Government of Pakistan
Ministry of Water Resources
O/o Chief Engineering Advisor & Chairman
Federal Flood Commission

ANNUAL REPORT 2024

OF

FEDERAL FLOOD COMMISSION




6-ATATURK AVENUE, SECTOR G-5/1,
ISLAMABAD, PAKISTAN

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FORWARD

Flooding has become a recurring challenge in Pakistan. Over the past 77 years, the country has experienced numerous catastrophic flood events, with increased frequency and severity over the last two decades. Looking ahead, the country's exposure to flood hazards is expected to intensify due to the adverse impacts of climate change. Rapid population growth in both urban and rural areas continues to heighten vulnerability to such natural disasters.

During the Monsoon Season 2024, Pakistan received 51% above-normal rainfall, resulting in the tragic loss of 368 human lives, alongside extensive damage to public infrastructure, private property, and livestock. Recent meteorological data indicate that, compared to previous monsoon seasons, major river catchments received reduced rainfall, with a noticeable shift in monsoon activity toward the southern regions of the country.

Therefore, despite the above-normal monsoon rains, the country did not experience any high to exceptionally high flood events in the major rivers of the Indus River System. However, the River Indus experienced medium flood levels at Kalabagh-Chashma-Taunsa-Guddu-Sukkur-Kotri reaches. Similarly, the River Chenab and River Kabul observed medium flood levels at the Marala–Khanki and Nowshera–Warsak reaches, respectively. The River Jhelum reached only low flood stage at Mangla, while the Rivers Ravi & Sutlej remained in normal flow conditions throughout the season.

Recognizing the urgent need for comprehensive and integrated flood risk management across the country, the Government of Pakistan, through the Federal Flood Commission (FFC), has implemented three ten-year National Flood Protection Plans (NFPPs) from 1978 to 2008. These efforts were also reinforced through annual interventions under the Normal/Emergent Flood Program upto 2022-23. The latest strategic plan, NFPP-IV, was approved in May 2017 by the Council of Common Interests (CCI). However, its implementation has been hindered due to a lack of financial resources. Following the catastrophic floods of 2022, and in line with the directions of the Prime Minister, the original NFPP-IV (2017 version) has been updated to incorporate key lessons learned from recent flood events and to address these issues to combat future heavy rain/flood events.

The updated National Flood Protection Plan-IV (NFPP-IV) is based on the Integrated Flood Risk Management (IFRM) approach, which promotes a coordinated and holistic strategy for managing flood risks across Pakistan. The plan features an expanded scope and assigns cross-cutting responsibilities to various institutions for the implementation of both structural and non-structural measures, including Nature-Based Solutions (NbS). One of the key lessons learnt from flood experience of 2022 was to ensure flood-proof land-use and water management in future through sustainable spatial planning. This can be achieved by tapping storage potential of hill torrents, expansion of the flood telemetry system and comprehensive remodeling of already constructed drains, in particular of Sindh province, for water conservation and safe passage of torrential flood flows from the Kirther range in Balochistan. Besides, the institutional capacity building & strengthening is also required at all levels.

Further details related to 2024 Monsoon Season have been provided in this Annual Report which provides a comprehensive and coherent overview of FFC's performance and strategic direction. We acknowledge the dedicated efforts of our professional engineers and support staff whose commitment was instrumental in the preparation of this report.

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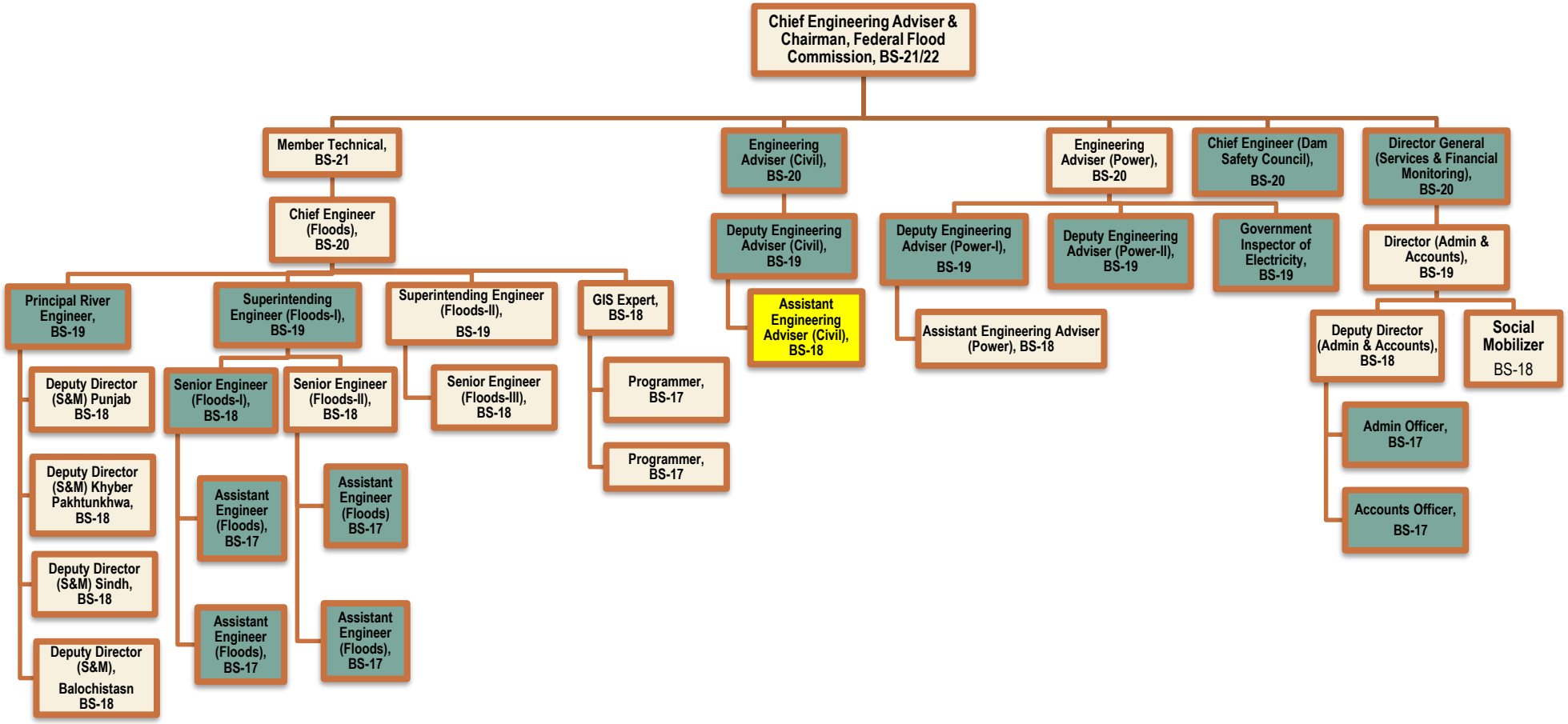
Act as Secretariat of Federal Flood Commission



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ABBREVIATIONS

ADB	Asian Development Bank
AJ&K	Azad Jammu & Kashmir
Cusec	Cubic Feet per Second
CDREP	Climate & Disaster Resilience Enhancement Programme
CEA	Chief Engineering Advisor
CFFC	Chairman Federal Flood Commission
DEM	Digital Elevation Model
EAD	Economic Affairs Division
FFC	Federal Flood Commission
FLAs	Federal Line Agencies
GCF	Green Climate Fund
GFAS	Global Flood Analysis System
GPS	Geographical Positioning System
GB	Gilgit Baltistan
IRSA	Indus River System Authority
JICA	Japan International Cooperation Agency
KP	Khyber Pakhtunkhwa
MAF	Million Acre Feet
MoWR	Ministry of Water Resources
Mo PD&SI	Ministry of Planning, Development & Special Initiatives
Mo CC& EC	Ministry of Climate Change & Environmental Coordination
NESPAK	National Engineering Services of Pakistan
NDMA	National Disaster Management Authority
NHA	National Highway Authority
NWC	National Water Council
NWP	National Water Policy
Pak Railway	Pakistan Railways
PDMA	Provincial Disaster Management Authority
PIDs	Provincial Irrigation Departments
PMD	Pakistan Meteorological Department
PCIW	Pakistan Commissioner for Indus Waters
RDA	Rawalpindi Development Authority
SCARP	Salinity Control and Reclamation Programme
WAPDA	Water and Power Development Authority
WASA	Water and Sanitation Agency
WB	World Bank
US$	United States Dollar

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SECRETARIAT OF FEDERAL FLOOD COMMISSION/FLOOD WING

1 SECRETARIAT OF FEDERAL FLOOD COMMISSION/ FLOOD WING

1.1 FFC Composition & Functions

Prior to 1976, the Provincial Governments were responsible for planning, management and implementation of flood protection projects. Disastrous floods of 1973 & 1976 resulted in heavy losses to private and public property highlighted that existing flood protection facilities and planning at Provincial level were inadequate for effective flood management at the country level and lacking integrated and holistic approach. The issue was discussed in the Inter-Provincial Coordination Conference held in January 1977 wherein it was decided by the Federal Government to constitute a forum at Federal level for Integrated Flood Management on country-wide basis. Accordingly, Federal Flood Commission (FFC) was established and notified on 4th January 1977 through resolution.

