



**GOVERNMENT OF PAKISTAN
MINISTRY OF WATER AND POWER**

ANNUAL FLOOD REPORT 2011



Pictures of 2011-Floods

**OFFICE OF THE CHIEF ENGINEERING ADVISOR &
CHAIRMAN, FEDERAL FLOOD COMMISSION
ISLAMABAD**

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MESSAGE

The last two decades are witness to Pakistan's vulnerability to floods. As a semi-arid country affected by climate change the shifting of the monsoon zone, Pakistan is exposed to extreme weather conditions causing floods and droughts. This is exacerbated by the inadequate capacity to process the high rainfall in particular degraded catchments, weakness in flood defenses and importantly a distorted natural drainage network. Capacity deficits exist at both the provincial and district levels and there is a lack of effective coordination of institutions involved in the response, caused in part by limitations of technical capacities such as dissemination of early warning, disaster preparedness measures, emergency response and structural disaster mitigation civil works and infrastructure related to reservoir capacity which covers only 9% of water needs (less than 30 days of average flow). At the community level, the local communities do not have disaster preparedness information and there is lack of general awareness raising, sensitization and education of the masses regularly affected by floods, focusing especially on populations located within the active flood plains of the low-lying areas in the canal commands.

Whilst the devastating consequences to nature and vulnerable communities is undeniable, there also needs to be recognition of the possible positive effect of high rainfall events- the irrigation of dry lands, the recharge of groundwater in areas with overuse and the impact on the environment and livelihoods in the Indus Delta. Where possible a flood response plan should not only reduce or prevent the negative impacts of the floods but also make use and channelize the beneficial impacts of the high rainfall events.

The exceptional intensity and prolonged periods of the 2010 and 2011 rains and resultant floods clearly highlighted limited existing physical limitations and policy environment and verified institutional limitations and the physical limitation to deal with the floods, including the inadequacy of reservoir operations, the shortfalls of irrigation and drainage operations, the insufficient maintenance of flood protection works and the encroachment of natural drains.

Ministry of Water and Power/Federal Flood Commission has initiated working on preparation of comprehensive flood management plan on integrated basis. Priority has been given to the water sector projects under public sector development programme. 12 medium dams (Punjab: 2, Sindh: 2, Khyber Pakhtunkhwa: 3, & Balochistan: 5) have been picked up as phase-I for implementation. These dams will not only provide help in flood

mitigation but also enhance the water storage capacity and hydropower potential for the country.

The Diamer Basha Dam multipurpose project is also top priority project. The existing flood forecasting and warning system is being upgraded and expended by installation new weather radars in order to cover the upper Indus above Tarbela and catchment areas of Kabul & Swat Rivers, besides coastal belt of Sindh and Balochistan. The flood telemetry system is also being expended to cover the Indus above Tarbela, Rivers Kabul and Swat above Nowshera. The SOPs of Tarbela reservoirs are being revisited for enhancing its role in flood mitigation. Flood plain mapping/zoning all along the Indus River and its major tributaries is being carried out for restricting by law permanent settlements in high and medium flood risk areas. The discharge capacity of barrages and bridges/head works on main and other rivers is being reviewed in light of floods experienced during 2010 monsoon season. All such structures having deficient discharge capacity would be considered for remodeling. And last but not the least is the construction of small dams which play very important role in flood management of flash floods of hill torrents. Therefore, present Government has given high priority to construction of medium and small dams on secondary/ tertiary rivers and flood flows generating hill torrents.

(Syed Naveed Qamar)
Minister for Water & Power



MESSAGE

Flood constitutes one of the world's most serious environmental hazards. Thousand years of recorded history tells man's repeated failure to evade the destruction of floods. In spite of many years of experience and highly developed techniques, flood continues to threaten life & property in Pakistan.

Generally, floods are caused by the heavy concentrated rainfall in the catchment areas of rivers during the monsoon season, which are often augmented by snowmelt. Pakistan has suffered a cumulative financial loss of more than US\$ 30 billion during the past 62 years. During the period 1950 to 2011, around 10,668 people lost their lives, some 166,075 villages damaged/ destroyed and a total area of 594,713 Sq.km was affected due to the 19 major flood events. The unprecedented floods of 2010 were the worst ever riverine floods in the history of the country in which 1985 people lost their lives, 1,608,184 houses damaged/destroyed, 17,553 villages affected and a total area of 1,00,000 Sq.km was inundated. Similarly, 2011- Rains/Floods affected an area of 26,305 Sq.km, population of about 9.20 million, claiming more than 500 lives, damaging 1.357 million houses and devastated standing crops on about 1.90 million acres.

In view of recent challenges including climate change, the government is planning to formulate a Comprehensive Flood Management Plan for next 10 years, based on integrated and innovative approaches. The discharge capacity of all those aged structures (Barrages/Bridges), which do not have the adequate flood flows capacity, are being reviewed for remodeling. The existing Flood Forecasting & Warning System of the country is being upgraded and expended by installation of new Weather Radars and expansion of Flood Telemetry Network Stations. I believe the implementation of these efforts would considerably mitigate future flood losses.

(Imtiaz Kazi)
Secretary Water & Power

EXECUTIVE SUMMARY

Prior to 1976, the Provincial Governments were responsible for the planning and execution of flood protection works. Heavy losses sustained to the economy during disastrous floods of 1973 and 1976 were discussed at an Inter-Provincial Conference in 1977 and subsequently in January 1977, it was decided by the Federal Government to establish Federal Flood Commission (FFC) at the federal level in order to ensure comprehensive integrated flood management on country wide basis. Since its establishment, FFC has so far prepared and executed three National Flood Protection Plans covering periods from 1978-1988 (NFPP-I), 1988-1998 (NFPP-II) and 1998-2008 (NFPP-III).

Keeping in view the level of investments made under the three 10-Year Plans (NFPP I,II&III), and the needs of the provinces, Gilgit-Baltistan & Federally Administered Areas (FATA & AJK) , the National Flood Protection Plan –IV was prepared and submitted to Ministry of Water and Power in November 2006, for approval of the Competent Authority. However, the same could not be approved in time due to low priority given to Flood Sector as result of drought like conditions over the country during that period and funding constraints. Keeping in view the large scale damages occurred during 2010 floods in country, the need for investment in flood sector has gained importance. It was therefore decided to update the draft National Flood Protection Plan-IV (NFPP-IV) keeping in view the lessons learnt from 2010-floods. For that purpose, FFC has prepared a PC-II for preparation of National Flood Protection Plan-IV (2012-22). The overall objective and scope of the study is to review the previous NFPPs and flood management documents keeping in view the lessons learnt from major flood events occurred in the past in the country, especially 2010-Floods & 2011 Rains/Floods and to formulate NFPP-IV for next 10 years based on an integrated and innovative approach.

A total investment of Rs 26.138 billion (this includes 1988-Flood Damages Restoration Project and 1992-94 Flood Damages Restoration Project costing Rs 1.80 billion and 6.50 billion respectively) has been made for construction of flood protection infrastructure and improvement in Flood Forecasting & Warning System in the past 34 years. Presently, the provinces & federal line agencies are maintaining more than 1410 No. of Spurs and around 6808 Km long flood embankments in various parts of the country.

Generally, floods are caused by the heavy concentrated rainfall during the monsoon season, which are sometimes augmented by snowmelt flows in rivers. Occasionally destructive floods are also caused due to Monsoon currents originating in the Bay of Bengal and resultant depressions which often result in heavy downpour in the Himalayan foothills, which is sometime augmented by the weather systems from the Arabian Sea (Seasonal Low) and from the Mediterranean Sea (Westerly Wave).

Pakistan has suffered a cumulative financial loss of more than US\$ 30 billion during the past 62 years. During the period from 1950 to 2011, around 10,668 people lost their lives, some 166,075 villages were damaged/ destroyed and a total area of 594,713 Sq.km was affected due to the nineteen major flood events. The 2010-Floods were worst flooding in the past about 80 years in the region. In comparison, Rains/Floods of 2011-monsoon season were of small scale, which mainly affected the Sindh Province, especially southeastern parts of the province, northeastern Balochistan, and southern Punjab.

Federal Flood Commission is responsible for integrated planning for flood management at the national level and arranges financial resources for the implementation of flood protection projects on country wide basis. Presently, funds are allocated under PSDP through Normal/Emergent Flood Programme. The four Provinces, Gilgit-Baltistan and Federally Administered Areas (FATA and AJ&K) submit their flood protection schemes, which are technically scrutinized by the Federal Flood Commission and submitted to Ministry of Water & Power for approval of DDWP/ CDWP. Flood Communication Cell of Federal Flood Commission remains operational on round-the-clock basis for the entire flood season (1st July to 15th October) and Flood Situation Report (main Rivers discharges at important locations and storages position of major storages reservoirs) is issued on daily basis to all concerned organizations/authorities.

2011-Floods

The catchment areas of main rivers of the country did not receive heavy precipitation during Monsoon Season 2011 hence, none of the major rivers attained danger flood level. That is why no serious riverine flooding was observed during 2011-Flood Season. However, the torrential monsoon rains of 2011 hit the Sindh Province, especially the southeastern parts of the province, which were historical events of about 150 years return period. The rains started in 2nd week of August and continued till mid September with short intervals. The first spell of heavy rainfall started from 10th August and continued till 17th August 2011 with short intervals, which caused more than 300 mm precipitation in Districts Badin, Mirpurkhas, Hyderabad, Tando Muhammad Khan, Shaheed Benazirabad (Nawabshah), Sanghar and generated surface run-off of more than 14000 cusecs in LBOD System against its designed discharge capacity of 4440 cusecs. Average rainfall recorded was 8-10 times more than the land drainage capacity of LBOD & Kotri Barrage Drainage System.

The 2nd spell of monsoon rains started from 29th August 2011, which caused averagely 200 mm and in some areas more than 400 mm rains were recorded. The cumulative rainfall recorded in the region was averagely 600 mm. The LBOD System (already flowing full) attained its maximum water level and overtopped at several locations, which badly affected the abadies, standing crops, private and public infrastructure of Districts Mirpurkhas, Badin, Shaheed Benazirabad (Nawabshah) and Sanghar, Tando Muhammad Khan, Umerkot, Tharparker, Tando Allyar and adjoining areas. As the land was already saturated, hence, the 2nd spell rains caused more damages to abadies, private & public

infrastructure, besides standing crops. The continued rains created flood like situation in the entire lower parts of Sindh.

The rains/floods affected an area of about 6.812 million acres (23 Districts in Sindh, 12 in Punjab & 1 in AJK) affecting 38,700 villages, claiming about 516 lives, damaging 1,598,629 houses & cropped area of about 2.311 million acres and population of about 9.303 million had been affected. Irrigation & Power Department, Government of Sindh with the help of donor agency (Asian Development Bank) has estimated damages occurred to irrigation, drainage & flood protection infrastructure and their restoration/reconstruction cost is around Rs. 6.00 billion.

Way Forward

Provincial Irrigation Departments and Federal Line Agencies may execute the remaining 2010-Floods damages rehabilitation/remodeling works on top priority basis, so as to ensure completion well before the start of monsoon season 2012. All urgent nature new flood projects as well as O&M works of flood protection infrastructure may be completed on priority basis before start of Flood Season 2012. SIDA/PID Sindh may carry out the restoration & strengthening work of irrigation, drainage & flood protection infrastructure damaged during Monsoon Season 2011 on fast track basis to make the system ready for next monsoon season. The encroachments in flood plains and waterways/ drains may be removed by the PID Sindh/SIDA with the help of Districts Administration in order to enhance the discharge capacity of drains and minimize the loss of human lives and damages to the property in future floods. SIDA/PID Sindh may also carry out feasibility studies for long-term measures/ permanent solution of drainage problem in order to avoid 2011 like situation in future. The following option may be given due consideration, while formulating proposal;

- Remodeling & enhancing the discharge capacity of existing drainage network on the basis of torrential rains experienced during Monsoon Season 2011;
- Construction of additional drains, wherever needed;
- Construction of an independent natural Dhoras Network & Syphons across Main Drain for diversion of flows into Dhora Puran (Shakoor Dhand) in order to off-load LBOD System.
- Construction of out-fall structure along KPOD to control tidal impact and sea water intrusion.
- Remodeling of weirs and increasing size of inlets and culverts etc. constructed across drains;
- Diversion of storm-water to Dhands of Thar desert such as Kakao, Kalankar and abandoned Dhoro Puran etc.

