, cyclones/storms and flooding. The country's vulnerability to disaster risks relating to the water is perhaps caused by poorly planed and designed integrated water resources infrastructure. Although, a rage of natural disasters threaten Pakistan but the hazards related to the water are mainly river erosion, draughts, floods and cyclones. An overview of effects of draughts and cyclones in Pakistan is presented in the paper. But the issues prevailing to flood and its management, its affect on country's socio-economic development and feasible and effective measures in terms of Institution, Community Partnership, strategies and technology to cope with such disaster has been talked about in detail. The strategies to tackle such disaster risks have also been elaborated.

1. INTRODUCTION

Previously floods were studied as a hydrological phenomenon for which structural and non-structural measures were adopted to cope with such disasters. But now the well being of people of the flood and other water-related prone areas, their economic growth, and social urgency for alleviating poverty prevailing in such areas are the overriding concerns. Therefore, adequate attention needs to be paid to these concerns from both national and regional perspectives. While realizing theses concerns and the importance of disaster risks reduction particularly water-related risks for social, economic and environmental development, the Government of Pakistan has earmarked upon putting in place appropriate policies, laws, institutions, latest tools, strategies and programmes so as to control the negative patterns of risk and vulnerability. Economic damages resulting from annual flooding are major burden on the country's GDP which still requires roadmap to put disaster management into practice through various case studies and field experiences on actual at the basin and country level. Therefore, it is mandatory to cope with the floods and other water related disasters.

Flood events in Pakistan often take the shape of a disaster. Since the creation of Pakistan in 1947, the total losses ascribable to floods are colossal while more that 9088 people lost their lives (Federal Flood Commission, Report 2006). Initially the flood management i.e. the construction works and maintenance of protection works were the responsibility of the provinces. However due to a major task to safe lives and property in 1977 a commission was established to handle the flood protection and maintenance works. As a result, the commission has played a major role through various objectives like National Flood Protection Plans, Early warning system, community partnership and efficient coordination with federal agencies and provincial departments and

review of flood damages to water-related infrastructure and its remedies for restoration and reconstruction works.

On the other hand, due to uncertain climate changes, the incidence of drought in Pakistan is becoming increasingly common with substantial consequences on national economy. The drought phenomenon of 1997-2002 brought extensive damages to Balochistan, Sindh and Southern Punjab provinces causing more than 120 deaths and affected 2.2 million people, while 2.5 million livestock died and another 7.2 million livestock were affected. The drought of year 2001 was termed as worst in the history of Pakistan which reduced the economic growth rate to 2.6 per cent as compared to an average growth rate of over 6.0 per cent (NDMA, Report 2006).

Therefore in addition to taking steps to reduce the disasters, there is a need for exchange of views and experiences, data and information sharing and working together to develop approaches and methods to address pertinent water related disaster management issues, nationally and regionally in an open and trusting atmosphere.

2. INDUS BASIN IRRIGATION SYSTEM AND FLOODS IN PAKISTAN

2.1 River System of Pakistan

Five main rivers, namely, the Indus, Jhelum, Chenab, Ravi and Sutlej flow through the country's plains (Fig.1). Supplemented by a number of smaller tributaries and streams, these rivers supply water to the entire Indus Basin Irrigation System (IBIS). The rivers have their origin in the higher altitudes and derive their flows mainly from snowmelt and monsoon rains. The catchement area of the Indus is most unique in the sense that it contains seven of the world's highest-ranking peaks, after Mount Everest. Likewise barring the polar areas, seven glaciers situated in the catchments of Indus. The basin is one of the largest river basins in Asia, lies in Pakistan and covers approximately 70% of the country's area (IUCN, Report 2005).

2.2 Irrigation Network of Pakistan

Fifty six (56%) percent of the Indus river basin i.e. comprises of 5 main rivers and its tributaries with 3 major storages, 82 large dams of 15 m & above, 19 barrages, 45 main canals and 12 inter-river link canals serving 36 million acres of cultivated land with annual water availability of 142 MAF comprising of 62 MAF of surface water and 44 MAF of groundwater. The allocations of water amongst provinces is being made by Indus River System Authority (IRSA). The irrigation system of Pakistan is one of largest integrated network in the world serving 42 million acres of the contiguous cultivated land. The total length of main canals, distributaries and minors is 64,000 km and water courses comprise of another 1,621,000 km.