On the order of the Honorable Supreme Court of Pakistan, it was reconstituted by the then Ministry of Water & Power vide Notification No. 3(22)/2015-Water dated 9th July 2015. Federal Flood Commission (FFC) forum consisting of the following members:

Table-1.1: Composition of Federal Flood Commission

Sr. No.	Description	Position
i.	Chief Engineering Adviser/Chairman Federal Flood Commission	Chairman
ii.	Secretary, Irrigation Department, Government of Punjab	Member
iii.	Secretary, Irrigation Department, Government of Sindh	Member
iv.	Secretary, Irrigation Department, Government of KP	Member
v.	Secretary, Irrigation Department, Government of Balochistan	Member
vi.	Chairman, National Highway Authority (NHA)	Member
vii.	Chief Executive Officer, Pakistan Railways	Member
viii.	Member (Infrastructure) Planning Commission	Member
ix.	Member (Water), WAPDA	Member
x.	Member (DRR), NDMA, Prime Minister's Office	Member
xi.	Pakistan Commissioner for Indus Waters (PCIW)	Member
xii.	Chairman, Indus River System Authority	Member
xiii.	Director General, Pakistan Meteorological Department	Member

Functions of the Federal Flood Commission are described as follows:

i. Preparation of Flood Protection Plan for the country including management of the plan;
ii. Scrutiny of flood control/protection schemes funded by Federal Government and prepared by Provincial Governments and Federal Agencies;
iii. Review of damage of flood protection works and review of plans for restoration and reconstruction works;
iv. Measures for improvement of Flood Forecasting & Warning System;
v. Preparation of Research Programme for flood control and protection;
vi. Standardization of designs and specifications for flood protection works;
vii. Recommendations regarding principles of regulation of reservoirs for flood control;
viii. Evaluation and monitoring of progress of implementation of the National Flood Protection Plans;

ix. Federal Flood Commission may notify sub-committees as it deems appropriate. The commission plays a crucial role in coordinating anti-flood measures nationwide and works closely with other organizations, such as the Pakistan Army and National Disaster Management Authority (NDMA).

The office of the Chief Engineering Adviser shall work as a Secretariat of the Commission. In performing its functions, the Commission may requisition assistance of experts of WAPDA and other Federal Agencies and the Provincial Government or co-opt such other as members as it may deem necessary. The commission may also engage consultants and experts as and when needed.

1.2 Federal Government Investments on Flood Protection

Since its establishment, FFC has so far prepared and executed three National Flood Protection Plans during the period (1977 to 2008), i.e. National Flood Protection Plan–I (NFPP-I) for the period (1978-1988), National Flood Protection Plan II (NFPP-II) for the period (1988-1998) and National Flood Protection Plan-III (NFPP-III) for the period (1998-2008). The table indicating Federal Government investment on the flood protection schemes under the three National Flood Protection Plans is given as under:

Table-1.2: Summary of Federal Investment on Flood Protection Works

Sr. No.	Flood Plans/ Programs	Location	No. of Schemes	Expenditure (Rs Million)
1.	**NFPP-I (1978-88)**			
i.	Normal Annual Development Programme GOP funded	Countrywide	311	1,730
		Sub-Total (NFPP-I)	***311***	***1,730***
2.	**NFPP-II (1988-98)**			
i.	Normal/Emergent Flood Programme	Countrywide	170	805
ii.	First Flood Protection Sector Project (FPSP-I) Co-financed by GOP & ADB	Four Provinces	256	4,735
iii.	Prime Minister's River Management Programme (1994-96)	Punjab, KP & Balochistan	10	613
		Sub-Total (NFPP-II)	***436***	***6,153***
3.	**NFPP-III (1998-2008)**			
i.	Normal/Emergent Flood Programme	Countrywide	362	4,192.348
ii.	Second Flood Protection Sector Project FPSP-II (1998-2007) Co-financed by GOP & ADB	Four Provinces	101	4,165.00
iii.	Special package executed through President Directives (2000-02)	Gilgit-Baltistan	21	92.035
iv.	Lai Nullah Flood Forecasting & Warning System through JICA grant-in-aid	District Rawalpindi & ICT	1	348.00
		Sub-Total (NFPP-III)	***485***	***8,797***
4.	**Normal/Emergent Flood Programme**			
i.	Normal/Emergent Flood Programme (2007-08 to 2022-23)	All over country	373	9,420
		Sub-Total (N/EFP)	**373**	**9,420**
5.	**Flood Damages Restoration Projects**			
i.	1988-Flood Damage Restoration Project	Four Provinces	2,028	1,874
ii.	1992-Flood Damage Restoration Project	Countrywide	1,980	6,888
		Sub-Total (FDRP)	**4,008**	**8,762**
	Grand Total (1+2+3+4+5)		**5,613**	**34,862**

FFC has also played a pivotal role in improving the Flood Forecasting & Warning System of the country. The following activities were undertaken under GOP & ADB jointly funded FPSP-I (1987-97) for improvement of Country's existing Flood Forecasting & Warning System.

i. Procurement & installation of Meteor-burst Telecommunication System (Phase-I) including one Master Station and 24 remote sensing stations.
ii. Installation of 10-CM Quantitative Precipitation Measurement (QPM) Weather Radar at Flood Forecasting Division (FFD) Lahore.
iii. Pre-feasibilities studies for four Barrages i.e. Suleimanki, Balloki, Trimmu & Panjnad for increasing their design discharge capacity to carry increased flood flows in view of 1992 floods.
iv. Preparation of Flood Plain Maps of Indus River (5-Reaches i.e. Chashma-Taunsa, Taunsa-Guddu, Guddu-Sukkur, Sukkur-Kotri & Kotri-Seas Reach).

The Country's Flood Forecasting & Warning System was further upgraded through ADB funded FPSP-II (1998-2007) by carrying out the following activities;

i. Procurement & installation of 24 No. HF-Radio Sets.
ii. Procurement & installation of 20 additional remote sensing stations under existing Meteor-burst Telecommunication System (Phase-II);
iii. Upgradation of 10 CM Quantitative Precipitation Measurement Weather Radar procured under FPSP-I in the premises of FFD, Lahore;
iv. Upgradation of 5.36 CM Sialkot Weather Radar into 10 CM Quantitative Precipitation Measurement Weather Radar;
v. Procurement & installation of a 10 CM Quantitative Precipitation Measurement Weather Radar at Mangla;
vi. Development of initial/1st version of Computer Based Flood Early Warning System (FEWS) through NESPAK, PMD & Delft Hydraulics;
vii. Expansion of Flood Plain Mapping activity covering major tributaries of River Indus i.e. Rivers Jhelum, Chenab, Ravi & Sutlej; &
viii. Bathymetric Survey & flow measurements of Indus River and its major tributaries *(Sutlej, Ravi, Chenab & Jhelum)* for improvements in discharge rating curves & to collect data for FEWS Model & Flood Plain Mapping activities.

Establishment of Flood Forecasting & Warning System for Lai Nullah Basin (Islamabad &Rawalpindi) through JICA Grant-in-Aid Programme.

1.3 Normal/Emergent Flood Programme (N/EFP)

Federal Flood Commission is the federal coordinating body at federal level for implementation of Normal/ Emergent Flood Programme (N/EFP), which was started in (1978-79). It is a yearly program in which Provincial Irrigation Departments (Punjab, Sindh, Khyber Pakhtunkhwa & Balochistan) and Federal Line Agencies [Gilgit-Baltistan, Merged Area (EX. FATA) & AJ&K] submit their schemes (based on their shares) each year, which are processed by FFC for technical clearance of Scrutinizing Committee of FFC, approval of DDWP/CDWP and release of funds by Planning Commission/Finance Division to the executing agencies.