- Identification of natural depressions, their strengthening for enhancing their storage capacities and identification of accessible high elevation areas for settlement of rain/flood affectees in future floods.

Acknowledgement

The preparation and distribution of Annual Flood Report of Federal Flood Commission commenced from 1998 with a view to compile essential information on yearly basis for documentation of the yearly flood events, flood flow data, lessons learnt from these yearly events, and for exploring the needs for future protective measures.

The 2011 Annual Flood Report contains inter-alia, information about historical floods in Pakistan, flood management works, functions of FFC & other related provincial and federal level organizations, flood warning dissemination system and flood preparedness activities carried out during flood season. The report specifically focuses on unprecedented rains/floods of 2011, which caused extensive damages to private as well as public sector infrastructure in the Sindh Province.

Services of following officers are greatly acknowledged who contributed in a dedicated manner for the preparation of 2011-Annual Flood Report of Federal Flood Commission:

Sr. #	Name	Designation	Role
1.	Mr. Asjad Imtiaz Ali	Chief Engineering Advisor/Chairman Federal Flood Commission	Supervisory
2.	Mr. Alamgir Khan	Chief Engineer (Floods)	Contributory
3.	Mr. Ather Hameed	Principal River Engineer	Contributory
4.	Mr. Ashok Kumar	Superintending Engineering (Floods)	Contributory
5.	Mr. Nasir Ibrar	Superintending Engineering (Floods)	Contributory
6.	Mr. Zafar Iqbal	Senior Engineer (Floods)	Contributory
7.	Mr. Muhammad Amin	Assistant Engineer (Floods)	Contributory
8.	Mr. Muhammad Mazhar Iqbal	Assistant Engineer (Floods)	Contributory

PHILOSOPHY OF FLOODS

1. PHILOSOPHY OF FLOODS

1.1 Flood Problem in Perspective

Floods constitute one of the world's most serious environmental hazards. Four thousand years of recorded history tells of man's repeated failure to evade the destructiveness of floods. In spite of many years of experience and highly developed scientific techniques, floods even now continue to play havoc almost in every part of this planet.

Losses from floods annually destroy about million acres of crops land and affect hundred thousands of people with a monetary loss in billion of rupees. Major direct flood damages in Pakistan are to agricultural crops, urban and rural abadies, besides, other private & public utilities.

It is generally recognized that complete prevention from floods is humanly impossible, but protection from flood is feasible and is a vital necessity. By proper planning, means can be devised to harness the fury of floods to safeguard human life and property. Devoid their destructive power, floods can be used in the service and the welfare of a community.

1.2 Floods in Pakistan

The floods in rivers are generally caused by heavy concentrated rainfall in the catchments, during the monsoon season, which is sometimes augmented by snow melt flows. Monsoon currents originating in the Bay of Bengal and resultant depressions often result in heavy downpour in the Himalayan foothills, which occasionally generate destructive floods in the main rivers and their major tributaries. Sometimes exceptionally high flood flows in major rivers are generated due to formation of temporary natural dams by landslide or glacier movement and their subsequent collapse.

Flooding of the Indus River and its tributaries represents the greatest hazard in Pakistan. Floods occur almost exclusively in summer season (July - October). Therefore, damages to agriculture are mainly to the standing Kharif crops. However, in some cases the inundated lands do not dry up in time and ultimately affecting sowing Rabi crops.

The major rivers (Indus, Jhelum, Chenab, Ravi, Sutlej) cause flood losses by inundating areas along their banks, by damaging irrigation and communication facilities across or adjacent to the rivers, and by erosion of land along the river banks. In the upper part of the Indus Basin, floodwater spilling over the high banks of the rivers generally returns to the river. However, in the lower part of Indus River (Sindh Province), which is flowing at a higher elevation than adjoining lands, spills water do not return to the main river channel. This largely extends the extent and period of inundation resulting in more damages. Although flood protection by embankments has been provided almost along the entire length in the Sindh Province and many locations in the upper parts of the country, however, sometimes, the bund breaches occurred (LMB Taunsa Barrage & Tori Bund events during 2010-Monsoon Season). Such breaches often cause greater damages than would have occurred without the bunds because of their unexpected nature and intensification of land use following the provision of flood protection.

The existing flood flows discharging capacity of important structures (Barrages and Rail or Road Bridges) on the Indus, Chenab and Ravi has been found to be inadequate. During exceptionally high floods stage this results in afflux on the upstream side, which

sometimes results in breaches in the flood embankments. At times, the flood embankments have to be breached at pre-selected locations to save the main structures (RMB Jinnah Barrage during Monsoon Season 2010).

1.3 Flood Control Objective & Need

Flood management planning for the major rivers of Pakistan is being carried out to essentially cover the following three specific objectives:

- *To reduce or eliminate damages to existing properties;*
- *To prevent future increase in damages; and*
- *To mitigate the residual hazard.*

Flood control planning for Pakistan is a complex problem and calls for great ingenuity and experience on the part of the planners. The nature of problems varies in each of the four provinces and federally administered areas due to varying physiographic, climatic, demographic, and socio-economic conditions. Even the characteristics of catchment areas of various rivers differ from each other. Flood problems relating to various provinces are given as under:

Punjab

In the Punjab, the flood protection bunds have been generally constructed either to protect Headworks and other irrigation structures, or to safeguard certain towns, villages & adjoining agricultural lands. Due to general topography of the area sloping towards the south-west, the embankments along Headworks and irrigation structures have been constructed in such a way that breaching sections are provided on the right marginal bunds to give relief to water heading up against the left marginal bunds. This is done to avoid breaches in the left marginal bunds which can cause widespread devastation, as most of the development is on the left side of the river. In order to protect areas from erosion, spurs have been constructed in critical reaches. These spurs have protected vast areas and in some cases even large tracks of eroded lands have been reclaimed.

Sindh

The Indus River flows on a ridge in Sindh Province and generally, surrounding areas are lower than the river bed; hence, water once leaving the Indus River does not return back to the main channel. Escaped water thus causes greater damage to widespread areas, and it persists for a longer period even after flood peaks are over (Refer Tori Bund, M.S bunds breaches during 2010-Monsoon Season). Moreover, Sindh is situated on a receiving end of drainage of all the rivers and if flood protection measures adopted in the upper reaches are not properly planned, severe damages are likely to occur in the Province. A double line of flood embankments has been constructed on both sides of the river from Guddu to few kilometers short of Arabian Sea. These embankments have been further compartmentalized to contain widespread inundation.

Khyber Pakhtunkhwa

In Khyber Pakhtunkhwa, the floods are mainly due to flash flood flows in secondary rivers (Kabul, Swat, Punjkora, Kurrum etc.) and major hill torrents having steep bed

slopes, which greatly increase flood velocity and severely erode the banks. In Khyber Pakhtunkhwa, mostly the spurs have been constructed to save the areas from erosion. A battery of about 40 spurs and a Marginal Bund have been constructed along the right bank of Indus River downstream Chashma Barrage for protection of D.I. Khan City and adjoining area from devastating flood flows of Indus River. A large number of spurs and flood embankments in critical locations have also been constructed along Kabul, Swat, Panjkora, Kurrum rivers and flood flows generating nullahs/hill torrents.

Balochistan

Due to peculiar physiographic and climatic characterizes in Balochistan, mostly the flood embankments & short spurs have been constructed for protection of orchards, agricultural lands and abadies. Some bunds have also been constructed to serve as a flood diversion/abatement measures. Similar nature flood protection measures have been undertaken in Gilgit Baltistan, FATA and AJK for protection of abadies and adjoining agricultural lands from erosive action of rivers/flood flows generating nullahs.

1.4 Flood Protection Facilities & Irrigation Network of Pakistan

Five main rivers, namely, the Indus, Jhelum, Chenab, Ravi and Sutlej flow through the country's plains. The Indus (including the Kabul, Swat and Panjkora tributaries) Jhelum and Chenab are known as the **western rivers**, and the Ravi, Beas, and Sutlej known as the **eastern rivers**. Supplemented by a number of secondary rivers and streams, these rivers supply water to the entire Indus Basin Irrigation System. The rivers have their origin in the higher altitudes and derive their flows mainly from snowmelt and monsoon rains. The catchment area of Indus is most unique in the sense that it contains seven (7) of the world's highest-ranking peaks, after Mount Everest. These include **K-2 (28,253 feet)**, **Nanga Parbat (26,660 feet)**, **Rakaposhi (25,552 feet)** etc. Likewise, barring the polar areas, seven (7) glaciers situated in the Indus catchment, **namely Siachin, Hispar, Biafo, Batura, Baltoro, Barpu and Hopper** are amongst the largest in the world.

The Irrigation System of Pakistan is the largest integrated irrigation network in the world, serving 45 million acres of contiguous cultivated land. The system is fed by the waters of the Indus River and its tributaries. The irrigation network of Pakistan mainly comprises of 3 major reservoirs, 19 Barrages, 12 inter-river link canals, 45 independent irrigation canal commands and 143 large/medium dams (having height 15 meters and above).

The major storage reservoirs include Tarbela (existing Live Storage Capacity = 6.557 MAF against original storage capacity of 9.70 MAF), Chashma (existing Live Storage Capacity = 0.263 MAF against original storage capacity of 0.70 MAF) on River Indus and Mangla with existing Live Storage Capacity = 5.019 MAF (this includes the additional storage capacity after Mangla Dam Raising allowing Maximum Conservation Level of 1210 feet) against original storage capacity of 5.34 MAF on River Jhelum. The total length of main canals/distributaries and minors is about 64,000 Kilometers. Watercourses comprise another 1,621,000 Kilometers. The schematic diagram of Indus Basin Irrigation System is given at **Figure-I**.