2.2 Causes of Floods in Pakistan

Generally major floods in the Indus basin occur in late summer (July to September) every year when the South Asian region is subjected to heavy monsoon rains.

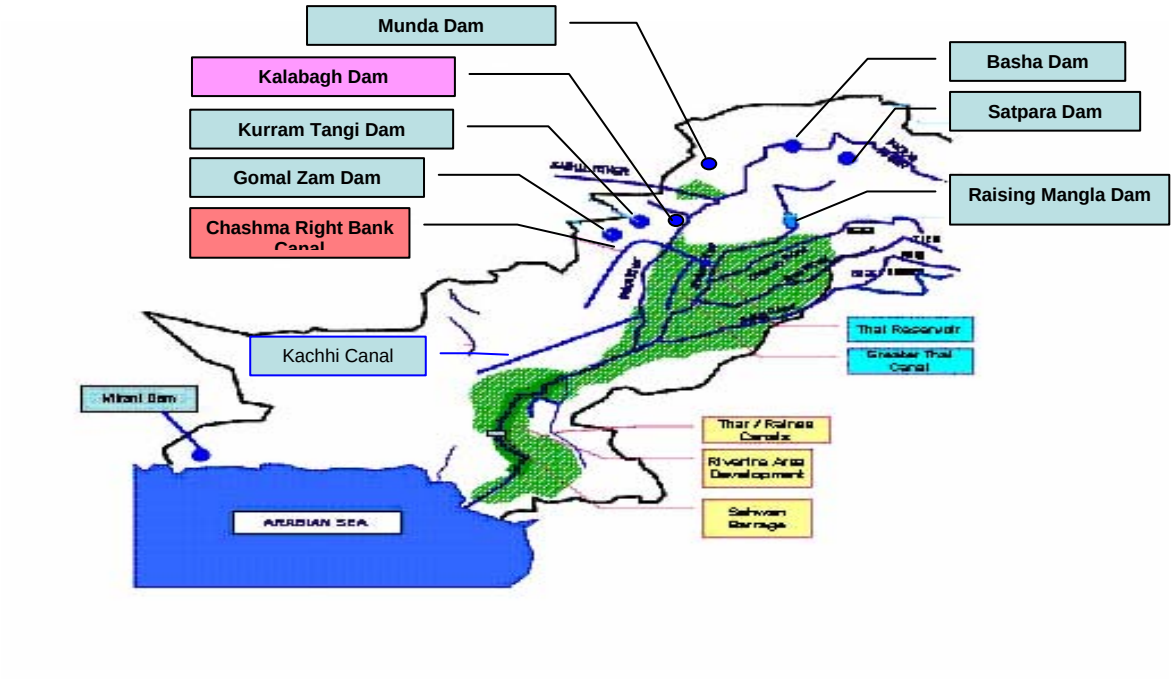

Figure 1: Indus River System of Pakistan

In the upper to mid rehearses of the basin, generally the tributaries cause flood rather than the Indus River itself. The monsoon low depression that causes intense rain develops either in the Arabian Sea or the Bay of Bengal (India). Major flooding is generally associated with the depression from the bay of Bengal moving across India in west/north-westerly direction and turning north at the border with Pakistan. The mountain ranges in the extreme north of Pakistan provide perennial source of inflow into rivers. River flood particularly hit Punjab and Sindh provinces while hill torrents tend to affect the hilly area of NWFP and Balochistan provinces and Northern federally administrated areas. Districts of Charsada, Mardan, Noshera and Peshawar in NWFP province are exposed to flood risks from the flooding in river Kabul which originate from Afghanistan and fed by many tributaries like Swat river. Since many rivers are snow-fed, they are also likely to cause flooding due to heat wave in early summer, combined with early monsoon. The major rivers cause losses by inundating areas along their banks, by damaging irrigation and communication facilities across or adjacent to their banks, and by erosion of land along the riverbanks. In the upper part of the Indus Basin System, flood water spilling over the riverbanks generally returns to the river. However, in the lower Indus Basin, where the Indus primarily flows at a higher elevation than adjoining lands, spills do not return to the river. This phenomenon extends the period of inundation, resulting in even greater damages. Although embankments are built along the entire length of the river in Sindh and at many locations in the upper Indus Basin have provided some protection against floods, but poor maintenance of the bunds causes breaches which often cause great damage

because of their unexpected nature and intensification of land use following the provision of flood protection.