The award of contract, execution and disbursement is the exclusive responsibility of Provincial Irrigation Departments (PIDs) and Federal Line Agencies (FLAs). The urgent nature flood protection works are proposed by the PIDs and FLAs for execution under N/EFP.

Around 1216 number flood project costing Rs 16.147 billion have been approved for implementation through N/EFP during the period 1978-79 to 2022-23. However, due to inadequate budget allocation under PSDP each year *(minimal as compared to the Provinces & Federal Line Agencies demands)* for N/EFP, the execution of some urgent nature flood protection schemes remained un-attended. It has now been merged under the recently approved Umbrella PC- of FPSP-III Updated.

The budget demanded by the Provinces and Federal Line Agencies, budget allocated and actually released during the past years is given in **Table 1.3**

Table 1.3: Status of Budget Demanded VS Allocated for N/EFP (2010-11 to 2021-22)

(Rs. Millions)

Sr. No.	Financial Year	Funds Demanded*	Budget Allocation under PSDP		Funds Released
			Original	Revised	
1.	2010-11	3,500.00	740.798	735.752	276.714
2.	2011-12	4,000.000	894.000	844.194	567.095
3.	2012-13	4,000.000	900.000	597.483	419.325
4.	2013-14	4,500.000	1,000.000	1,000.000	855.533
5.	2014-15	5,000.000	1,000.000	1,000.000	898.477
6.	2015-16	5,500.000	1,000.000	964.430	964.430
7.	2016-17	5,515.000	500.000	500.000	267.500
8.	2017-18	11,223.516	500.000	500.000	244.010
9.	2018-19	10,000.00	1,000.000	1,000.000	610.000
10.	2019-20	10,000.00	500.000	500.000	500.000
11.	2020-21	10,000.00	1500.000	0.000	0.000
12.	2021-22	10,000.00	1500.000	720.368	720.368
Total		**83,236.516**	**11,034.798**	**8,362.227**	**6,323.452**

***** Funds demanded by PIDs & FLAs for execution of flood protection works

1.4 Discontinuation of Normal/Emergent Flood Programme by GOP

Since 1978, the Government of Pakistan has been allocating annual funds under the Public Sector Development Programme (PSDP) for the Normal/Emergent Flood Programme (N/EFP), a need-based initiative aimed at executing emergent flood protection works across the provinces. This programme played a vital role in safeguarding vulnerable settlements from flood damages. Between 1978 and 2023, a total of 1216 small-scale flood protection projects were implemented by the provinces through federal funding under this programme.

However, following the approval of the Umbrella PC-I for the Flood Protection Sector Project-III (FPSP-III) by ECNEC on June 27, 2023, it was directed that the Normal/Emergent Flood Programme be merged into FPSP-III. Consequently, the standalone programme was discontinued in the current fiscal year, and no allocation was made by the Government of Pakistan.

Although ECNEC approved Umbrella PC-I of FPSP-III and the GOP has allocated Rs 10 billion and Rs 3 billion under FY 2023–24 and FY 2024–25 respectively but no funds have been released to date due to the non-availability of foreign financing, which constitutes approximately 80% of the total project cost. As a result, flood protection works under FPSP-III could not be initiated.

Moreover, with the closure of the Normal/Emergent Flood Programme and the delay in FPSP-III implementation, no federal flood protection works have been executed in the provinces over the past two years by the Federal Government, significantly increasing the risk of flood-related damages.

The N/EFP has historically held great importance, and its discontinuation combined with the delayed execution of FPSP-III has had serious implications for national flood resilience and disaster preparedness.

1.5 Formulation of National Flood Protection Plan-IV (NFPP-IV)

Work on preparation of National Flood Protection Plan-IV (NFPP-IV) was initiated during the year 2006-07. Keeping in mind the investment level made under the first three Plans (NFPP I, II &

III) and needs of the Provinces & Federally Administered Area (Gilgit-Baltistan, Merged Area (EX. FATA) and AJ&K), the National Flood Protection Plan –IV (NFPP-IV) having investment cost Rs 26.00 Billion was prepared through in-house technical staff and submitted to Ministry of Water and Power (now Ministry of Water Resources) in November 2006, for approval of the Competent Authority. However, the same could not be approved at that time due to low priority given to Flood Sector because of no evidence of disastrous floods in the recent past in the country.

The country experienced super flood during 2010. It was the worst ever riverine floods in the history of Pakistan, which caused over 1985 deaths, affected about 20 million populations, 1.60 million houses were damaged/destroyed, 17,553 villages and 1/5th of country's land area (around 160,000 Km^2) was affected. After the large scale damages as a result of 2010 floods followed by subsequent floods during 2011 & 2012, the need for investment in flood sector gained importance. It was therefore decided to formulate a comprehensive National Flood Protection Plan-IV keeping in view the lessons learnt from 2010-floods based on integrated and innovative approaches.

In the aftermath of 2010 devastating floods, causing a total cumulative damage to the tune of USD 10.056 billion, country's fourth (4th) National Flood Protection Plan (NFPP-IV) was formulated with total investment cost of Rs 332.246 billion. The Plan was approved by the CCI in its 4th meeting on May 02, 2017. Benefits the then envisaged in NFPP-IV, included protection of about 779,250 hectares of land from erosion and around 2,479,555 hectares of land from inundation besides reclamation of 154,176 hectares of land. For the total Plan cost of Rs 332.246 billion, an Umbrella PC-I was processed for CDWP's approval in April 2019. Pre-CDWP advised to curtail its cost owing to tight financial position, by only keeping the top priority interventions. In view of the above, rationalized proposal titled as Umbrella PC-I of Flood Protection Sector Project-III (FPSP-III) costing Rs 95.980 billion was processed for CDWP's approval. CDWP cleared/ recommended the Umbrella PC-I of FPSP-III in its meeting held on October 12, 2020 for further consideration/ approval by the ECNEC subject to exploring the financing expeditiously by Economic Affairs Division (EAD). Despite vigorous efforts by EAD, till 30th June 2022, no financing was available from foreign donors i.e. ADB, World Bank, JICA etc.

In view of devastating 2022 rains/ floods experienced by the country, the Prime Minister of Pakistan, in a meeting held on 29th August 2022, directed PD&SI Division that "Flood Protection Plan 2017 to be updated and protection measures against flash floods and hill torrents to be included in the Plan". In compliance to above, CDWP re-considered the already processed Umbrella PC-I of FPSP-III in its meeting held on 14th September 2022 and decided to update it by including fresh proposals based on lessons learnt from 2022 Floods, especially in the context of flash floods, hill torrents and drainage system. During the above meeting, Asian Development Bank (ADB) expressed interest to support Updation of NFPP-IV. Accordingly, FFC undertook the task of NFPP-IV Updation with the support of ADB and wider stakeholders' consultation. FPSP-III (Updated) is part/ Phase-I of the updated NFPP-IV.

In compliance of decision taken in CDWP meeting held in September 2022, FFC updated Umbrella PC-I of FPSP-III by incorporating priority requirements of Federal and Provincial stakeholder departments, as recommended in NFPP-IV original and their fresh proposals based on lessons learnt from 2022 Floods. Subsequently, Updated Umbrella PC-I costing Rs 194.625 billion was approved by the ECNEC in its meeting held on June 27, 2023. MoWR issued the Administrative Approval of FPSP-III Updated on July 25, 2023.