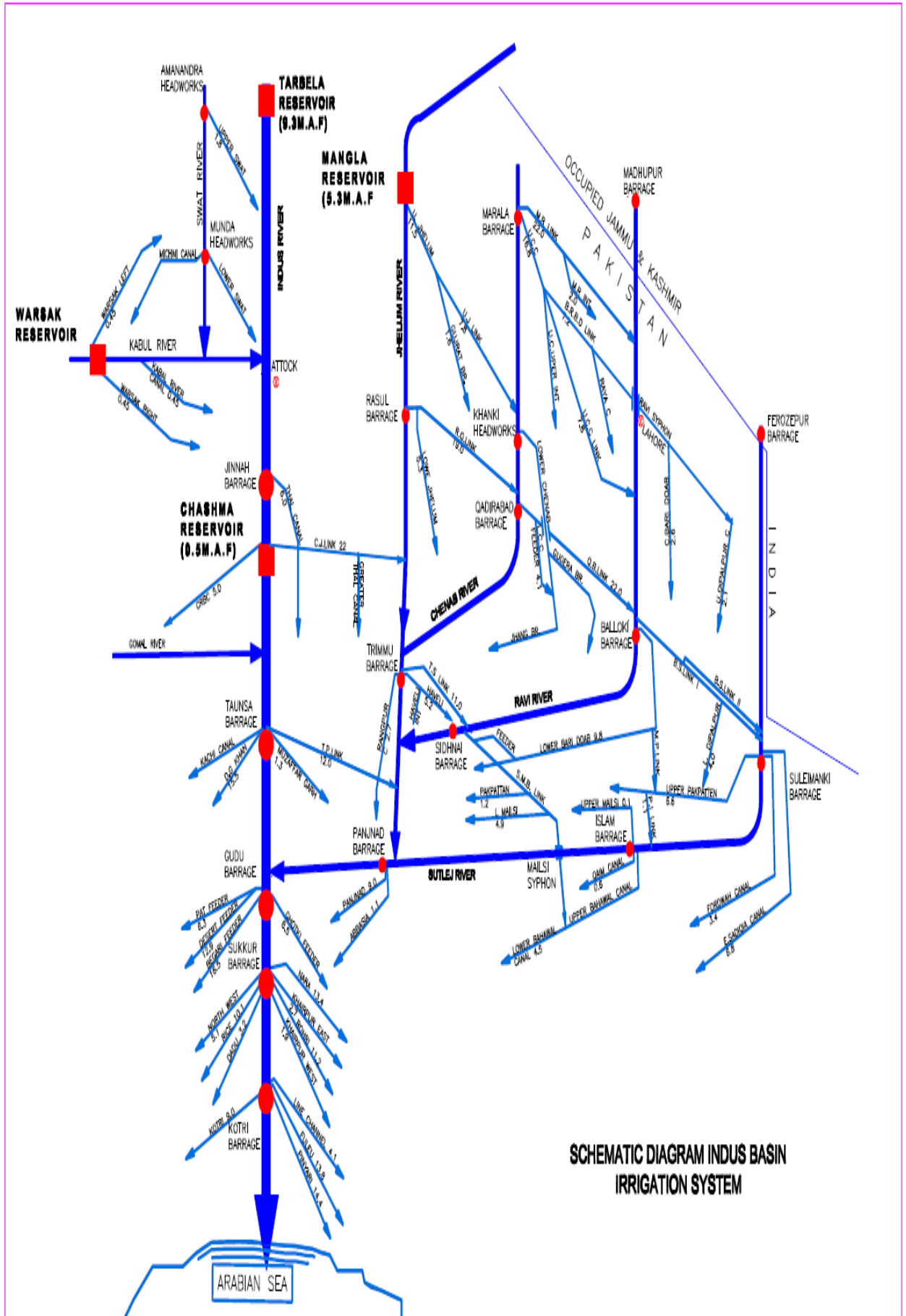
Diversion of river waters into off-taking canals is made through barrages, which are gated diversion weirs. The main canals in turn deliver water to branch canals, distributaries and minors. The watercourses get their share of water through outlets in the irrigation channels. Distribution of water from a watercourse is made through a time-schedule called "warabandi".

Average annual surface water availability is 139 MAF whereas the annual canal withdrawal is 102 MAF. Water availability at farm gate is 106 MAF comprising 62 MAF of surface water and 44 MAF of groundwater. Supplemented by an annual groundwater withdrawal of some 44 MAF, the average depth of water available at the farm gate is 3.07 feet per acre. Approximately 3 million individual farms with an average size of about 12 acres benefit from this system. Indus River System Authority (IRSA), created in consequence of 1991 Water Accord between the provinces, makes the inter-provincial water allocations.

The existing flood management strategy includes flood flows regulation by three major reservoirs (Tarbela, Chashma on Indus & Mangla on Jhelum), flood forecasting & early warning, protection of important infrastructure, and urban/rural areas by flood embankments and spurs etc. located along the rivers banks, besides, rescue and relief measures in case of flooding situation. The Provincial Irrigation Departments (PIDs) maintain about 6,807 km of flood protection embankments and around 1410 spurs along the rivers. Province-wise break up of existing flood protection infrastructure is given in **Table-1**.

Table-1
EXISTING FLOOD PROTECTION INFRASTRUCTURE

Name of Province	Embankments (KM)	Spurs (No)
Punjab	3,334	496
Sindh	2,424	46
Khyber Pakhtunkhwa	352	186
Balochistan	697	682
Total	6,807	1,410



SCHEMATIC DIAGRAM INDUS BASIN IRRIGATION SYSTEM

Figure 1: Schematic Diagram of Indus Basin Irrigation System

1.5 Impact of Global Warming/ Climate Change

Global Warming is emerging as a major drive of disasters, with frequent and intense floods and storms, increasing forced displacement as an extremely likely consequence. The world weather crisis that is causing floods in Pakistan, wildfires in Russia and landslides in China is evidence that global warming predictions are correct. According to climate change experts, all these disasters happened more or less simultaneously as the result of a global climate pattern, yet each was reported as a separate event and interpreted as though there was no connection.

According to the experts from World Climate Research Programme and the World Meteorological Organization (WMO), the climate change was a major contributing factor in this “unprecedented sequence of extreme weather in Pakistan” in months of July and August 2010. Scientists from Intergovernmental Panel on Climate Change (IPCC) warn that man-caused climate changes can contribute to those disasters happening more frequently. In 2007 report, a UN scientific body of the IPCC concluded that “it is very likely that hot extremes, heat waves and heavy precipitation events will continue to become more frequent.” IPCC also warns; “the floods of the kind that hit Pakistan may become more frequent and more intense in the future in the same region and other parts of the world”.

As per analysis of Dr. Qamar-uz-Zaman Chaudhry, Ex. Director General PMD/presently Advisor, Climate Affairs, Ministry of Defence, Government of Pakistan, regarding the extremely unprecedented intensity of monsoon rains in Sindh during 2011-Monsoon Season, if we look at the frequency and the trend of the extreme weather events impacting Pakistan then it would be easy to find its linkage with climate change. Further, the pattern of recent extreme weather events in Pakistan show clear indication of increased frequency and intensity of such events in Pakistan which is in line with the international climate change projections.

Dr. Qamar-uz-Zaman Chaudhry, who is also the lead author of the country’s National Climate Change Policy, concludes that Pakistan is heading for increased frequency and intensity of extreme weather events which includes frequent floods and droughts and we need to adapt and plan for that. According to Dr. Qamar, the total volume of water fallen over Sindh during the four weeks of monsoon season 2011 is estimated to be above 37 Million Acres Feet, which is unimaginable.

In the case of Pakistan, an enormous portion of the country’s farmland has been destroyed, along with much of its infrastructure, and this has taken place in an area that is so poor that people have little to fall back on. Pakistan is among the countries, which will be hit hardest by effects of climate change even though it contributes only a fraction to global warming. The severe droughts in 1999 and 2000 are the main examples that caused sharp declines in water tables and dried up wetlands, severely degrading ecosystems. Precipitation has decreased 10 to 15 % in the coastal belt and hyper-arid plains over the last 40 years while there is an increase in summer and winter rains in northern Pakistan.

1.6 Historical Flood Events in Pakistan

Since its creation, Pakistan has faced 19 severe flood event i.e. 1950, 1955, 1956, 1957, 1959, 1973, 1975, 1976, 1977, 1978, 19981, 1983, 1984, 1988, 1992, 1994, 1995, the worst ever floods of 2010 and unprecedented 2011 Rain/Urban flooding in Sindh Province. The floods of various magnitudes since 1950 to 2011 affected vast areas in the

four provinces including Gilgit-Baltistan, FATA & Azad Jammu & Kashmir. Flood damages are caused mainly due to riverine flooding in main rivers and flash floods in secondary and tertiary rivers including hill torrents, besides cyclone & urban flooding. The unprecedented floods of 2010 was the worst ever riverine floods in the history of the country in which about 1985 people lost their lives, 1,608,184 houses were damaged/destroyed, 17,553 villages were affected and a total area of 160,000 Sq.km was affected. In the recent years, vulnerabilities of urban flooding have increased. The Sindh province, particularly southeastern parts of the province was severely affected due to unprecedented rains during Monsoon Season-2011 and inadequate drainage facilities. The historical flood events experienced in the past are given in the **Table-2**.

Table-2

Sr. No.	Year	Direct losses (US\$ million)		Lost lives (No)	Affected villages (No)	Flooded area (Sq-km)
		@ 1US\$= PKR 40	@ 1US\$=PKR 86			
1	1950	227	488.05	2190	10000	17920
2	1955	176	378.4	679	6945	20480
3	1956	148	318.2	160	11609	74406
4	1957	140	301	83	4498	16003
5	1959	109	234.35	88	3902	10424
6	1973	2,388	5134.2	474	9719	41472
7	1975	318	683.7	126	8628	34931
8	1976	1,621	3485.15	425	18390	81920
9	1977	157	337.55	848	2185	4657
10	1978	1,036	2227.4	393	9199	30597
11	1981	139	298.85	82	2071	4191
12	1983	63	135.45	39	643	1882
13	1984	35	75.25	42	251	1093
14	1988	399	857.85	508	100	6144
15	1992	1,400	3010	1008	13208	38758
16	1994	392	842.8	431	1622	5568
17	1995	175	376.25	591	6852	16686
18	2010	-	10000	1985	17553	160000
19	2011	-	171.09*	516	38700	27581
	Total	8,923	29,355.54	10,668	166,075	594,713

*As received from PID Sindh. PID, Balochistan is reportedly compiling the damages reports, which will take some time. Damages details by rest of the Provinces/Federally Administrated Areas have not been reported, as no serious floods were experienced during monsoon season-2011.

1.7 Integrated Approach in Flood Management

Integrated flood management calls for a paradigm shift from the traditional, fragmented and localized approach, and encourages the use of the resources of a river basin as a whole, employing strategies to maintain or augment the productivity of floodplains, while at the same time providing protective measures against losses due to flooding.

In the past, floods were considered as a hydrological reality; only structural and non-structural measures were adopted to deal with this phenomenon, but now well-being of the people of the flood prone areas, their economic growth; and social urgency for alleviating poverty prevailing in these floods affected areas, are over riding concerns. Enough hard work is required to address these concerns from both national and regional perspectives. The regional approach is of particular significance as activities undertaken in one region may affect, positively or negatively, the extent of floods in the other regions, particularly the downstream ones.

There is a need for an approach to flood management that improves the functioning of the river basin as a whole, recognizing that floods have beneficial impacts and can never be fully controlled. Such an approach seeks to maximize the net benefits from the use of floodplains and to minimize loss of life, subordinating flood loss reduction to the overall goal of maximizing the efficient use of the floodplain. Therefore integrated flood management is a process that promotes an integrated, rather than fragmented, approach to flood management. It integrates land and water resources development in a river basin, within the context of integrated water resources management with a view to maximizing the efficient use of floodplains and to minimizing loss of life.

Integrated flood management plans should include drought management, and should take measures to maximize the positive aspects of floods such as by retaining a portion of flood flows for use of agriculture development. Urban flood plans must manage both storm-water quantity and the effects of storm water on water quality. Flood management needs to recognize, understand and account for linkages between upstream and downstream in order to realize synergies in improving river basin performance. Land-use planning and water management should be combined in one synthesized plan with a certain common field, such as the mapping of flood hazards and risks, to enable the sharing of information between land-use planning and water management authorities.

FEDERAL FLOOD COMMISSION

2. FEDERAL FLOOD COMMISSION

2.1 Historic Background

After creation of Pakistan in August 1947, a Central Engineering Authority was established to manage the issues of water, power and allied engineering matters at national level. It was re-designated as Chief Engineering Advisor's Office after the establishment of Water & Power Development Authority (WAPDA) in 1959.

Prior to 1976, the Provincial Governments were responsible for the planning and execution of flood protection works. Disastrous floods of 1973 and 1976 caused heavy loss of life and property and it was felt that the existing flood protection facilities and planning were inadequate to provide effective protective measures for the country. Heavy losses to the economy were discussed at the Inter-Provincial Conference held in 1977 and consequently, in January 1977, it was decided to establish Federal Flood Commission (FFC) for integrated flood management on country wide-basis.

2.2 Functions of Federal Flood Commission

The functions under the charter of duties for FFC, as given in para-2 of Resolution, dated 4th January, 1977, are as under:

- i. Preparation of National Flood Protection Plans (NFPPs);
- ii. Approval of flood control schemes prepared by Provincial Governments and concerned federal agencies;
- iii. Review of flood damages to flood protection infrastructure and review of plans for restoration and reconstruction works;
- iv. Measures for improvements in Flood Forecasting and Warning System;
- v. Standardization of designs and specifications for Flood Protection Works;
- vi. Evaluation and monitoring relating to progress of implementation of the National Flood Protection Plans (NFPPs);
- vii. Preparation of a research program for Flood Control and Protection; and
- viii. Recommendations regarding principles of regulation of reservoirs for flood control.