Pakistan, being the downstream user of the rivers and also embroiled in political conflicts with the upper riparian state India, has to be particularly careful about flood management. India has several structures in place like Bhakra Nagal Dam on Sutlej, the Pong Dam on the Beas and the Thein Dam on the Ravi that augment its capability to transfer flood surges to Pakistan and this has happened in the past.

2.3 Historical Floods and Damages in Pakistan

During the last sixty (60) years in the country, the total losses ascribable to floods are colossal and the economic damages are a major burden on the country. Heaviest direct floods threaten country's vital agricultural, communication infrastructure and have caused damages to urban and rural property and public utilities and losses worth USD $ 4 billion recorded for the ten largest floods since country's independence in 1947 (IUCN, Report 2005). Historical flood damages up to 2006 in Pakistan are as given in Table 1.

2.3.1 Floods and Damages in the Year 2007

According to the situation report issued by the National Disaster Management Authority (NDMA), Government of Pakistan on 20 August 2007, the flood occurred during the current year has been declared as the most severe disaster after the Earthquake (October 08, 2005). The flooding situation started during early June when the flow in the River Kabul was exceptionally high. On the other hand, Indus River (largest one) giving peak flows in the Mid July when Tarbela Dam was approaching its maximum conservation level. Lack of safe drinking water, sanitation and hygiene, shelter, health and even temporary houses continue to be major issues for the thousand affected people particularly in the provinces of Balochistan and Sindh (Fig. 2). A statement showing the detail of losses/damages caused due to Rain/Flood 2007 as on 12 September 2007 is given in Table 2.

Figure 2: Displaced people during Flood in 2007

Table 1: Historical Flood Damages in Pakistan

Year	Lives Lost	Monitory Losses (Billion rupees)	Villages Affected	Area Flooded (miles)
1950	2190	9.08	10,000	7,000
1955	679	7.04	6,945	8,000
1956	160	5.92	11,609	29,065
1957	83	Not available	4,498	Not available
1973	474	5.52	9,719	16,200
1975	126	12.72	8,628	13,645
1976	425	64.84	18,390	32,000
1978	393	41.44	9,199	11,952
1988	508	15.96	1,000	4,400
1992	1008	56.00	13,208	15,140
1995	591	7.00	6,852	6,518
1996	307	3.50	3,769	3,852
1997	607	Not available	3,245	2,300
2001	219	Not available	50	
2003	484	Not available	4,376	400
2004	85	Not available	47	Not available
2005	59	Not available	1,931	Not available
2006	541	Not available	2,477	Not available
Total	**8,939**	**229.02**	**115,945**	**150,470**

Table 2: Flood Damages in Year 2007

Province	**Punjab**	**Sindh**	**NWFP**	**Balochistan**	**FATA**	**NA**	**AJ & K**	**Grand Total**
Village Affected	12	1,486	Not received	5,000	Not received	Not received	Not received	6,498
Persons Affected	172	402,507	Not received	2,000,000	Not received	Not received	Not received	2,402,679
Area Affected (Acres)	Not received	669843	38,098	204,045	Not received	Not received	Not received	911,986
Cropped Area Affected (Acres)	2,817	114825	2,706	321,672	493	Not received	Not received	442,513
House Damaged Partially	66	38550	2,554	117,445	1,357	Not received	Not received	159,972
House Damaged Fully	6,603	Not received	1,011	36,819	212	Not received	Not received	44,645
Persons Died	52	185	132	205	7	5	Not received	586
Persons Injured	Not received	104	140	Not received	28	Not received	Not received	272
Cattle Heads Perished	40	40,204	734	Not received	28	Not received	Not received	41,236
Relief Camps Established	4	127	Not received	Not received	Not received	Not received	Not received	131
Persons in relief Camps	Not received	33,579	Not received	Not received	Not received	Not received	Not received	33,579

2.3.2 An Overview of Disaster due to Cyclones

The climate change is causing increase in the frequency and intensity of storms, changes in their tracks and create strong winds. Although the frequency of cyclones is low along Pakistani coast, yet they cause considerable damage in the area, when they occur. Coastal belt is mostly low-lying, therefore storm surges extend several kilometers inland and they damage crops and convert the agricultural land into gully lands for long time.