1.5.1 Scope of Sub-Projects Proposed under Umbrella PC-I of FPSP-III

Structural interventions, proposed under Umbrella PC-I of FPSP-III updated, include construction of flood embankments, spurs, protection walls, flood diversion/ dispersal structures, small/ medium dams for conservation of flood water, strengthening/ remodeling of flood works and improving the drainage network. Non-Structural interventions mainly focus on improving Flood Forecasting & Early Warning System, including installation of 262 Automatic Weather Stations (AWS) and Establishment of Regional FF&W Centres (by PMD), Installation of 457 new Flood Telemetry stations, Improvements of Stream Gauging Network & HF Radio Network, and formulation of National Watershed Management Plan and Ecosystem-based interventions by M/o

CC&EC under Recharge Pakistan Project. Summary of cost of Umbrella PC-I of FPSP-III's structural and non-structural measures, is presented in Table 1.4 below:

Table-1.4: Summary of cost FPSP-III's structural and non-structural measures

Sr. No.	Description	No. of Sub-Projects	Estimated Cost (Rs Million)
A.	**Structural Interventions** *(Construction of small to medium dams, flood diversion/ dispersal structures, construction/strengthening/ remodeling of flood embankments & improving drainage) small/medium dams, works etc.)*		
1.	Punjab	12	29,708.250
2.	Sindh	40	50,570.590
3.	Khyber Pakhtunkhwa (KP)	31	14,157.200
4.	Balochistan	29	44,289.410
5.	Merged Areas (Khyber Pakhtunkhwa)	25	1,206.801
6.	Gilgit-Baltistan	10	8,197.507
7.	AJ&K	4	11,052.59
	Sub-Total (A)	**151**	**159,182.35**
B.	**Non-Structural Interventions** *(Installation of new AWS, Establishment of Regional FFW Centres, Installation of Flood Telemetry stations and strengthening other Gauging Networks of WAPDA, besides, green interventions through Recharge*		
8.	WAPDA	05	15,318.743
9.	PMD	02	5,025.390
10.	MoCC & EC	01	6,000.000
11.	LiDAR Survey of Floodplains of Indus River & its major tributaries	01	779.900
12.	Hill Torrent Management Studies updation + Institutional Reforms	04	457.590
13.	FFC **(**Project Coordination & Management Unit, Supervisory Consultants, Urban Flood Management/ RWH Works, Studies etc.)	-	7,861.030
	Sub-Total (B)	**13**	**35,442.650**
Grand Total (A+B)		**164**	**194,625.00**

ECNEC approved the project with the following financing arrangements;

- GOP Equity= 20% Federal Components + 10% Provincial Components
  Provinces= 10% Provincial Components
  Donor Financing= 80%.

As per above, total foreign funding required for FPSP-III is Rs 155,700 million. Details of sub-projects along with their benefits are given in Table 1.5 below:

Table-1.5: Sub-Projects Under Updated Umbrella PC-I of FPSP-III

Sr.#	Region (Projects)	No. of Structures	Expected Benefits
A	**Structural Interventions**		
a.	Punjab (12)	34 No. Flood embankments & 17No. Spurs/Studs, Flood Carrying Channels for Vidore & Mithawan Hill Torrents Remodeling of Nutkani Flood Carrying Channel Bela removal upstream Qadirabad Barrage at River Chenab Modernization of IRI, Lahore	Protection of 160,000people 5,000 houses, 12 BHU, 20 No. Irrigation Channels, 30 No. schools, 10 No. roads and 31,000 acres of lands
b.	Sindh (40)	81 River Training works, 79 No. Gabion structure, 51No. Flood embankments and 66 No.FDR works Flood Carrying Channel from MNV Head Regulator (RD 224 – 346) along FP Bund	Protection of 2,507,800people, 65,500 households, and 685,000 acres of agricultural lands
c.	Khyber Pakhtunkhwa (31)	56 No. flood protection/ river training works gabion wall and embankments etc.	24,699 acres of agricultural lands, Village abadies& other properties along Rivers Swat, Panjkora, Kabul and their tributaries and hill torrents like Tochi Rivers etc.
d.	Merged Area Khyber Pakhtunkhwa (25)		
e.	Balochistan (29)	80 No. River Training Works, 9 No. Dispersal structures, 9 Small Dams (154,863 Acre-feet), 1 No. Distribution Structure, 39 No. flood embankments and 33 No. FDR Works of 2022	Approx. 22,850people, 3,811 farm families, 5,762 houses, 12,910 acres crop lands, 1,500 livestock and 223 No. Tube Well
f.	Gilgit-Baltistan (10)	Channelization of nullahs, Construction of Gabion Flood Protection wall and Stud/Spur, & Dispersal Structure in 10 Districts i.e. Gilgit, Diamer, Ghizar, Hunza, Nagar, Astore, Skardu, Shigar, Ghanche & Kharmong.	Around 1,200,000 population, 93,466 acre agricultural lands and 4,500 houses

Sr.#	Region (Projects)	No. of Structures	Expected Benefits
g.	AJ&K (4)	26 No. small dams and construction of flood protection wall on the vulnerable locations	200 acres agriculture land, Conservation of 55,345 Acre feet of flood water for irrigation (about 19,224 acres) and drinking purposes (0.521 MGD), Population of 520,150, 1,539 Tons Fish annually, Hydropower 566,800 KW
B	**Non-Structural Interventions**		
h.	WAPDA	05	Installation of 457 Telemetry Stations on country wide basis, Formulation of National Watershed Management Plan covering Swat Basin, Indus Basin & Upper Indus Basin, Hazara Area, Haro & Soan River, Gomal, Zhob, Kohat and various hill torrents, Nari Basin Hub Basin, Nai Gaj Basin and Gilgit-Baltistan, Besides sub-projects for improved data sets for making more accurate flood forecasts and conducting climate studies, timely flood early warnings etc.
i.	PMD	02	Improved weather forecast, riverine flood and flash flood forecast, Institutional weather early warning capabilities strengthening and increased satisfaction of end-users, besides others, Six (06) New Regional Flood Forecasting & Early Warning Centers at Karachi, Peshawar, Quetta, Konadas (G-B), Muzaffarabad and Multan. Besides Upgradation of FFD, Lahore & National FF&EW Centre at Islamabad, 252 No. Automatic Weather Stations on countrywide basis.
j.	Recharge Pakistan Project (MoWR + MoCC)	01	More than 10 million people will directly benefit from the project, while 20 million people across 50 vulnerable districts of Pakistan will be the indirect beneficiaries. The project will be implemented in selected sites, spanning over a stretch of 1,300 km of Indus River, across Khyber Pakhtunkhwa, Punjab, Sindh and Balochistan.

Sr.#	Region (Projects)	No. of Structures	Expected Benefits
k.	LiDAR Survey of flood plain areas of Indus River and its tributaries (Army's Survey Group)	01	Capture High Resolution images alongwith accurate terrain information/ DEM **River Indus** include Section I (Kalabagh-Chashma), Section II (Chashma-Taunsa), Section III (Taunsa-Guddu), Section IV (Guddu- Sukkur) and Section V (Sukkur- Kotri); • **River Chenab** (Marala-Trimmu); • **River Jhelum** (Rasul- Trimmu); & • **River Kabul** (Warsak- River Indus)
l.	Hill Torrent Management Studies updation (PCRWR)+ Institutional Reforms of attached Departments of MoWR	04	Minimize environmental degradation of catchment areas Green interventions in Gilgit-Baltistan {20 No. Solar-Powered Lifting Pumps, 20 water storage ponds, drip irrigation to irrigate 100 hectors barren lands, 20 orchards sites and afforestation of trees, grasses and hedges} besides in Thar Desert.
m.	Federal Flood Commission	Lump sum	PCMU including office renovation (FFC's office building), Project Supervisory Consultants, Important Technical Studies, Urban Flood Management Works, Rainwater Harvesting & Urban flood management studies, etc.

PD&SI Division allocated an amount of Rs 3000.00 million (Rs. 1,000.0 million GoP as local share & Rs. 2,000.0 million as external/ foreign financing) under PSDP 2024-25, for implementation of Umbrella PC-I of FPSP-III. So far, two meetings of FFC's Securitizing Committee on the FPSP-III sub-projects have been held respectively on Sep 18, 2023 and Dec 18, 2023 wherein PC-Is/ PC-IIs of 14 sub-projects were considered. The Committee recommended following five (05) sub-projects after making proposed amendments for submission to MoWR for approval by CDWP/ ECNEC:

Table-1.6: List of PC-Is of Umbrella PC-I of FPSP-III submitted for approval

Sr. #	Name of Sub-Projects	Estimated Cost (in Rs Million)
1.	PC-I for National Master Plan for Flood Telemetry Network (Phase-I)	15,496.00
2.	PC-I for Strengthening and O&M of Glacier Monitoring Research Centre	350.00
3.	PC-I for Strengthening and O&M of SWHP Network	380.31
4.	PC-I for Strengthening and O&M of High Frequency (HF) Radio Network & Flood Information Centre (FIC)	884.46
5.	Restoration/ Rehabilitation of Malir Weirs-I, II, III & Thado Dam	13,950.451

For the following nine (09) sub-projects, concerned executing agencies were directed to re-submit amended PC-Is after compliance of FFC's observations for reconsideration in the SC of FFC:

Table-1.7: PC-Is for re-submission after amendments

Sr. No.	Name of Sub-Projects	Estimated Cost (in Rs Million)
1.	PC-I of Expansion of Meteorological Network by Installation of Automatic Weather Stations in Pakistan under FPSP-III; and	5,025.392
2.	Establishment of Regional Flood Forecasting and Early Warning System of PMD under FPSP-III	
3.	Construction of T-Spur and stone apron at Mile 135/5 along S.M Bund (Bhanoth) in Saeedabad, District Matiari, Hala Bund Sub Division.	874.082
4.	Rehabilitation of Qadirpur Shank & Construction of Stone Studs and T-Head, District Ghotki.	3,404.763
5.	Construction of Flood Protection Infrastructure on Right & Left bank of River Neelum at Makri and Chela Bandi, District Muzaffarabad	129.18
6.	Construction of Flood Protection walls at Qadirabad, Chahtter, Rehra, Dhuli Bridge, Huda Bridge, Manjhari and Dhol Qazian in District Bagh	88.2
7.	Hydrological Assessment of Hill Torrent Potential and Strategies for Efficient Utilization to Mitigate Flooding in Southern Punjab, Upper Sindh and Northern Balochistan Regions. (PC-II)	63.160
8.	Improving Climate Resilience in Gilgit Baltistan through Headwater Management, Geochemical Assessment and Risks Characterization of Rivers, Springs & Lakes. (PC-II)	118.383
9.	Integrated Water Resources Development and Management through Rainwater Harvesting, Bio-Saline Agriculture and Aquaculture in the Thar Desert. (PC-II)	110.590

Project's physical implementation on ground, has not yet started for want of availability of matching foreign cost, yet to be arranged by EAD in line with ECNEC's decision. MoWR has requested EAD in January 2025 to approach ADB for indication of financing commitment to execute priority projects under Umbrella PC-I of FPSP-III, including the National Master Plan for Flood Telemetry. Based on above, seven (07) PC-Is of priority FPSP-III sub-projects were submitted to MoWR for further processing for their approval.

Further to above, a Chinese Grant of USD 100 million is also under consideration by EAD to support implementation of following FPSP-III sub-projects: -

(a) Construction of Duki Dam Project in District Duki, Balochistan, costing Rs. 9,361.98 million with indicative grant of USD 26.27 million;

(b) Flood Mitigation Structures along Kalpani and Bagheri Nullah, District Swabi, costing Rs. 957 million through likely grant of USD 2.68 million; &

(c) Flood protection works from Kheshki village to Motorway bridge at Kabul River (Reach-II) District Charsadda, costing Rs 2,089.615 million (Grant indicated USD 5.86 million).

Establishment of Project Coordination & Management Unit (PCMU) for FPSP-III has been approved by DDWP in March 2025, which is also a key requirement under ABD-funded Climate and Disaster Resilience Enhancement Program (CDREP).

1.5.2 National Flood Protection Plan-IV Updated (NFPP-IV-Updated)

Draft 'Updated NFPP-IV' was discussed during a Consultative Meeting held in PD&SI Division in February 2024 wherein PD&SI Division directed to include 4RF/ non FPSP-III/NFPP-IV projects in Updated NFPP-IV (without their cost implications) and circulate the draft Plan document

among the Provinces/ respective FLAs in order to seek their endorsement on respective sub-projects that these sub-projects were intended for flood protection works that emerged after floods 2010 and 2022. Subsequently, after ensuring the inclusion of 4RF (Non FPSP-III/NFPP-IV) projects and aforementioned endorsement letter & certificates of Provinces/ Stakeholder departments in Updated NFPP-IV, FFC submitted the draft Updated NFPP-IV document to MoWR in April 2024 for its approval by the Council of Common Interests (CCI). Ministry of Water Resources forwarded draft summary of Updated NFPP-IV to the CCI in August 2024 for approval. In response, the CCI, advised MoWR to obtain views/ comments of the concerned departments and Provincial Governments regarding the draft summary of NFPP-IV Updated. As of now, MoWR is pursuing feedback from Finance Division, Government of Sindh, and Government of Gilgit-Baltistan while views/comments stand received from other stakeholders. Overview of Sub-projects and Costs (PKR billion) for Phase-I and Phase-II of NFPP-IV (2024) is given in Table 1.8 below:

Table-1.8: Overview of Sub-projects and Costs of NFPP-IV Updated (2024)

Phase #	No. of Sub-Projects	Cost (Rs Billion)
Phase-I	170	195
Phase-II	205	630
Total Phase I+II	**375**	**825**

1.6 Floods in General Perspective

1.6.1 Causes of Floods: Broad-spectrum

The riverine floods take hours or even days to develop, giving ample reaction time to locals to prepare/evacuate. However, flash floods generate quickly in mountainous regions with little warning/reaction time for locals. Flash floods can be extremely dangerous, instantly turning a babbling brook into a thundering wall of water and sweeping everything on its way downstream. Floods occur in all types of rivers and their tributaries. Localized flooding may be caused or exacerbated by drainage obstructions such as landslides, ice, debris, or dam failure. The increase in flow may be the result of sustained rainfall, rapid snow melting, monsoon/depression (weather system) or tropical cyclones. Rapid flood events including flash floods, more often occur on smaller rivers, rivers with steep valleys or rivers that flow for much of their length over impermeable terrain. The cause may be localized convective precipitation (intense thunderstorms) or sudden release from an upstream impoundment created behind a dam, landslide or glacier.

Disaster experts classify floods according to their likelihood of occurring in a given time period. A hundred-year flood, for example, is an extremely large, destructive event that would theoretically be expected to happen only once every century. But this is a theoretical number. In reality, this classification means there is a one-percent chance that such a flood could happen in any given year. Over recent decades, due to global climate change, hundred-year floods have been occurring worldwide with frightening regularity.

Climate change is considered to be a critical global challenge and recurring flood events have demonstrated the growing vulnerability owing to climate change. The impacts of climate change range from affecting agriculture to further endangering food security, to rising sea levels and the accelerated erosion of coastal zones, increasing intensity of natural disasters like floods & droughts, species extinction and the spread of vector-borne diseases.

It is generally recognized that complete prevention from floods is humanly impossible but protection from flood is feasible and 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.

1.6.2 Pakistan's Flood Context and Control Objectives

Pakistan is a country with diverse type of land and fluctuating pattern of climate. Climate is usually considered hot and dry in Pakistan but it has shown significant obvious variations in last few years. Many districts and urban centers located along the rivers banks are ever on a great risk to

confront with various types of floods i.e. riverine flood, flash flood and urban floods particularly in Punjab & Sindh provinces. The floods cause damages to hundred thousand acres of fertile agricultural lands, standing crops and affect adjoining populations with monetary loss in billions of rupees. Major direct flood damages are caused to agricultural lands, standing crops, urban and rural populations, besides, other private & public property.
The riverine floods are generally caused due to heavy concentrated rainfall in the rivers catchments, during monsoon season, which is sometimes augmented by snow melt flows. Monsoon currents originating from Bay of Bengal and resultant depressions (weather system) often result in heavy downpour in the Himalayan foothills, which occasionally generate destructive floods in main rivers and their 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 usually in summer season (July - October). Therefore, damages to agriculture sector 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 and Sutlej) and secondary rivers (Kabul, Swat etc.) cause flood losses by inundating low lying areas around the rivers bed by damaging irrigation and communication network, besides, land erosion along the rivers banks. In the upper part of the Indus Basin (Punjab & Khyber Pakhtunkhwa), floodwater spilling over the high banks of the rivers generally turns back to the main rivers channel.

In the lower parts of the country i.e. Lower Indus Basin (Sindh province); River Indus is flowing at ridge i.e. higher elevation than adjoining lands. That is why flood embankments have been provided along both sides of the river. The flood water, if breaches the embankments do not return to the main river channel. This largely extends the area and period of inundation resulting in more damages to settlements, standing crops and other private as well as public infrastructure.

Sometimes breaches are occurred in the flood embankments, when the rivers attain the Exceptionally High Flood Level. At times, the flood embankments are breached at pre-determined locations to save the main structures across main rivers. The remodeling/ rehabilitation works of Barrages, on the basis of 100 years return periodhas been taken up by the Punjab & Sindh province. The construction of new Khanki Barrage on River Chenab, Rehabilitation of Jinnah &Taunsa Barrages on River Indus, Sulemanki Barrage on River Sutlej, Balloki Barrage over Ravi River and Trimmu and Panjnad Barrages over Chenab River have been completed. Remolding works on Guddu& Sukkur Barrages across River Indus is in progress.