The provincial governments and federal line agencies undertake the implementation of the National Flood Protection Plans (NFPPs). The Federal Government, however, provides the resources for meeting the capital costs of projects under NFPPs.

2.3 Achievements of FFC

Since its establishment in 1977, FFC has so far executed three 10-Years National Flood Protection Plans covering periods from 1978-1988 (NFPP-I), 1988-1998 (NFPP-II) and 1998-2008 (NFPP-III). Brief details of projects executed under the three 10-Years Plans are given as under:

National Flood Protection Plan-I (1978-88):

Details of flood protection schemes executed through various programme/projects are given as under;

Normal/ Emergent Flood Programme:

- Expenditure incurred: Rs 1,630 million
- No. of flood protection schemes completed in the four Provinces, AJ&K, FATA & NA (now G-B): 350
- Source of Funding: 100% by GOP

Under NFPP-I, emphasis was mainly given on the implementation of structural flood protection measures. Pakistan Meteorological Department (PMD) and WAPDA carried out improvements/expansion in existing Flood Telemetry Network and Flood Forecasting & Warning System.

National Flood Protection Plan-II (1988-98):

Details of flood protection schemes/activities carried out through various programme/projects are given as under;

Normal/ Emergent Flood Programme:

- Expenditure incurred Rs 2,541 million
- No. of Schemes executed 170
- Source of funding 100% by GOP

Flood Protection Sector Project-I:

- Expenditure incurred Rs 4,860 million
- No. of flood protection schemes executed 257
- Co-financed by GOP & ADB ADB=80%
GOP = 20%

Prime Minister's River Management Programme 1994-1996

- Expenditure incurred Rs. 613.384 million
- No. of schemes executed (in Sindh & Punjab) 10
- Source of Funding 100% by GOP

Under NFPP-II, the following activities were undertaken for improvement of Country's existing Flood Forecasting & Warning System;

- Procurement & installation of Meteoroburst Telecommunication System (Phase-I) including one Master Station and 24 remote site stations.

- Installation of 10-CM Quantitative Precipitation Measurement (QPM) Weather Radar for Flood Forecasting Division (FFD) Lahore.
- Pre-feasibilities studies for four barrages for increasing their design discharge capacity to carry increased flood flows in view of 1992 floods.
- Preparation of Flood Plain Maps of Indus River (3-reaches).
- Establishment of National Flood Forecasting Bureau (NFFB) now FFD, Lahore.

National Flood Protection Plan – III (1998-2008):

Details of flood protection schemes/activities carried out through various programme/projects are given as under;

Normal/Emergent Flood Program:

- | | |
|--|------------------|
| • Expenditure incurred | Rs 3,415 million |
| • No. of flood protection schemes executed in four Provinces, AJ&K, FATA, ICT and NA (Now G-B) | 362 |
| • Source of Funding | 100% by GOP |

Second Flood Protection Sector Project:

- | | |
|--|---------------------------|
| • Expenditure incurred | Rs 4,165 million |
| • No. of Flood Protection Schemes executed | 101 |
| • Source of Funding | 80% by ADB,
20% by GOP |
| • Flood Forecasting & Warning System | Rs 432.123 million |

The major activities undertaken for improvement of country's existing Flood Forecasting & warning System include;

- Procurement & installation of 24 No. HF-Radio Sets, also some coverage to Kabul River & Swat River.
- Procurement & installation of 20 additional remote stations under existing Meteoroburst Telecommunication System (Phase-II);
- Upgradation of 10-CM Quantitative Precipitation Measurement Weather Radar installed in the premises of FFD, Lahore;
- Upgradation of 5.36-CM Sialkot Weather Radar into 10-CM Quantitative Precipitation Measurement Weather Radar;
- Procurement & installation of new 10-CM Quantitative Precipitation Measurement Weather Radar at Mangla;

- Development of initial/1st version of Computer Based Early Warning System through NESPAK, PMD & Delft Hydraulics, Flood Early Warning System;
- Expansion of Flood Plain Mapping activity covering remaining reaches of River Indus, alongwith rivers Jhelum, Chenab, Ravi, Sutlej etc.
- Bathymetric Survey and flow managements in the Indus River and its major tributaries (i.e. Sutlej, Ravi, Chenab and Jhelum) for improvements in the discharge rating curves and to collect data for FEWS Model & Flood Plain Mapping Activity.

Establishment of Flood Forecasting & Warning System for Lai Nullah Basin in Islamabad & Rawalpindi:

- Expenditure incurred: Rs 348 million
- Source of Funding;
 - *Japanese Grand –in-Aid* Rs 337 million
 - *GOP share* Rs 11.00 million
- Facilities provided include:
 - Two No. Telemetry rainfall gauging stations at Golra, Islamabad and Bokra, Islamabad;
 - Two No. water level gauging stations at Kattarian Bridge, Rawalpindi and Gawalmandi Bridge, Rawalpindi;
 - Master control station in PMD, Islamabad;
 - Two monitoring stations at FFC and TMA/Rescue-1122-Rawalpindi respectively;
 - Executive Warning Control room in Rawalpindi Fire Brigade , and
 - Nine (9) No. warning posts at various locations.

2.4 National Flood Protection Plan -IV and its Updation in view of 2010-floods

Keeping in view the level of investments made under the three 10-Year Plans i.e. (NFPP I, II & III), need and execution capability of the Provinces/Federal Line Agencies, the National Flood Protection Plan –IV worth Rs 30.00 billion was prepared in consultation with PIDs & Federal Line Agencies for execution of flood protection infrastructure (Civil Works) and procurement/installation of Flood Forecasting & Warning System equipment. The Plan was submitted to Ministry of Water and Power in November 2006, for approval of the Competent Authority. However, the same could not be considered due to low priority given to flood sector as result of drought like conditions over the country and funding constraints.

After experiencing 2010 floods in country, the need for investment in flood sector has gained importance. Therefore, the draft National Flood Protection Plan-IV (NFPP-IV) was reviewed in a high level meeting held on May 21, 2011 under the Chairmanship of Chief Engineering Adviser/ Chairman, Federal Flood Commission in his office at

Islamabad and it was decided that FFC will engage consultants for review and updation of draft NFPP-IV. For that purpose TORs for consultancy services were prepared in consultation with Provinces & Federal Line Agencies. FFC has accordingly prepared the PC-II for formulation of National Flood Protection Plain-IV (2012-22). The task is planned to be carried out within period of eight (8) months (March 2012 to October 2012). The PC-II has been submitted to Ministry of Water & Power for approval of DDWP. The overall objectives and scope as given in PC-II are to review the previous NFPPs and flood management documents and lessons learnt from major flood events occurred in the past in the country, especially 2010-Floods in entire country & 2011 Rains in Sindh Province and to formulate NFPP-IV for next 10 years based on an integrated and innovative approach.

Presently, the urgent nature flood protection works are being undertaken through GOP funded Normal/Emergent Flood Programme, which is funded through PSDP in order to meet the urgent needs of the Provinces and Federal Administered Areas.

2.5 Summary of GOP Investment on Flood Protection Works

The summary of federal investment on flood protection works since 1978 to June 2011 is given in Table 3.

Table 3
Summary of Federal Investment on Flood Protection Works

Flood Plans/ Programs	Location	No. of schemes	Expenditure (Rs Million)
NFPP-I (1978-88)	Countrywide	311	1,729.75
NFPP-II (1988-98)			
Normal/Emergent Flood Programme	Countrywide	170	805.33
First Flood Protection Sector Project (FPSP-I)	Four Provinces	256	4,735.29
Prime Minister's River Management Programme (1994-96)	Province of Punjab & Sindh	10	613.38
1988-Flood Damage Restoration Project	Four Provinces	2028	1,926.00
1992-Flood Damage Restoration Project	Countrywide	1980	6,659.22
NFPP-III (1998-2008)			
Normal/Emergent Flood Programme	Countrywide	362	4,192.35
Second Flood Protection Sector Project FPSP-II (1998-2007)	Four Provinces	101	4,165.00
Special Grant through President/ Chief Executive Directive (2000-2002)	Gilgit-Baltistan	21	92.80
Lai Nullah Flood Forecasting & Warning System <i>through Japanese Grant</i>	Distt. Rawalpindi (Punjab Province)	-	348.00
Normal/Emergent Flood Programme (2008-11)	All over the country	62	1,169.00
	Grand Total	5301	26,436.12

FLOOD MANAGEMENT MECHANISM

3. FLOOD MANAGEMENT MECHANISM

3.1 Organizations involved and responsibilities

Flood management is a multifunctional process involving a number of organizations. The Government Organizations which play major role in the flood management are the Provincial Irrigation Departments (PIDs), WAPDA, Provincial Relief Organizations, Pak Army, PCIW, Emergency Relief Cell (ERC) of the Cabinet Division, Federal Flood Commission (FFC), Flood Forecasting Division (FFD) and National Disaster Management Authority (NDMA)/ Provincial Disaster Management Authorities (PDMAs) and the District Administration. Functions of these organizations are briefly described hereinafter.

3.1.1 Provincial Irrigation Departments:

The Provincial Irrigation Departments (PIDs) play a front line role in flood management and mitigation. Major flood related functions include:

- i. Operation of Barrages and measurement of discharges at specific sites (Barrages) on rivers, canals and nullahs;
- ii. Planning, design, construction and maintenance of flood protection and River training works;
- iii. Running of data communication network to provide the river flow data to FFD, Lahore;
- iv. Supervision of operation of the Flood Warning Centre (on behalf of Relief Commissioner, D.G, respective provincial Disaster Management Authorities) to ensure timely dissemination of the flood forecasts/warnings;
- v. Director (Floods), PIDs, in his capacity as member FFD maintains close coordination with Chief Meteorologist FFD, Lahore for the issuance of flood forecasts/warnings;
- vi. Preparation & implementation of the flood fighting plans for monsoon period every year.

3.1.2 WAPDA

WAPDA is actively involved in the flood forecasting process as it provides river flows and rainfall data collected through telemetric system/gauge sites in the catchments of Indus and Jhelum rivers. The system is supplemented by meteor-burst communication system. WAPDA supports another hydrometric data measurement and transmission system through its Surface Water Hydrology Project.

WAPDA's telemetric network is directly linked to FFD, Lahore. WAPDA provides hydrometric flood data, as well as data from Tarbela, Chashma and Mangla dams. Coordination between FFD and WAPDA has considerably improved after the 1992-flood disaster. Daily meeting in the office of General Manager (Planning & Design) is held during flood season and suitable advice is given to Tarbela and Mangla Dam Flood Management Committees.

3.1.3 Provincial Relief Organizations/ Provincial Disaster Management Authorities:

Ultimate aim of flood warnings is to reduce the potential loss to the life and property of the community living in the flood liable areas. Provincial Relief Organizations (now Provincial Disaster Management Authorities) are responsible for disaster preparedness, emergency response and post disaster activities like formulation of the provincial disaster management policy, obtaining the approval of the Provincial Commission; coordination and monitoring of the implementation of the National Policy, National Plan and Provincial Plan; examine the vulnerability of different parts of the province to different disasters and specify prevention or mitigation measures; lay down guidelines to be followed for preparation of disaster management plans by the Provincial Department and District Authorities; evaluate preparedness at all governmental or non-governmental levels to respond to disaster and enhance preparedness; coordinate response in the event of disaster; give directions to any provincial department or authority regarding actions to be taken in response to disaster; and promote general education, awareness and community training etc. pertaining to all disasters including floods. Relief functions at the District and Tehsil level are now performed through the District Disaster Management Authorities, who coordinate with the other departments to execute the disaster management functions at the district level.