Costal belt of Pakistan is highly vulnerable to cyclones and associated storm surges. Fourteen cyclones were recorded between 1971 and 2001. Cyclones can cause large scale damage to the coastal areas of Sindh and Balochistan. The cyclone of 1999 in Thatta and Badin districts wiped out 73 settlements, and it killed 168 people, and 11,000 cattle. Nearly 0.6 million people were affected. It destroyed 1800 small and big boats and partially damaged 642 boats, causing a loss of Rs. 380 million. The losses to infrastructure were estimated at Rs. 750 million.

A Cyclone entered into Pakistani coast during June 2007 as shown in (Figure 3) extended several kilometers inland (Balochistan province) and destroyed crops, electric and communication installations, human settlements and other infrastructure and areas are left water logged where cultivation is not possible for months.

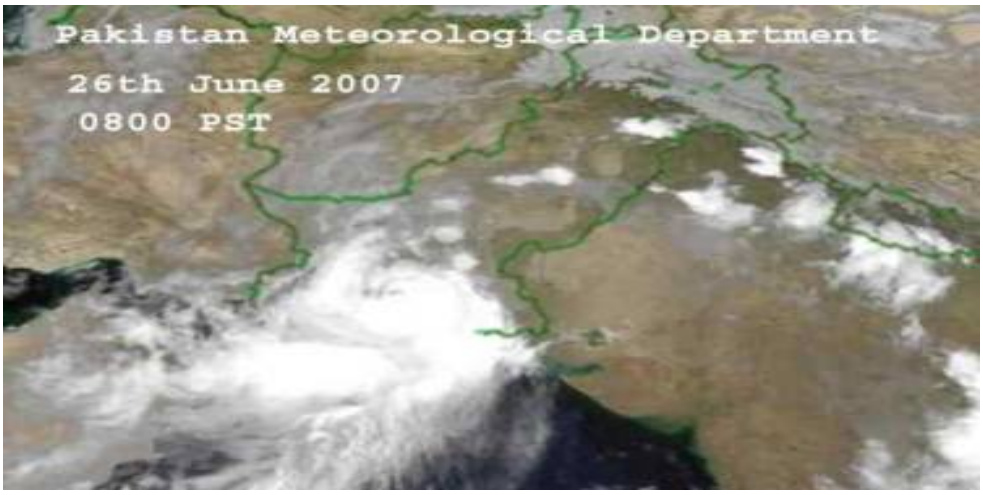

Figure 3: Cyclones entering in Pakistan during June 2007

2.4 Feasible and effective measures to cope with the Flood

Flood management planning for Pakistan is a complex problem and calls for greater ingenuity and experience on the part of planners. The nature of problems varies at different locations due to varying climatic, physiographic, demographic and socio-economic condition in the four provinces. However, flood management is being carried out by the federal government with the active involvement of provincial departments and Pak Army.

2.4.1 Flood Protection and River Training Works

Pakistan's rivers are characterized by highly active, meandering channels and moving beds due to the erodible nature of the river plains and variations in the river discharges and sediment concentration. Seasonal floods are also regular features of river flows in IBIS. Extensive efforts have been made in the past to train the rivers and protect the adjoining areas from river erosion and flood damages. This has mainly been done with the help of a network of embankments reinforced by various types of spurs. To safeguard the areas from inundation, about 5,600 km of embankments have been constructed along major rivers and their tributaries in system. In addition, more than 600 spurs have been constructed to protect these embankments. The province-wise detail of the flood protection and river training works is given in Table 3 and federal investment on these projects since 1977 to 2006 is estimated as Pak Rs. 10,0561million (locally funded) with additional Foreign funding of US $ 578.70. The province-wise detail is given in Table 4.