Flood management planning in Pakistan is being carried out to essentially cover the three specific objectives namely (i) To reduce or eliminate damages to existing properties, (ii) To prevent future increase in damages; and (iii) To mitigate the residual hazards.

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

Punjab

- **Flood protection marginal bunds** have been generally constructed either to protect Headworks and other irrigation structures, or to safeguard certain towns, villages & adjoining agricultural lands in the province.

- Due to general topography of the area, **pre-determined breaching sections** have been provided in the Right Marginal Bunds (RMBs) for operation for safety of Headworks/ Barrages in case of exceptional high flood flows i.e. likely to exceed the designed level.

- In order to protect areas from floods, flood protection structures in the form of Spurs, Studs and Flood Protection Walls etc. have been constructed in critical reaches. These structures

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 (outside the flood embankments) are lower than the river bed; hence, water once leaving the Indus River does not return to the main channel.
- The escaped water thus causes greater damage to widespread areas, and it persists for a longer period even after flood peaks are over.
- Sindh province is situated at tail end, hence, drain out all rivers and if flood protection measures adopted in the upper Sindh are not properly planned, severe damages are likely to occur in the Province.
- In most of the reaches, 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 flood embankments have been further compartmentalized to contain widespread inundation.

Khyber Pakhtunkhwa

- The floods in the province are mainly due to flash flood flows in secondary rivers (Kabul, Swat, Panjkora, Khurram etc.) and major hill torrents/flood flow generating nullahs having steep bed slopes, which greatly increase flood velocity and severely erode the banks.
- Mostly flood protection walls/embankments and short spurs have been constructed to save the areas from spill action and erosion.
- A battery of around 40 spurs having considerable shank length with Marginal Bund have been constructed along the right bank of Indus River "Chashma Barrage – Ramak Reach" 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/flood protection walls in critical locations have also been constructed along Kabul, Swat, Panjkora, Kurram rivers and their tributaries including flood flows generating nullahs/hill torrents.

Balochistan

- Due to peculiar physiographic and climatic characterizes in Balochistan, the bed slopes of rivers and nullahs in Balochistan are very steep.
- It generates flash flood flows with high velocity causing banks erosion and inundations of low lying area along the banks of rivers and their tributaries.
- Mostly flood protection walls/embankments & short spurs have been constructed for protection of orchards, agricultural lands and abadies.
- Flood flows regulators/ flood diversion structures have also been constructed to dissipate the thrust of flood water and use the same for agriculture in the area.

Federally Administered Areas (Gilgit-Baltistan, AJ&K and Merged Area Khyber Pakhtunkhwa/ Ex-FATA)

- The bed slopes of rivers and nullahs in Gilgit-Baltistan, Merged Area Khyber Pakhtunkhwa (Ex- FATA) and AJ&K are very steep.

- The flash flood flows generated in main rivers and their tributaries cause severe banks erosion.

- Flood Protection walls and short spurs in PCC & gabion crates are constructed in order to check the spill and erosive action of flood flows in rivers/hill torrents.

- The main purpose of such interventions is to provide protection to abadies, agricultural lands and other private and infrastructure.

1.6.3 Flood Protection and Irrigation Infrastructure in Pakistan

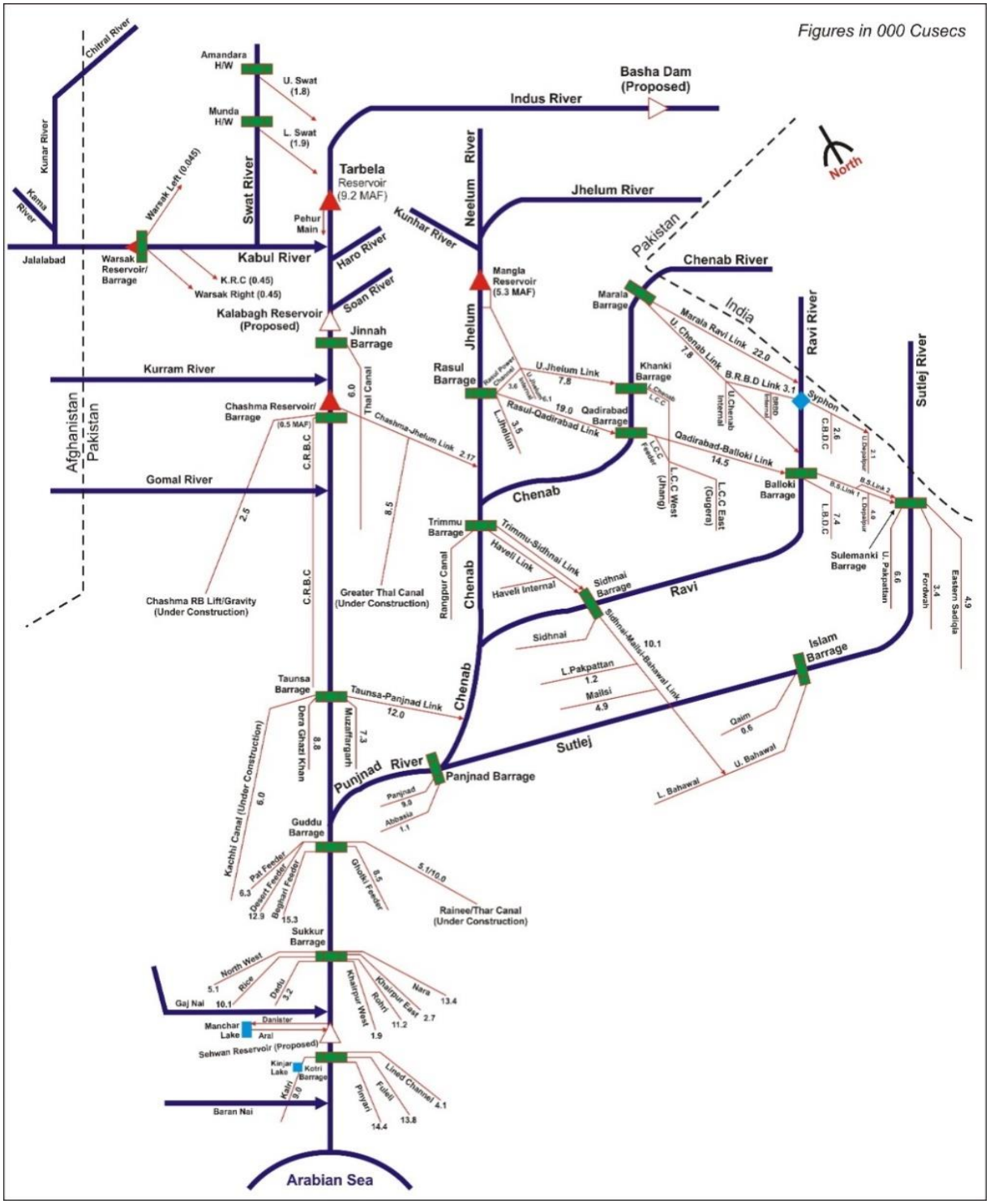
Five main rivers, namely, the Indus, Jhelum, Chenab, Ravi and Sutlej and their tributaries flow through the country's plains. The Indus, Jhelum and Chenab are known as the **Western Rivers** and Ravi, Beas, and Sutlej known as the **Eastern Rivers**. These rivers supply water to the entire Indus Basin 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 around 35.58 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 (Tarbela, Mangla & Chashma), 19 Barrages, 12 Inter-river Link Canals and 43 independent irrigation canal commands, besides, 435 Large, Medium & Small Dams.

The major storage reservoirs include Tarbela (existing Live Storage Capacity = **5.728 MAF** against original storage capacity of 9.70 MAF), Chashma (existing Live Storage Capacity = **0.311 MAF** against original storage capacity of 0.70 MAF) on River Indus and Mangla with existing Live Storage Capacity = **7.277 MAF** (this includes the additional storage capacity of 2.88 MAF after Mangla Dam Raising allowing Maximum Conservation Level of 1242 feet) against original storage capacity of 5.34 MAF on River Jhelum. The schematic diagram of Indus Basin Irrigation System is given at **Figure 1.1.**

Figure 1.1: Schematic Diagram of Indus Basin Irrigation System



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".