3.1.4 Pak Army:

Pak Army's Corps of Engineers under the command and control of Engineer-in-Chief (E-N-C) is charged with the responsibility to provide necessary help to the civil authorities to carry out the rescue and relief operations during and after the floods. It is the responsibility of the Provincial Governments to provide all the support equipment (boats, life jackets, vehicles, tents etc) to the Army for such operations.

Pakistan Army's flood related functions encompass all the three phases of flood operations from the pre-flood to post flood phases including the important flood phase. Pre-flood phase is the flood preparatory phase during which the adequacy and the serviceability of the flood fighting equipment is ensured. Pre-flood meetings are held at the E-IN-C to coordinate activities with other organizations/agencies in providing the required support to the Pak Army. Pre-flood inspections of the flood protection structures are also carried out by the respective commander corps of engineers for their respective areas to ensure that the structures (bunds, barrages, spurs etc.) are in satisfactory state of maintenance. Deficiencies, if any, are brought to the notice of the Relief Commissioner and PIDs. Availability of sufficient stock of explosives is ensured to activate the breaching sections, whenever required.

An officer of the 4 Corps Engineers is placed on duty in the Flood Warning Centre, Lahore, to keep a close watch on the flood situation. All flood forecasts and warnings are communicated to the CC Engineers 4 Corps in time to be transmitted to the D.G. Engineers and all other CC Corps of the Engineers. In the event of floods, units of the Army move out to their respective areas of responsibility and carry out the relief and rescue operations in coordination with the respective civil administration. A post flood meeting is held under the chairmanship of E-IN-C to discuss the performance of all the flood related agencies with the view to bring about the necessary improvement in future.

3.1.5 Pakistan Commissioner for Indus Waters (P.C.I.W)

Pakistan has a unique flood-forecasting problem in the sense that greater part of the flood generating in upper catchments of Rivers Sutlej, Ravi, Jhelum and Chenab lie across the border in India/held Kashmir. A number of water storage reservoirs have been constructed over the rivers across the border. As a result, the free flood flow conditions are disrupted making the operation of the rainfall/runoff model extremely difficult. The situation underlines the need for the acquisition of rivers flow data from across the border in respect of important sites over the rivers in India/held Kashmir. Consequently, an agreement had been signed between the two countries in 1989 through their respective Commissioners for Indus Waters, which includes provision to share river discharges data with India such rivers flow and rain data as is considered important for flood forecasting in Pakistan. A number of river flow stations are specified for this purpose.

The Pakistan Commissioner for Indus Waters receives the data normally once in a day. The data is then passed on to the FFD, Lahore. Frequency of data reception is increased to six hourly and even to hourly in case of severe flood situation. Pakistan Commissioner for Indus Waters is thus responsible to provide to the Chief Meteorologist, FFD, Lahore, the much-needed data obtained from India for use in the flood forecasting models to ensure accurate forecasts for Rivers Sutlej, Ravi, Jhelum & Chenab. Pakistan Commissioner for Indus Waters is the only forum through which any clarification or further information can be obtained from India with regard to flood flows data or the flood control structures in India.

3.1.6 Emergency Relief Cell (ERC), Cabinet Division

Emergency Relief Cell (ERC) exists under the Cabinet Division and is controlled by the Cabinet Division. The Cell is headed by the Director General. The main functions of the Emergency Relief Cell include:

- Planning and assessment of relief requirements for major disasters;
- Stock piling of basic need items during emergency such as dry ration, tents, blankets etc;
- Establishing emergency fund upon declaration of any part of the country as calamity affected; and
- Maintaining contact with UNO and its related organizations, besides other international aid giving agencies

3.1.7 FFC and its Role in Flood Management/Mitigation

Since its establishment in 1977, FFC has prepared three National Flood Protection Plans i.e. NFPP-I, II&III and implemented through PIDs & Federal Line Agencies. The Plans envisaged both structural as well as the non-structural measures. Structural measures include construction of flood embankments, spurs and river training works, whereas non-structural measures mainly pertain to establishment of a modernized Flood Forecasting & Warning System to provide timely and reliable weather/flood information to the organizations dealing with flood management and general public as well. One big step towards this end is installation of 10 CM QPM Doppler Weather Radar one each at FFD,

Lahore and Mangla, besides up-gradation of Weather Radar at Sialkot to afford the acquisition of the much needed rainfall data of Rivers Sutlej, Beas, Ravi, Chenab and Jhelum upper catchments lying across the border through the process of remote sensing. The other important step is the development of improved flood forecasting models i.e. Flood Early Warning System Model (FEWS Model) for FFD, Lahore. Improvement in measurement and transmission of the hydrometric data based upon the meteor-burst a physically based model accounting for the hydro dynamical changes in the flood wave. The model calls for the survey of the channel geometry to determine the channel parameters at suitable intervals of the channel length. It has, therefore, built-in discharge/elevation relationship, which should readily yield the flood levels at any point along the channels. This is of great advantage in the area of flood warning since it allows the estimation of the areas of inundation along the channel. In turn Flood inundation maps (Flood Plain Mapping) have been prepared to facilitate the identification of the villages and other public & private property and installation, which may likely to inundate at certain flood flow stage, so as to make them safe against that magnitude of floods. All that can be determined on the basis of Hydrodynamic model. The existing Flood Telemetry and Meteorburst Communication Systems of WAPDA have also been considerably improved and expanded.

A large number of flood protection works, i.e. 6803 km of embankments and 1410 spurs have so far been executed through Provincial Irrigation Departments and Federal Line Agencies through financial and technical support provided by GOP and foreign donor agencies.

Establishment of Flood Communication during Flood Season

During flood season, each year, Flood Communication Cell of Federal Flood Commission remains in operation on round-the-clock basis for the entire flood season (July 01 to October 31) and Daily Flood Situation Report is issued to all concerned.

The main objective of the Flood Communication Cell is to obtain information from the Flood Forecasting Division (FFD), Lahore, and other Flood Warning Centers set up in the Provincial Headquarters. Also data relating to river discharges at RIM stations and other important control points and information with regard to rainfall at important stations, besides flood flows data of Eastern Rivers is received through PCIW. Besides this, duty staff (for round-the-clock collection of data), alongwith one officer remains available during all working days as well as on Sundays and National Holidays for collection of necessary information regarding rain/flood damages and flood-damaged bunds/ breaches.

Chairman FFC also sends reports to the President and the Prime Minister Secretariat as and when the situation demands. A Daily Flood Situation Report on Weather & River Discharges as received from FFD, Lahore is prepared and issued to important Government officials on daily basis during the flood season every year containing the following:

- i. Actual rivers flood flows position of major rivers in a tabular form;
- ii. Prevailing weather system situation;
- iii. Concise forecast relating to the movement of various weather systems and river flow condition for the next 24 hours including likely inundation /flooding of nullahs etc. as received from PMD/FFD, Lahore.

- iv. Damage details in the event of flood emergency in a certain area. In case of exceptionally High Flood Stage/emergency situation, special Advisory on Weather & Rivers flood flows position is issued on six hourly basis.

3.1.8 Flood Forecasting Division (FFD), Lahore

FFD, Lahore, of the Pakistan Meteorological Department plays a pivotal role in the flood forecasting & warning process. Hydro meteorological data from the various national and international sources is received in this Division, which is then analyzed to produce flood forecasts and warnings and disseminated to various Federal/Provincial organizations and print/electronic media. Major responsibilities of FF, Lahore prior, during & after flood season are summarized as under:

- i. Ensure serviceability of the meteorological equipment including QPM radars (Lahore, Mangla & Sialkot, Tele-printer Network, FAX, APT and Internet.
- ii. Ensure availability of the following items in sufficient quantity to last for the whole of the flood season:
 - Surface and upper air meteorological charts;
 - Iso-hyetal maps;
 - Various forecast forms;
 - Data tabulation sheets; and
 - Stationery etc.
- iii. Update the calibration of radars and flood forecasting models;
- iv. Ensure availability of sufficient staff strength to maintain round-the-clock roster of duties for the meteorological and hydrological work;
- v. Liaison with PTCL's Coordination Officer to provide 24 hours maintenance services for the tele-printers, internet and the office and residential telephones of all the flood related functionaries; and
- vi. Conduct a familiarization training of the senior cadre and junior cadre Govt. functionaries involved in the process of flood mitigation. Senior cadre training may be limited to one day only and must include such functionaries as the Relief Commissioner, Director General (Relief), Chief Engineer Hydrology, WAPDA, Chief Engineer, FFC, Chief Engineer, Hydrology & Drainage, PIDA, Director Flood PIDA, Director PDMA.

3.1.9 National Disaster Management Authority (NDMA)

Government of Pakistan had embarked upon establishing appropriate policy to minimize risks and vulnerabilities and passed NDMA ordinance 2006. National Disaster Management Authority (NDMA) has been established to serve as the focal point and coordinating body to facilitate implementation of disaster risk management strategies. This necessitates NDMA to directly interact/ communicate with all stakeholders, including Ministries, Divisions, and Departments in relaxation to normal communication channel.

NDMA is an expedient to provide for an effective national disaster management system and for matters connected therewith and incidental thereto. As per National Disaster management Authority Act-2010, the main functions of NDMA are as under:

- i. Act as implementing, coordinating and monitoring body for disaster management;
- ii. Prepare the National Plan to be approved by the National Disaster Management Commission;
- iii. Implement, coordinate and monitor the implementation of the national policy;
- iv. Lay down guidelines for preparing Disaster Management Plans by different ministries or departments and the provincial authorities;
- v. Provide necessary technical assistance to the provincial government and provincial authorities for preparing their Disaster Management Plans in accordance with the guidelines laid down by the National Disaster Management Commission;
- vi. Coordinate response in the event of any threatening disaster situation or disaster;
- vii. Lay down guidelines for or give directions to the concerned ministries or provincial governments and provincial authorities regarding measures to be taken by them to response to any threatening disaster situation or disaster;
- viii. For any specific purpose or for general assistance requisition the services of any person and such person shall be co-opted as member and exercise such power as conferred upon him by the authority in writing;
- ix. Promote general education and awareness in relation to disaster management;
- x. Perform such other functions as the National Disaster Management Commission may require to perform.

3.2 Flood Warning Dissemination System:

Monsoon Season normally starts each year in 1st week of July and ends in last week of September. Sometimes, it prolongs upto mid October. However, the Flood Warning Centers of all flood forecasting & warning related agencies start functioning from 15th June every year for data collection and keep continue upto 15th October. During this period effective interaction and communication between various floods related provincial as well as federal departments/agencies is maintained on round-the-clock basis in order to counter any eventuality due to monsoon rains/floods.

The earlier weaknesses in the flood warning dissemination system called for the following remedial actions: -

- i. Police communication system (for the reception of flood data and the dissemination of flood forecasts/warnings) be replaced with some advanced automatic data communication system. However, until such a system becomes available the police operators posted on flood duties be given some training to enable detection of simple data errors and also to understand the urgency and importance of timely communication of data and flood forecast.
- ii. Dissemination of the flood/warning at least to the important recipients be done by the Flood Forecasting Centre to ensure timely dissemination under the overall supervision of the Chief Meteorologist, FFD, Lahore.

- iii. Some mechanism to ensure proper coordination between the various departments/agencies involved in the flood mitigation/management process be established. This may be done by an authority having the full legal jurisdiction over all the concerned agencies.

The problems and the possible remedies were frequently discussed in flood meetings at Provincial and Federal Government levels. As a result of such efforts the earlier flood warning dissemination system underwent gradual changes as reflected in the system currently in vogue. Salient features of current flood warning dissemination system are as follows:

- i. Pre-flood familiarization training has been started since the last few years to acquaint the newly inducted people of Irrigation and WAPDA with the commonly used hydromet terms.
- ii. Flood Forecasting Bureau, Lahore has been re-designated as the Flood Forecasting Division, Lahore.
- iii. FFD, Lahore has taken in hand the dissemination of flood forecasts/warnings to considerably large number of recipients directly or indirectly concerned with the flood mitigation process, over and above the dissemination being done by FWC.
- iv. Press briefings/issuance of Press Release has been started in the office of Chief Meteorologist at FFD, Lahore as a regular feature to ensure correct and authentic flood and weather information to the public. Such briefings are arranged through the representative of the Punjab Information Department on duty at the FWC, only when the flood situation is or is likely to become serious enough to call for such briefings.