Table 3: Embankments and Spurs Constructed

Province	Embankments	Spurs
Punjab	2,690	408
Sindh	2,378	35
Balochistan	277	-
NWFP	250	171
Total in Pakistan	**5,595**	**614**

Table 4: Summary of Federal Investment on Flood Protection Works

Province/Federal Line Agency	Investment (Pak Rs. Million)	Investment (% age)
Punjab	4,456.30	44.31
Sindh	3,576.00	35.56
NWFP	1,043	10.37
Balochistan	750	7.46
FATA	120	1.19
Northern Areas	81.40	0.81
Azad Jammu & Kashmir	29.40	0.29
Total in Pakistan	**10,056.1**	**100**

2.4.2 Flood Warning System and Flood Forecasts

Ultimate aim of flood warning is to reduce loss to the life and property of the community living in the flood liable areas. The flood warning centers are established at the district and tehsil level and are being administrated and monitored by the provincial departments like Provincial Irrigation and Drainage Authority (PIDA) and Provincial Relief Organizations (PROs). The flood warning system in Pakistan consists of high frequency radio communication system, telemetry System and telephonic system. In addition to

that there are 24 telemetric gage stations within the upper catchments of Indus and Jhelum rivers to early record the rain data. The system had been replaced with a new set of equipment using meteorobrust based communication system. Water and Power Development Authority (WAPDA) supports another hydrometric data measurement and transmission system by its Surface Water Hydrology Department. An overlap of the two systems also exists at number of sites, most of which are within the Mangla Dam (on Jhelum river) catchment.

Pakistan has a unique flood forecasting problem in the sense that greater part of the flood producing upper catchments of the Sutlej, Ravi, Jhelum and Chenab rivers lie across the border in India/held Kashmir. The meteorological situation is also the one linked with a monsoon low/depression. The flood forecasting system includes a 10-CM Quantitative Precipitation Measurement (QPM) weather radar system in Jhelum river (Mangla Dam Catchment), High Resolution Picture Transmission (HRPT) equipment for Meteorological Dissemination System and 5-CM Weather Surveillance Radars. These systems are normally monitored by Pakistan Met Department which plays a key role in the entire flood warning and disaster management related to flood.

The flood forecasting model (FFM), a composite set of rainfall-runoff models and river flow routing models, is the backbone for predicting water levels and discharges at key locations within the Indus Basin. The flood forecasting model (Fig. 4) incorporates flood control measures such as flood reduction by using the storage capacity of Mangla reservoir and diversion of flood water near important bridges and barrages. In times of floods the predicted hydraulic conditions in the FFM are regularly updated by assimilating on-line collected rainfall, water level and discharge data.

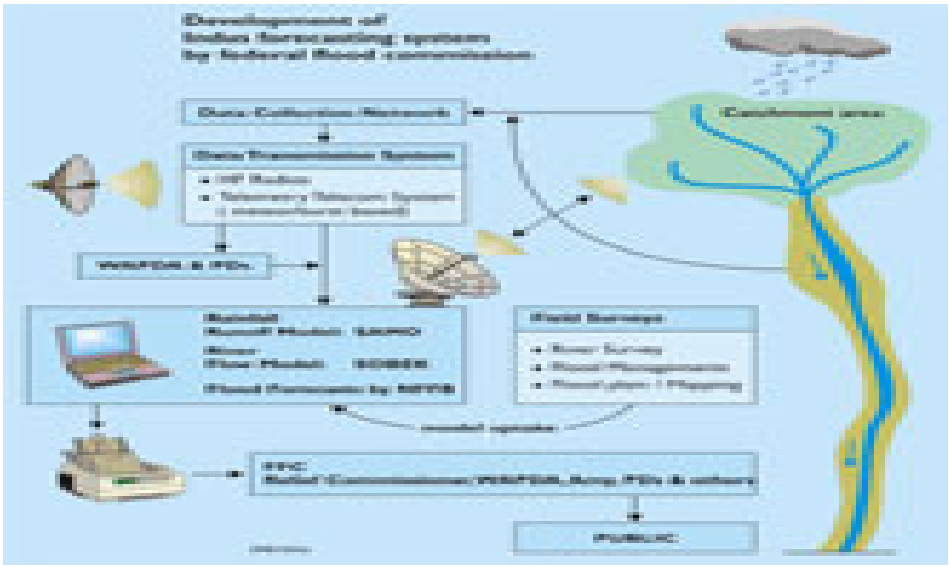

Figure 4: Flood Forecasting Model

2.4.3 Institutional Arrangements for Flood Control

Soon after independence, a Central Engineering Authority was constituted to deal with the vast water, power and allied engineering issues at the national level. It was also to serve as an executive body for the execution of several projects. After the creation of WAPDA in 1959, reorganization was undertaken

with reduced tasks at the federal level and the Central Engineering Authority was re-designated as the Chief Engineering Advisor's Office with a redefined role.