The existing flood management strategy includes flood peaks regulation by three major reservoirs (Tarbela, Chashma on Indus & Mangla on Jhelum), protection of private & public infrastructure, urban/rural abadies and adjoining agricultural lands from spill and erosive action of major and other rivers including Hill Torrents by flood embankments/protection walls and spurs including other interventions, besides, Flood Forecasting & Early Warning System, Rescue & Relief measures in case of flooding situation.

1.6.4 Impacts of Global Warming & Climate Change on Flood Management

Global warming causes climate change, which is a serious issue for the entire world. It is a serious threat to the third world as its impacts will not be felt equally across the earth. Developing countries including Pakistan are much more vulnerable to the impacts of climate change. The melting rate of glaciers in South Asia has increased, which has increased the risk of GLOFs in Pakistan; Shishper glacier's bursting is one example. Pakistan economy has faced significant losses due to environmental damages and degradations.

Pakistan is amongst the top ten countries on the globe experiencing frequent and intense climate change events such as floods, droughts, heavy rains, heat waves/extremely high temperatures etc. The average global temperature has increased due to increasing concentrations of carbon dioxide and other greenhouse gases in the atmosphere for last many years. During the last century, it increased by 1.6 degree Centigrade and is likely to increase further by 1.0 ^{o}C to 4.0 ^{o} C till the end of the current century.

The most recent extreme climate events witnessed by Pakistan were 2022 floods hitting various parts of the country during the monsoon season. The frequency of occurrence and intensity of floods has considerably increased during the past several years. The water security of the country is also threatened by the climate change. The increasing temperatures in the northern mountains of the country are likely to result in glacier melting, thereby affecting the flows of Indus River System.

The projected effects of global warming include changes in atmospheric and oceanic circulation, and many subsystems of the global water cycle are likely to intensify, leading to altered patterns of precipitation and runoff. Various climate model simulations show complex patterns of precipitation change, with some regions receiving less and others receiving more precipitation than they do now.

As per Pakistan Meteorological Department (PMD, climate change has rendered a 100 km spatial shift towards west in the overall monsoon pattern in the country. Rainfall distribution patterns have not only shifted spatially but also seasonally. The analysis showed that summer monsoon rainfalls have shifted towards late season; similarly, winter rain and snowfall have also shifted towards late February and March. Changing patterns result as emergence of new vulnerable areas to floods which include Khyber Pakhtunkhwa, South Eastern Punjab and Central Sindh.

1.6.5 Historical Flood Events in Pakistan

Since its creation, Pakistan has faced various severe flood events. The 2010 & 2022 floods have been the worst ever in the country. The floods of various magnitudes affected vast areas in the four provinces including Gilgit-Baltistan, Merged Area, Khyber Pakhtunkhwa (Ex-FATA) & Azad Jammu & Kashmir. Owing to adverse impacts of climate change, in the recent years, vulnerabilities of communities to coastal & urban flooding have also increased.

Flood damages are caused mainly due to riverine flooding in main rivers and flash floods in Secondary & Tertiary Rivers/Hill Torrents, Coastal flooding due to Cyclone & urban flooding due to torrential rains and inadequate storm drainage facilities, besides, GLOFs in northern parts of the country. The unprecedented floods of 2010 were one of the worst floods in 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 total area of 160,000 Km^2 was affected.

The floods of Monsoon 2022 are said to have surpassed the 2010 floods as this caused a humanitarian catastrophe with over 33 million people affected and 1739 deaths (*source: NDMA sitrep dated 18th November 2022*). There has also been a substantial impact on livestock, homes and other infrastructure across Sindh, Khyber Pakhtunkhwa, Southern Punjab and Eastern Balochistan. The major historical flood events and their damages are given in **Table 1.9** on the next page.

Table 1.9 Major Flood Events Witnessed in Pakistan & their damages

Sr. No.	Year	Direct Losses (US$ million)	Lives Lost (No)	Villages Affected (No)	Flooded Area (Sq-Km)
1	1950	488	2,190	10,000	17,920
2	1955	378	679	6,945	20,480
3	1956	318	160	11,609	74,406
4	1957	301	83	4,498	16,003
5	1959	234	88	3,902	10,424
6	1973	5,134	474	9,719	41,472
7	1975	684	126	8,628	34,931
8	1976	3,485	425	18,390	81,920
9	1977	338	848	2,185	4,657
10	1978	2,227	393	9,199	30,597
11	1981	299	82	2,071	4,191
12	1983	135	39	643	1,882
13	1984	75	42	251	1,093
14	1988	858	508	100	6,144
15	1992	3,010	1,008	13,208	38,758
16	1994	843	431	1,622	5,568
17	1995	376	591	6,852	16,686
18	2010	10,056 @ 1US$= PKR 86	1,985	17,553	160,000
19	2011	3,730 @ 1US$= PKR 94	516	38,700	27,581
20	2012	2,640 @ 1US$= PKR 95	571	14,159	4,746
21	2013	2,000 @ 1US$= PKR 98	333	8,297	4,483
22	2014	440 @ 1US$= Rs 101	367	4,065	9,779
23	2015	170 1US$= PKR 105.00	238	4,634	2,877
24	2016	6 1US$= PKR 104.81	153	43	-
25	2017	-	172	-	-
26	2018	-	88	-	-
27	2019	-	235	-	-
28	2020	-	409	-	-
29	2021	-	198	-	-
30	2022	30,000 1US$= PKR 225	1,739	6,631	85,000
31	2023	-	226	-	-
32	2024	-	368	-	-
Total		**68,225**	**23,982**	**203,704**	**701,558**

1.6.6 Traditional & Innovative Approaches in Flood Management

Flood management plays important role in protecting people and their socio-economic activities in flood prone areas from flooding. The development in the river basins has been closely linked with successful implementation of flood control projects. In the past, exposure to flood risks has been handled largely through structural measures. However, strategies that rely largely on structural solutions may alter the natural environment of the river, which may result in loss of habitats, biological diversity and ecosystem productivity.

Further, structural approaches are bound to fail the moment an extraordinary or unforeseen event occurs. These traditional approaches, where the risks are merely transferred spatially, are likely to generate conflicts and inequities. Environmental degradation has the potential to threaten human security, including life and livelihoods, food and health security. This realization has recently led to calls for a paradigm shift from traditional flood management approaches to Integrated Flood Risk Management (IFRM). Based on this, 4th National Flood Protection Plan of the country (NFPP-IV) is being updated with support from ADB.

IFRM aims at minimizing loss of life from flooding while maximizing the net benefits derived from flood plains. This is the concept that addresses issues of human security against flood risks and sustainable development within the framework of Integrated Water Resources Management (IWRM) and can play an important role in sustainable development and poverty reduction.

Historically, flood plains have been the preferred places for socio-economic activity as is evident from the very high densities of human settlement found there. Floods are a natural phenomenon, with both negative and positive impacts, and generally, should not be considered a hindrance to economic development. Floods play a major role in replenishing wetlands, recharging groundwater and support agriculture and fisheries system, making flood plains preferred areas for human settlements and economic activities. Extreme demands on natural resources due to population growth have forced people and their property to move closer to rivers in many parts of the world. Further, flood control and protection measures have encouraged people to utilize protected and reclaimed areas extensively, thereby increasing flood risks and consequent losses.

Recurrent and extreme flooding, however, pose grave risks to development and have negative impacts on lives, livelihoods and economic activity and can cause occasional disasters. Flood disasters result from the interaction between extreme hydrological events and environmental, social and economic processes. These disasters have the potential to put development back by five to ten years, particularly in developing countries. The spiraling economic losses in developed countries also have given rise to grave concerns. The balancing of development needs and risks is essential. The evidence worldwide is that people will not, and in certain circumstances, cannot abandon flood-prone areas. There is a need, therefore, to find ways of making life sustainable in the floodplains. The best approach is to manage floods in an integrated manner.

The traditional management response to severe floods was typically an adhoc reaction – quick implementation of a project that considered both the problem and its solution to be self-evident, and that gave no thought to the consequences of flood risks for upstream and downstream areas. Thus, flood management practices have largely focused on mitigating floods intensity and reducing their localized damages to private and public property. Traditional flood management has employed both structural and non-structural interventions, besides, physical and institutional interventions. These interventions were employed prior, during and after flooding and have often overlapped. Traditional flood management interventions are briefly described below:

i. **Source Control to Reduce Runoff** Permeable pavements, afforestation artificial recharge;
ii. **Storage of Runoff** Detention Basins, check dams and small/medium/large reservoirs etc.;
iii. **Capacity enhancement of Headwork/Barrages across Rivers** Remodeling of Barrages/Headworks for enhancing their discharge capacities besides, provision of Bypass/Escape channels, wherever feasible;
iv. **Separation of Rivers and Population**
Land-use control, flood plan mapping & zoning, removal of illegal encroachments as per River Law/Act, construction of flood protection infrastructure

v. **Emergency Management during Floods** Flood Forecasting & Warnings, flood fighting works i.e. raising/strengthening flood embankments, flood flows diversion and evacuation of flood affectees from dangers zone and their temporary settlement at safe places; and
vi. **Flood Recovery** Compensation of flood affectees and rehabilitation/restoration of damaged public infrastructure.