The significant improvement has been made in the dissemination system since the time that it was initially started. Most of the discrepancies stated above have been removed. A much better coordination now exists with WAPDA as regular meetings or verbal advice is given by Chief Meteorologist, FFD, Lahore, to General Manager (Planning & Coordination) WAPDA.

The existing dissemination process has been reviewed and lists of the recipients of flood information have been streamlined. Basically, there are two types of flood information required to be provided for use by the appropriate recipients i.e. (i) the flood forecasts and (ii) the flood data. The flood forecasts are disseminated by FFD, Lahore/FWC, whereas the flood data is disseminated by the FWC itself.

3.3 Pre-Flood Meetings:

A number of pre-flood meetings are organized annually by the concerned flood management organizations, i.e. Pak Army, NDMA, and Ministry of Water & Power/FFC to review the status of preparedness and Flood Fighting Plans/arrangements of concerned organizations. The following pre-flood meetings were held in 2011:

- i. Pak Army Pre-Flood Coordination Conference was held on May 19, 2011 at Engineers Directorate, GHQ Rawalpindi, which was attended by the Commanders of concerned Army formations, FFC, NDMA, PMD, WAPDA etc. The Flood Preparedness Plans were reviewed;

- ii. 5th Pre-Monsoon Coordination Meeting of NDMA was held on June 15, 2011 to assess preparedness, response and recovery capacity of Federal and Provincial Departments;
- iii. First Pre-Flood meeting of Federal Flood Commission was held on May 02, 2011 under the Chairmanship of Honorable Federal Minister for Water & Power, wherein it was emphasized that Provinces & Federal Line Agencies would put all out efforts to speed up the physical progress and complete all mid-term restoration works by/before June 30, 2011 i.e. well before the start of monsoon season-2011. Provinces & Federal Line Agencies were also advised that they must adopt all pre-emptive measures, as recommended by Federal Flood Commission, in order to avert possible damages in case of un-expected rainfalls and floods during monsoon season 2011. The directions given to PIDs/ Federal Line Agencies & WAPDA are given under **Section 5.2**.
- iv. 46th Annual/ 2nd Pre-Flood Meeting of Federal Flood Commission was organized on June 30, 2011, under the Chairmanship of Honourable Federal Minister for Water & Power, to review the status of preparedness of concerned Federal/Provincial Government organizations and arrangements made for safe passage of Flood Season-2011. The directions given to PIDs/ Federal Line Agencies, WAPDA, PMD & NDMA are given under **Section 5.3**.

FLOODS-2011

4. MONSOON SEASON 2011

4.1 Seasonal Rainfall Forecast for Monsoon Season 2011 issued by PMD

Pakistan Meteorological Department predicted **Normal** monsoon rains during the period from July to September 2011. The official prediction of seasonal monsoon rainfall by Pakistan Meteorological Department, issued on 13th June, 2011, is reproduced hereunder;

“Pakistan Summer Monsoon rainfall is invariably affected by the global, regional and local climatic conditions prevailing prior to the season. Analysis of their combined effect indicates that total amount of rainfall averaged over Pakistan during monsoon season (July – September) 2011 will remain 10% below normal”.

However, there are chances of about 10% above normal rainfall in northern parts of Pakistan including Punjab, Khyber Pakhtunkhwa provinces and Kashmir. At occasions, the interaction of easterly and westerly systems may result in heavy downpour causing localized urban/flash flooding. This outlook is prepared at 80% confidence interval and meant for the planning purpose. The area weighted normal rainfall of Pakistan for monsoon season is 137.5 million.

4.2 Floods/Rains 2011

The catchment areas of main rivers of the country did not receive heavy precipitation during Monsoon Season 2011, hence, none of the major rivers attained danger flood level. That is why no serious riverine flooding was observed during 2011-Flood Season. However, the torrential monsoon rains of 2011 hit the Sindh Province, especially the southeastern parts of the province, which were historical events of about 150 years return period. The rains started in August and continued till mid September with short intervals. The first spell of heavy rainfall started from 10th August and continued till 17th August 2011 with short intervals, which caused more than 300 mm precipitation in Districts Badin, Mirpurkhas, Hyderabad, Tando Muhammad Khan, Shaheed Benazirabad (Nawabshah) & Sanghar, generated runoff of more than 14000 cusecs in LBOD System against its designed discharge capacity of 4440 cusecs. Average rainfall recorded was 8-10 times more than the land drainage capacity of LBOD & Kotri Barrage Drainage System.

The 2nd spell of monsoon rains started from 29th August 2011, which caused averagely 200 mm and in some areas more than 400 mm rains were recorded. The cumulative rainfall recorded in the region was averagely 600 mm. The LBOD System (already flowing full) attained its maximum levels and overtopped at several locations, which badly affected the abadies, standing crops, private and public infrastructure of Districts Mirpurkhas, Badin, Shaheed Benazirabad (Nawabshah), Sanghar, Tando Muhammad Khan, Umerkot, Tharparker, Tando Allyar and adjoin areas. As the land was already saturated, hence, the 2nd spell rains caused more damages to abadies, private & public infrastructure, besides standing crops. The continued rains created flood like situation in the entire lower parts of Sindh.

2011-rains/floods affected

The rains/floods affected an area of about 6.812 million acres (23 Districts in Sindh, 12 in Punjab & 1 in AJK) affecting 38,700 villages, claiming about 516 lives, damaging 1,598,629 houses & cropped area of about 2.311 million acres and population of about

9.303 million has been affected. Irrigation & Power Department, Government of Sindh with the help of donor agency (Asian Development Bank) has estimated damages occurred to irrigation, drainage & flood protection infrastructure and their restoration/reconstruction cost as Rs 6.00 billion. Irrigation & Power Department, Government of Sindh has evolved strategy for restoration/rehabilitation & improvement works in the following two (2) categories;

Emergent Nature Restoration Works:

The following activities have been planned to be carried out before start of Monsoon Season 2012;

- Procurement of earth moving machinery under Chinese Loan worth US \$ 32 Million and Provincial Share of Rs 1.60 Million;
- Restoration of Existing main drains & sub-drains including rehabilitation of banks;
- Re-sectioning of Dhoro Puran & rehabilitation of banks including removal of encroachments near Jhudo Town;
- Bank protection with stone pitching of vulnerable sections, bridges & crossings;
- Construction of Temporary pumping station to drain out rain/storm water from stagnant areas;
- Identification of encroachments along existing Dhoras and their removal;
- Identification of obstacles along road network and railways crossings etc.
- Engagement of Consultants & detailed design works for Master Planning as Long-Term Measures.

Long-term Measures:

- Remodeling & enhancing the discharge capacity of existing drainage network on the basis of 20 years frequency period;
- Construction of additional drains including towns/cities to discharge into existing Dhoras;
- Construction of an independent natural Dhoras Network & Syphons across Main Drain for diversion of flows into Dhoro Puran (Shakoor Dhand) in order to off-load LBOD System.
- Construction of out-fall structure along KPOD to control tidal impact and sea water intrusion.
- Remodeling of weirs and increasing size of inlets and culverts etc.
- Diversion of storm-water to Dhands of Thar desert such as Kakao, Kalankar and abandoned Dhoro Puran and like others.

- Identification of natural depressions, their strengthening and construction of raised plat forms to settle displaced people.
- Other essential necessary works.

4.3 Hydro-Metrological Causes of 2011-Rains/ Floods

During Monsoon Season 2011, the Area Weighted Rainfall all over the country was recorded as 236.5 mm against the Normal figure of 137.5 mm (72% increase). Sindh Received 444 mm against the average/normal rainfall of 127.5 mm. Punjab experienced 349 mm rainfall against the average normal figure of 236 mm. Similarly, Khyber Pakhtunkhwa got 249 mm rainfall against the average normal rainfall of 225 mm, whereas Balochistan received averagely 82 mm rains against average figure of 59 mm. In the month of July, 2011, the country received below normal monsoon rains. However, in 2nd week of August a strong weather system entered in the southeastern parts of Sindh Province from the Indian states of Rajasthan and Gujarat and gained further strength with the passage of time, which caused heavy downpours. The four weeks of continuous rains created severe flood situation in Sindh, especially southeastern parts of the province.

The abadies, private & public property and standing crops in Sindh province were badly damaged. The unprecedented monsoon rains from 10th August to 2nd September 2011 caused loss of human lives, standing crops, houses, infrastructure, etc. The highest ever recorded monsoon rains in Sindh displaced hundred thousands of people, besides destroying million of acres of cropped land. The District Badin received record breaking rainfall of 615 millimeters during the monsoon spell breaking earlier recorded 121 millimeters in Badin in 1936. The area of Mithi also received record rainfall of 1,290 millimeters against the previous maximum rainfall of 114 millimeters in 2004. The heavy rainfalls recorded in Sindh province in the months of August and September 2011 are given in **Table-4**.

Table-4
Torrential rainfall recorded in August & September, 2011 in Sindh

City	Rainfall in mm		
	August 2011	September 2011	Total
Mithi	530*	760*	1290*
Mirpur Khas	263.1*	603*	866.1*
Shaheed Benazirabad	275.2*	353.2*	628.4*
Badin	331.2*	284.1	615.3*
Chhor	276	268	544*
Dadu	134.1	348.1	482.2*
Padidan	251.2	172	423.2*
Hyderabad	162.2	244.2	406.4
Karachi	61.2	212.2	273.3

* Indicates new record.

Source: PMD

4.4 Overall Assessment of 2011-Monsoon Season

According to Pakistan Meteorological Department, 2011-Monsoon rainfall, over province of Sindh, was 248 % above normal, which was the heaviest, recorded during the period 1961–2011. However, no significant flood situation was experienced in the major rivers during 2011-Monsoon season. The maximum discharge experienced by River Indus was at Chashma i.e. 356,500 cusecs (on 28.7.2011), which is a Low Flood Stage. River

Jhelum experienced a maximum discharge of 141,300 cusecs (on 16.9.2011) at Mangla, River Chenab 171,400 cusecs (on 17.9.2011) at Khanki, River Ravi 72,100 cusecs (on 15.8.2011) at Balloki and River Sutlej 82,000 (on 29.8.2011) at Suleimanki respectively. Highest ever recorded flood peaks during major flood events at various control points Indus Basin are given in **Table 5**.