Up to the end of 1976, the provincial governments were responsible for the planning and execution of flood protection works. The disastrous floods of 1973 and 1976 resulted in heavy losses indicating that the protection facilities and planning at that time were inadequate. In January 1977, the Federal Flood Commission was established. This is the principal institution for flood planning and control in Pakistan. Its mandate includes the preparation of the National Flood Protection Plan, approval of flood control schemes, review of flood damages, plans for reconstruction works, improvements in flood forecasting and warning system, monitoring and evaluation, etc. Other institutions that play a major role in flood management are PIDAs/ PIDs, WAPDA, Provincial Relief Organizations, Pakistan Army, Pakistan Commissioner for Indus Waters, Emergency Relief Cell and National Flood Forecasting Division. The major studies undertaken at national level in this sector in Pakistan are:

i. National Flood Protection Plan I (1977-87) worth Rs. 1.767 billion
ii. National Flood Protection Plan II (1988-98) worth Rs. 7.576 billion
iii. Master Feasibility Studies for Harnessing of Flood Flows of Hill Torrents of Pakistan (1998)

Currently, the Flood Protection Sector Project II is being implemented. The project is worth Rs. 8.0 billion. Its main objectives are to construct flood protection and river training works, improve the weather radar data collection system and create awareness and adaptability among masses.

2.5 Strategies for Water-related Disaster management

Government is stern to cope with and taking very various initiatives to put the disaster management into practice at the country as well as at organization level. Various programmes have been launched for this purpose. To achieve such targets during Millennium Development Goals it is also included in action plans like Water Strategy 2002, Medium Term Development Framework (MTDF-2005~10) and National Water Policy 2004, to develop the technical and operational capacities of relevant scientific organizations involved in the disaster risks to monitor and predict hazards with maximum lead time possible. This will be done by improving the existing technological networks and by further expanding them through introduction of latest technology. It will also include facilitating multi-agency interface, and strengthening the sharing of technical information about hazards amongst multiple agencies. The role of media will also be enhanced and institutional partnerships amongst media and scientific organizations would be promoted to improve dissemination of warnings.

In order to promote community level disaster risk reduction and preparedness activities in hazard prone areas, the capacity of existing community organizations will be developed and enhanced by the district, and tehsil authorities. In case of absence of any community level organizations, the

establishment of new groups will be encouraged by the local authorities to work on disaster risk reduction and preparedness. The community organizations will be trained to develop local early warning systems, and capacities in the areas of evacuation, first aid, search and rescue and fire fighting. The community organizations will also be linked with the relevant tehsil and district level technical and resource organizations.

2.6 Results and Discussion

Pakistan will have to strengthen its early warning capacities for droughts and flooding which are two most high impact hazards in the country. The early warning system will need to be developed for hazards like cyclones and tsunami, which although might be low in frequency but can have high impact. Considering the high exposure to seismic hazards, Pakistan also needs to develop better monitoring and analysis capabilities in this area.

Flood management in the Indus Basin is a multi-dimensional process that demands intensive resources and requires efficient coordination between various government agencies. However, even advanced flood management systems are no guarantee against flood disasters as it has often been proved in the more developed countries. Although the National Water Policy provides the necessary guidelines for flood and drought management, but still there is a need for a separate national policy to deal specifically with the flood and drought issues in the country. The task of quantification of flood risk thorough detailed studies and subsequent measures required in minimizing the risk should be taken on priority basis. Community level disaster risk reduction and preparedness activities in hazard prone areas should also be promoted on priority basis. The use of land in flood hazard areas should be promoted appropriately.

2.7 References

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