Table-5
Major Flood Events & Historic Flood Peaks Recorded in Major Rivers

Dam/ Barrage Site	Designed Capacity	Highest Recorded		1973 Peak Date	1976 Peak Date	1988 Peak Date	1992 Peak Date	2010 Peak [^] Date	2011-Peak [^] Date
		Year	Flow in Cfs						
Indus River									
Tarbela Reservoir	1,500,000	1929	8,75,000	<u>420,000</u> July 1973	<u>304,000</u> 3.8.76	<u>450,000</u> 4.8.88	<u>500,000</u> 10.9.92	<u>833,000</u> 30.7.10	<u>272,200</u> 28.6.11
Jinnah Barrage	950,000	1942	950,000	<u>564,000</u> 20.7.73	<u>862,000</u> 2.8.76	<u>605,000</u> 2.8.88	<u>849,245</u> 10.9.92	<u>937,453</u> 30.7.10	<u>293,900</u> 26.7.11
Chashma Barrage	950,000	1958	950,000	<u>510,000</u> 22.7.73	<u>787,000</u> 3.8.76	<u>580,000</u> 3.8.88	<u>668,000</u> 11.8.92	<u>1,036,673</u> 1.8.10	<u>356,500</u> 28.7.11
Taunsa Barrage	1,000,000	1958	789,000	<u>568,000</u> 29.7.73	<u>675,000</u> 7.8.76	<u>560,000</u> 28.7.88	<u>655,000</u> 14.9.92	<u>959,991</u> 2.8.10	<u>249,200</u> 31.8.11
Guddu Barrage	1,100,000	1976	1,176,000	<u>1,084,000</u> 18.8.73	<u>1,199,000</u> 15.8.76	<u>1,163,000</u> 30.7.88	<u>1,087,000</u> 18.9.92	<u>1,148,738[*]</u> 8.8.10	<u>272,300</u> 3.9.11
Sukkur Barrage	900,000	1976	1,161,000	<u>1,077,000</u> 21.8.73	<u>1,161,000</u> 16.8.76	<u>1,119,000</u> 31.7.88	<u>1,068,000</u> 20.9.92	<u>1,130,995[*]</u> 10.8.10	<u>260,800</u> 6.9.11
Kotri Barrage	875,000	1956	980,000	<u>786,000</u> Aug 1973	<u>765,000</u> Aug 1976	<u>648,290</u> 11.8.88	<u>689,300</u> 30.9.92	<u>964,900</u> 27.8.10	<u>261,400</u> 14.9.11
Jhelum River									
Mangla Reservoir	1,230,000	1929	1,100,000	<u>2,20,000</u> 9.8.73	<u>480,060</u> 3.8.76	<u>425,515</u> 16.7.88	<u>1,030,000</u> 10.9.92	<u>344,400</u> 30.7.10	<u>141,300</u> 16.9.11
Rasul Barrage	8,50,000	1929	1,000,000	<u>2,70,000</u> 9.8.73	<u>2,69,000</u> 4.8.76	<u>261,664</u> 17.7.88	<u>952,170</u> 10.9.92	<u>263,796</u> 30.7.10	<u>105,800</u> 17.9.11
Chenab River									
Marala Barrage	1,100,000	1957	1,100,000	<u>770,000</u> 9.8.73	<u>549,000</u> 1.8.76	<u>751,000</u> 25.9.88	<u>845,000</u> 10.9.92	<u>314,378</u> 6.8.10	<u>150,400</u> 16.9.11
Khanki Barrage	8,00,000	1957	1,066,000	<u>1,000,000</u> 10.8.73	<u>615,000</u> 2.8.76	<u>864,000</u> 26.9.88	<u>910,500</u> 10.9.92	<u>334,437</u> 7.8.10	<u>171,400</u> 17.9.11
Qadirabad Barrage	9,00,000	1992	9,50,000	<u>854,000</u> 10.8.73	<u>629,000</u> 2.8.76	<u>892,000</u> 26.9.88	<u>948,530</u> 11.9.92	<u>329,483</u> 7.8.10	<u>171,000</u> 17.9.11
Trimmu Barrage	6,50,000	1959	9,43,000	<u>753,000</u> 12.8.73	<u>706,000</u> 10.8.76	<u>584,000</u> 19.7.88	<u>888,000</u> 14.9.92	<u>328,926</u> 11.8.10	<u>132,900</u> 20.9.11
Panjnad Headworks	7,00,000	1992	8,10,000	<u>803,000</u> 17.8.73	<u>710,000</u> 12.8.76	<u>507,000</u> 27.7.88	<u>744,152</u> 18.08.92	<u>310,117</u> 13.8.10	<u>151,300</u> 24.9.11
Ravi River									
Jassar	-	1988	5,82,000	<u>228,000</u> 10.8.73	<u>170,000</u> 9.8.76	<u>122,000</u> 25.9.88	<u>149,000</u> 11.9.92	<u>195,000</u> 23.8.10	<u>27,700</u> 19.9.11
Shahdara	-	1988	5,76,000	<u>237,380</u> 11.8.73	<u>170,000</u> 10.8.76	<u>576,000</u> 27.9.88	<u>63,000</u> 12.9.92	<u>41,900</u> 21.8.10	<u>43,000</u> 14.8.11
Balloki Barrage	2,25,000	1988	3,99,000	<u>2,44,000</u> 13.8.73	<u>234,000</u> 11.8.76	<u>399,000</u> 28.9.88	<u>112,157</u> 13.9.92	<u>69,900</u> 23.8.10	<u>72,100</u> 15.8.11
Sidhna Barrage	1,75,000	1988	3,25,000	<u>2,10,000</u> 18.8.73	<u>244,000</u> 15.8.76	<u>330,000</u> 2.10.88	<u>95,500</u> 16.9.92	<u>27,600</u> 28.7.10	<u>30,300</u> 19.8.11
Sutlej River									
Suleimanki Headworks	3,25,000	1955	5,97,000	<u>177,000</u> 15.8.73	<u>119,000</u> 6.9.76	<u>399,000</u> 30.9.88	<u>197,000</u> 3.9.92	<u>58,300</u> 30.9.10	<u>82,000</u> 29.8.11
Islam Headworks	3,00,000	1955	4,93,000	<u>166,000</u> 17.8.73	<u>111,000</u> 8.9.76	<u>306,000</u> 4.10.88	<u>183,000</u> 7.9.92	<u>31,500</u> 20.9.10	<u>49,600</u> 3.9.11

* It does not include flood flows passed through breaches occurred in LMB Guddu Barrage.

** It does not include flood flows passed through breaches occurred in Tori Flood Bund.

[^] Based on the Inflows experienced upstream of the Dam/ Barrage site.

4.5 Country-Wide Losses/Damages due to 2011 Rains/Floods

The 2011-rains/floods affected an area of about 6.812 million acres (23 Districts in Sindh, 12 in Punjab & 1 in AJK) affecting 38,700 villages, claiming about 516 lives, damaging 1,598,629 houses & cropped area of about 2.311 million acres and population of about 9.303 million has been affected. Province wise detail of losses/damages is given in

Table-6. District-wise detail of flood damages caused due to 2011 Rains/Floods in Sindh Province is also given in **Table-7**.

Table-6
COUNTRY-WIDE LOSSES/DAMAGES DUE TO RAIN/FLOOD 2011

Province/ Region	Villages Affected	Persons Affected	Area Affected (Acres)	Cropped Area Affected (Acres)	Houses Damaged	Persons Died	Persons Injured	Cattle Heads Perished
Punjab	335	26393	136758	125513	1284	4	17	Nil
Sindh	38347	9275568	6674859	2184951	1596807	497	753	116529
Khyber Pakhtunkhwa	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Balochistan	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
FATA	15	671	439	310	534	3	Nil	1209
Gilgit-Baltistan	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
AJ & K	3	170	4	Nil	4	12	Nil	Nil
G. Total	38700	9302802	6812060	2310774	1598629	516	770	117738

Table-7
LOSSES/DAMAGES IN SINDH PROVINCE DUE TO RAIN/FLOOD 2011

District	Villages Affected	Persons Affected	Area Affected (Acres)	Cropped Area Affected (Acres)	Houses Damaged	Persons Died	Persons Injured	Cattle Heads Perished
T.M Khan	2835	585411	390997	78038	72935	17	24	187
Sh. Benazir Abad	4104	900000	-	290000	200000	41	82	22646
T. Allahyar	1609	569829	369685	81645	70163	3	5	197
Mirpur Khas	3178	705151	819833	171522	118110	61	230	12280
Thatta	901	178011	225738	64293	15693	23	15	131
Hyderabad	681	377992	113333	26227	20644	17	27	32
Badin	6395	1021301	984805	375,718	382562	73	10	10060
Matiali	415	109629	160970	83739	32803	25	28	1101
Umerkot	3769	821,581	927966	108303	122103	31	7	18824
Tharparker	2284	907179	51782	12647	178356	28	9	30623
Shikarpur	0	0	0	20218	0		0	0
Khairpur	2075	384137	323924	182891	29023	25	65	327
Dadu	1454	325000	187811	97,248	18594	19	51	161
Jamshoro	614	97350	30,086	39,133	43950	16	11	83
Sanghar	5182	1237432	927201	356473	213928	39	93	19040
Jacobabad	0	0	0	3594	0		0	0
Karachi	0	4	0	0	5	25	8	9
N' Feroze	437	671499	698434	73660	31455	26	50	512
Ghotki	1361	172067	258661	68,679	31630	11	19	1
Kamber	543	145030	150600	4192	7439	6	15	219
Kashmore	102	12610	40240	14532	1620	4	3	4
Larkana	408	54355	12793	5396	5794	6	1	92
Sukkur	0	0	0	26803		1	0	0
G. Total	38347	9275568	6674859	2184951	1596807	497	753	116529

Source: Sindh Provincial Disaster Management Authority

4.6 2011-Rains/Flood Damages Need Assessment

The post rains/flood damages need assessment report-2011 related to Irrigation, Drainage & Flood Protection Infrastructure as received from PID Sindh indicates that around Rs. 6.00 billion would be required for restoration of Irrigation Drainage & Flood Control Structures damaged during 2011-Flood season. Sector wise summary of damages assessment for Sindh province is attached as **Appendix-I**.

**SPECIFIC / SPECIAL ACTIVITIES
PERFORMED DURING
2011-FLOOD SEASON**

5. ACTIVITIES PERFORMED DURING 2011-FLOOD SEASON

The following specific activities were performed by Federal Flood Commission for better flood management during 2011-Flood Season;

5.1 Establishment of Flood Communication Cell

The Flood Communication Cell of Federal Flood Commission started functioning from 15th June 2011 on round-the-clock basis and communicated river flow data to all provinces and concerned agencies on daily basis in normal/low flood stage and 6-hourly basis in case of danger flood levels in main rivers. Based on PMD's Weather Forecasts and Advisories, FFC also issued Daily Flood/Weather Situation Reports to all concerned agencies through its Flood Communication Cell during the entire flood season-2011.

5.2 First Pre-Flood Meeting of Federal Flood Commission

Prior to start of Monsoon Season (1st July to 15th October) every year, Federal Flood Commission (FFC) holds meetings to review the flood fighting arrangements made by Federal/Provincial organizations in case of flood situation during coming flood season. The First Pre-Flood meeting of Federal Flood Commission was held on May 02, 2011 under the Chairmanship of Honorable Federal Minister for Water & Power, wherein the following directions were issued:

- i. Provinces & Federal Line Agencies must adopt all pre-emptive measures, as recommended by Federal Flood Commission, in order to avert possible damages in case of un-expected rainfalls and floods during monsoon season 2011.
- ii. Provinces & Federal Line Agencies would put all out efforts to speed up the physical progress and complete all mid-term restoration works by/before June 30, 2011 i.e. well before the start of monsoon season 2011.
- iii. The urgent nature O&M works of flood protection/ river training works (not included in restoration works) should be immediately started by the Provinces & Federal Line Agencies so as to complete the same before start of flood season 2011, at all valuable reaches.
- iv. Provinces & Federal Line Agencies will ensure pre-flood monitoring of all flood protection infrastructures (flood bunds, spurs barrages and allied works etc.) well before start of flood season of 2011.
- v. Provinces & Federal Line Agencies will ensure strict vigilance and round the clock monitoring of flood bunds along major and other rivers at vulnerable locations during monsoon season, particularly during peak flood flows, besides major hill torrents and flood generating nullahs during flood season.

5.3 2nd Pre-Flood Meeting of Federal Flood Commission

Federal Flood Commission (FFC) convened the 46th Annual/2nd Pre-Flood Meeting on June 30, 2011, under the Chairmanship of Honourable Federal Minister for Water & Power, to review the status of preparedness of concerned Federal/Provincial Government organizations and Flood Fighting Plans for flood management during flood season 2011.

The directions given to PIDs/ Federal Line Agencies, WAPDA, PMD & NDMA were as under:

- i. The PIDs/Federal Line Agencies will adopt all pre-emptive measures as recommended by Federal Flood Commission, in order to avert possible damages due to un-expected rainfalls and floods during the next monsoon season 2011.
- ii. Provinces & Federal Line Agencies will complete all mid-term restoration works by July 20, 2011. The compliance report in this regard will be submitted to all concerned departments including FFC.
- iii. Provinces & Federal Line Agencies will complete all urgent O&M works of flood protection/river training works (not included in restoration works) at all vulnerable reaches before July 15, 2011. Adequate reserve stone stock, machinery and labour would be arranged by Provincial Irrigation Departments / Federal Line Agencies at all critical locations within a week's time.
- iv. Provinces & Federal Line Agencies will carry out all possible efforts to remove the encroachment from flood plains. A status report in this respect would be shared with all concerned organizations including FFC.
- v. Provinces & Federal Line Agencies will ensure strict vigilance and round the clock monitoring of flood funds along major and other rivers at critical locations as identified during monsoon season 2011, particularly during peak flood flows, besides major hill torrents and flood generating nullahs.
- vi. Provincial Irrigation Department, Government of the Punjab will prepare Contingency Plan for Shahdara & Sher Shah Railway Bridges including Muhammad Wala Bridge in consultation with Pak-Railway and PDMA's to ensure safe passage of peak flood flows during monsoon season 2011.
- vii. PDMA in consultation with PID, Punjab, Pakistan Railway and District Administration will prepare Contingency Plan for evacuation of people to the safe places and relief measures to be adopted in case of flood situation in River Ravi at Shahdara Bridge, Sher Shah Bridge and Muhammad Wala Bridge so as to avoid loss of life and valuable items.
- viii. Pakistan Railway in consultation with PID, Punjab and District Administration will prepare long-term plan for permanent solution of the long outstanding issue regarding increasing the flood flows discharge capacity of Shahdara & Sher Shah Railway Bridge.
- ix. National Highway Authority (NHA) in consultation with PID, Punjab, Pak Army, District Administration, NDMA, PDMA and FFC will identify the breaching section / relief cut on left right bank of Chenab River upstream Muhammad Wala Bridge before July 07, 2011 and all necessary arrangement would be made at site in order to avert emergency situation during flood season-201. The compliance report will be submitted to all stakeholders including Federal Flood Commission.
- x. PID, Punjab will complete the tendering and other codal formalities of project namely "Raising & Strengthening Akbar Flood Bund, District Multan" on war footing basis and execute the work on top priority basis.

- xi. The Pakistan Meteorological Department will provide timely and accurate weather and rivers flow forecast during 2011-monsoon season to help in better flood management.
- xii. PMD and WAPDA must ensure that Radars Network and all other forecasting equipments maintained by them are fully operational and work flawlessly during the monsoon season-2011.

5.4 Pre-emptive measures to avert the possibility of the impact of un-expected rainfalls and floods during the Monsoon Season 2011

Based upon lessons learnt by experiencing the worst floods of 2010 and the subsequent devastation, Federal Flood Commission advised Provincial Irrigation Departments of the four provinces, Gilgit-Baltistan, Federal Line Agencies & WAPDA, PMD etc. to take the following pre-emptive measures in order to avert the possibility of the impact of un-expected rainfalls and floods during the monsoon season 2011:

- i. Pre-flood monitoring of all flood protection infrastructures (flood bunds, spurs barrages and allied works etc.) may be ensured well before start of flood season of 2011 and report in this respect be prepared and circulated among all concerned including Federal Flood Commission.
- ii. Preparation of District/Area-wise Comprehensive Flood Fighting Plan by the Provinces/Federal Line Agencies depending upon the vulnerability of the Area.
- iii. Outline SOPs for implementation of Flood Fighting Plan in their respective areas, keeping in view the experience of 2010 Floods.
- iv. Review existing SOPs of major reservoirs so as to ensure their flood mitigation role and also prepare SOPs for barrages and ensure their implementation in their respective jurisdiction for safe passage of flood peak in future.
- v. Ensure strict vigilance and round the clock vigilance/ Monitoring of flood bunds at vulnerable locations particularly during peak flow hours besides vulnerable hill torrents and flood generating nullahs during flood season.
- vi. Effective arrangement for liaison with Flood Forecasting Division (FFD) Lahore Pakistan Meteorological Department and WAPDA for issuance of flood warnings well in time upto the levels of District Administration.
- vii. Ensure effective implementation of laws/bylaws related to execution of development projects in flood prone areas and Riverine areas.
- viii. Updation of inventory of flood bund indicating design parameters and their existing condition with the date of last field monitoring. Also ensure proper maintenance of flood embankments to avoid major losses.
- ix. Ensuring provision of adequate O&M funds by the respective Federal & Provincial Agencies in their annual development programme and completion of all needed work including 2010 flood damage restoration works well before the start of monsoon season 2011.
- x. Ensure Monitoring of ongoing flood works as per existing mechanism of Federal Flood Commission.

- xi. Associate local abadies/beneficiaries/NGOs for coordinated flood management & protective measures as social mobilization is important factor.
- xii. After peak flow/flood season, reconnaissance of all the floods works be carried out. Status Report may be prepared and submitted to all concerned with in two months. Remedial measures should also be started immediately wherever required.
- xiii. The Reconstruction /PC-Is of flood protection infrastructure damaged during 2010-Floods based on DNA report may be submitted at the earliest to this office for further processing.

5.5 Post Flood Meeting of FFC

The Post Flood meeting of Federal Flood Commission was held on December 19, 2011 under the Chairmanship of Honourable Federal Minister for Water & Power in the Committee Room of Ministry of Water and Power, A-Block Pak. Secretariat, Islamabad. Minister for Water & Power showed serious concern over the non-compliance of decisions of 2nd Pre-Flood meeting held on June 30, 2011. The Honourable Federal Minister for Water & Power stressed the representatives of Provincial Irrigation Department and Federal Line Agencies for utmost efforts for early completion of urgent nature restoration/rehabilitation works and strictly follow up of schedule of implementation of Normal/Emergent Flood Programme, which was approved by ECNEC in 2004 so that proposed works could be completed well before the start of Monsoon Season 2012. The following decisions were taken in the meeting;

- (i) Ministry of Water & Power will write D.O letter to Chief Secretary, Government of Balochistan for allocation of requisite funds out of Provincial ADP/resources for completion of ongoing urgent nature restoration/rehabilitation works of Irrigation, Drainage & Flood Protection Infrastructure.
- (ii) Ministry of Water & Power will write D. O. Letters to Chief Secretaries of the four Provinces, Gilgit-Baltistan, FATA & AJK for organizing coordination meetings of all concerned organizations (PDMAs, DDMA's, Districts Administration, WASA etc.) before start of monsoon season every year without waiting for emergency occurrence for drawing SOPs in consultation with FFC, NDMA & other related organizations.
- (iii) Ministry of Water & Power will write D.O letter to Secretary Ministry of Kashmir Affairs & Gilgit-Baltistan and SAFRON for submission of advance copy of PC-I of Water Sector Projects of Federal Line Agencies directly to Ministry of Water & Power for saving time and expediting approval process of the projects from CDWP/ECNEC.
- (iv) Ministry of Water & Power will review the portfolio of WAPDA's Water Sector projects for looking possibility of re-appropriation of funds from slow moving projects to urgently needed restoration works & Flood Telemetry and Drainage projects.
- (v) Ministry of Water & Power will approach Ministry of SAFRON for expediting the pending PC-I costing Rs 795.00 million of FATA regarding rehabilitation of damaged Irrigation & Flood Protection Infrastructure during 2010- Floods.

- (vi) PIDs/Federal Line Agencies will complete all ongoing urgent nature/Mid-Term Restoration/Rehabilitation Works of Irrigation, Drainage & Flood Protection Infrastructure before March 31, 2012.
- (vii) SIDA/PID, Sindh will carry out field surveys and prepare restoration plan for Irrigation, Drainage & Flood Protection Infrastructure damaged due to 2011-Rain/Floods.
- (viii) Provincial Irrigation Departments & Federal Line Agencies will carry out field surveys for checking the status of all flood embankments/flood protection structures and all essential O & M works (not included in 2010-Restoration/Rehabilitation Works) must be completed well before the start of Monsoon Season 2012.
- (ix) National Highway Authority will expedite approval process of Breaching Section of Muhammad Wala Bridge across River Chenab near Multan in consultation with PID, Punjab, Pak. Army, NDMA, FFC, PDMA & District Administration and convey approval of Competent Authority to FFC & other concerned organization by/before December 28, 2011.
- (x) Federal Flood Commission will conduct inquiry for coordination failure among PID, Punjab, NHA and other concerned organizations at planning & design stage of Muhammad Wala Bridge and report will be submitted to Ministry of Water & Power and Planning Commission for taking further action in the matter.
- (xi) National Highway Authority will involve Provincial Irrigation Departments, at planning & design stage of all future bridges projects. The Raising of flood embankments, if needed as a result of construction of such bridges would be the responsibility of National Highway Authority so as to avoid situation like in case of Muhammad Wala Bridge across River Chenab.
- (xii) PID, Punjab/executing agency will speed up progress on implementation of project namely "Raising & Strengthening Akbar & Nawab Pur Flood Bunds, in District Multan, Estimated Cost Rs 162.633 Million", in order to complete the project within next two months **(End February 2012)**.
- (xiii) Planning Commission will process the PC-I costing Rs 3.141billion jointly prepared by PID, Punjab, C&W Department and Pakistan Railway for strengthening and increasing the flood flows discharge capacity of existing Shahdara Railway Bridge on top priority basis and will included in the agenda of next meeting of CDWP.
- (xiv) PIDs/Federal Line Agencies will collaborate with their concerned Districts Administrations for making utmost efforts to remove the encroachments from Flood Plains. The compliance report in this respect would be submitted to FFC and other concerned organization well before the start of Monsoon Season 2012.
- (xv) PIDs/Federal Line Agencies will strictly follow the ECNEC approved schedule for Normal/Emergent Flood Programme so that urgent nature flood protection schemes could be executed well before the start of monsoon season each year and allocated funds fully utilized.

APPENDIX-I

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PRELIMINARY DAMAGE AND NEEDS ASSESSMENT
RAINS/FLOODS-2011 (SINDH PROVINCE)
IRRIGATION, DRAINAGE, & FLOOD SECTOR

Currency Exchange Rate; 1US\$= Rs 87.00

Structure Description							
Divisions	Canal / Water Channels	Drains and Appurtenant Structures	Flood Protection Embank- ments	Building etc	Others	Division Wise Total	
						(M.Rs)	US Dollars
Rohri	189	-	83	65	-	337	3.9
Nasrat	229	-	-	21	-	250	2.9
Dad	155	-	13	13	-	181	2.1
Hala Irr	41	-	110	10	-	161	1.9
Nasir	318	-	-	21	64	403	4.6
Barrage	50	-	-	58	-	107	1.2
Khairpur West	298	-	-	35	-	333	3.8
Khairpur East	362	-	-	40	-	402	4.6
Mirpur	117	15	-	40	-	172	2.0
Ghotki	154	33	-	75	-	263	3.0
Tubewell	-	15	-	120	-	135	1.5
Jamrao	245	370	-	13	-	628	7.2
Mithrao	159	-	-	28	-	187	2.1
Thar	173	85	10	51	-	318	3.7
Drainage Sang	-	233	-	32	-	264	3.0
Warah	72	-	16	15	-	102	1.2
Saifullah Magsi	41	-	11	6	-	57	0.7
Shahdad Irr	46	-	-	30	-	76	0.9
Rice Canal	102	-	13	4	-	119	1.4
Northern Dadu	24	-	32	-	-	55	0.6
Southern Dadu	60	-	132	27	-	219	2.5
Shahbaz Irr	5	-	4	1	-	9	0.1
Akram Wah	118	-	-	43	-	161	1.8
Fulleli	190	-	-	26	-	216	2.5
Guni	129	-	-	24	-	153	1.8
Drainage Badin	0	702	-	19	-	721	8.3
Structure Wise Total	3,278	1,453	422	812	64	6,029	69.3

**PRELIMINARY DAMAGE AND NEEDS ASSESSMENT
RAINS/FLOODS-2011 (SINDH PROVINCE)
IRRIGATION, DRAINAGE, & FLOOD SECTOR**