Surface water storages (large, medium & small dams), flood embankments and flood flows retention basins, is a traditional approach to attenuating flood peaks. Water storage attenuate floods by slowing the rate of rising waters, by enhancing the time it takes for the waters to attain high level and evade the synchronization of flood peaks, hence, lowering the peak level in the downstream areas. Such storages reservoirs serve multiple purposes i.e. storage of water mainly for irrigation water supplies, hydropower generation including flood management. Storage Reservoirs have to be used in an appropriate combination with other structural and non-structural measures.

Seemingly self-evident, but regularly overlooked in practice, is the need to make flood management a part not only of the planning and design, but also of the operation of reservoirs. Releases of surplus water from reservoirs at the time, when rivers in the downstream areas experiencing high flood flows can create risks, therefore, careful operation of reservoirs can minimize the loss of human life and damages to property due to properly flood flows regulation and releases in the downstream areas. In this context, trans-boundary cooperation is indispensable.

Flood embankments are most likely to be appropriate for floodplains that are already intensely used, in the process of urbanization, or where the residual risks of intense floodplain use may be easier to handle than the risks in other areas i.e. (Landslides or other disturbances).

Land-use control is generally adopted where intensive development on a particular floodplain is undesirable. Providing incentives for development to be undertaken elsewhere may be more effective than simply trying to stop development on the floodplain. Where land is under development pressure, however, especially from informal development, land-use control is less likely to be effective. Flood protection or construction of houses at high elevation is most appropriate where development intensities are low and properties are scattered, or where the warnings times are short. In areas prone to frequent flooding, protection of the infrastructure and the communication links from floods can reduce the debilitating impacts of flood on the economy.

Flood Forecasting & issuance of timely warnings are complementary to all forms of intervention. A combination of timely, clear & accurate warning messages with a high level of community awareness gives the best level of preparedness for self-reliant action during floods. Public education program/awareness campaign is crucial to the success of warnings intended to preclude a hazard from turning into a disaster.

Evacuation is an essential constituent of emergency planning and evacuation routes may be upward into a flood refuge at a higher elevation or outward, depending upon the local circumstances. Outward evacuations are generally necessary where the depths of water are significant, where flood velocities are high and where the buildings are vulnerable. Successful evacuations require planning and awareness among the population of what to do in a flood emergency.

Active community participation in the planning stage and regular exercises to assess the viability of the system help ensure that evacuations are effective. The provision of basic amenities such as water supply, sanitation and security in areas where affectees gather is particularly important in establishing a viable evacuation system.

1.6.7 Challenges in Flood Management

Besides many other challenges, climate change is emerging as perhaps the greatest environmental challenge for the region in general and for Pakistan in particular, causing floods, droughts and increasing hunger, poverty, displacement, soil degradation and deforestation. Rising number of extreme climate events, shift of monsoon rainfall zone from North-east to North-west, intense, concentrated monsoon rains in short time of interval, inconsistent behavior of monsoon and

erratic flash flood events are the major future challenges. There is strong need to educate people about these natural disasters and their frequent occurrence in the region including Pakistan.

There is a growing recognition that current approaches regarding flood management are not as sustainable as they might be. Hence, it is imperative to cope with increasing risks of flooding and the uncertainties of climate change more effectively. Increased population pressure and enhanced economic activities in flood prone areas/floodplains, such as the construction of buildings and infrastructure, further increase the risk of flooding. In developing countries with primarily agricultural economies, food security is synonymous with livelihood security. Floodplains contribute substantially to the food production that provides nutrition for the people of these countries.

Asia-Pacific region is under the very frequent and severe impacts of floods because of its geographical composition. Majority of the region's major cities are located nears river bank s or coastal areas, which have concentration of population, assets, economic & industrial development and infrastructures. In addition to riverine floods, Pakistan is also facing urban flooding, which is mainly caused due to torrential rains/heavy falls in urban areas, especially those cities which are overcrowded and having inadequate storm water drainage facilities are badly affected almost every year. Flash floods in semi mountainous regions are causing severe damages to private and public properties. Increasing urban flood risk has pushed all national and international organizations to take measures to confront the threats caused by floods and to build flood resilient cities.

Pakistan is a resource constraint country with a fast growing population, low natural resource development based and unfavorable local socio-cultural conditions, and climate change is an additional stress for the country. Educating masses about natural disasters and building up their preparedness at educational institutions can be of great help to minimize the damages of disasters. Media can play its due role in this regard as without its support, awareness cannot be boosted. Areas vulnerable to climate change-induced natural disasters must have adequate flood protection facilities, besides, reliable medium and long range Weather & Flood Forecasting & Warning System at place.

1.6.8 Impact of Rapid Urbanization on Flood Management

The world is experiencing a historically unprecedented transition from predominantly rural to urban living. In 1950, one-third of the world's population lived in cities. Today the number has already reached more than 50% and by 2050, city dwellers are expected to account for more than two-thirds of the world's population. This rapid rise will mainly take place in developing countries. Africa and Asia are likely to be the fastest urbanizing regions. The urban population projected to reach 64% in Asia by 2050 (currently at 48%).

People move from rural environments into cities (urban areas) to seek economic opportunities and better access to basic services. Climate change is likely to accelerate the migration rate into urban areas by altering the livelihood basis from both fishing and farming and by increasing the occurrence and intensifying the effects of natural hazards. Land use and other human activities influence the peak discharge of floods by modifying how rainfall and snowmelt are stored on and run off the land surface into streams.

Construction of roads and buildings often involves removing vegetation, soil, and depressions from the land surface. The permeable soil is replaced by impermeable surfaces such as roads, roofs, parking lots, and sidewalks that absorb little water, reduce infiltration of water into the ground, and accelerate runoff to ditches and streams. With less storage capacity for water in urban regions and more rapid runoff, urban areas streams rise more quickly during storms and have higher peak discharge rates than rural areas streams. Total volume of water discharged during a flood tends to be more in urban streams as compared to rural areas streams.

1.6.9 Urban Floods in Pakistan: Causes, Impact & Control

Urban floods are being experienced in Pakistan in different cities, especially in monsoon season, having high population density (Karachi, Lahore, Faisalabad, Multan, Hyderabad, etc.) with unplanned, clogged, encroached and undersized drainage systems. Urban flooding is a relatively serious problem in the city, especially in the dense parts of the city. The Karachi's vulnerability to the

urban flooding is due to population growth, blocking of drainage channels, inappropriate land use and urbanization.

Karachi has many large and small drains, but most of them are chocked or encroached. Urban flooding takes place due to the insufficient and encroached storm water drainage system, unplanned urbanization and impact of climate change. The climate vulnerability has contributed to the unpredictability of precipitation in many parts of the world and also to frequent urban flooding in Karachi, which is not only capital of Sindh province of Pakistan but the country's biggest city in terms of both population and area. Karachi is most populous city of Pakistan with population of 14.9 million (according to 2017 census). Karachi is hub of governance, education, business, industry, transport, finance and banking.

The urban flooding in Pakistan usually occurs due to the following reasons:

- High intensity of rainfall and uneven rainfall (due to climate change)
- Population growth/ unplanned housing
- Inadequate sewerage/Storm water drains system.
- Encroachments in the drain way
- Inadequate cleaning of Drains/Nullahs
- Mismanagement at city/provincial government level
- Little height from sea level (In case of Karachi it is only 1.5 meters above mean sea level)

Based on the review of available literature, the following recommendations may be helpful made to minimize the damages to human lives and public and private properties in Karachi due to urban flooding:

i) Flood hazard map of Karachi needs to be prepared with respect to the drainage system and different nullahs on the basis of degree of hazards.
ii) Once hazard mapping is available early warning system needs to be provided on the different mullahs keeping in view the degree of danger so that necessary evacuation may be carried out in case of emergency situation.
iii) Cleaning of different nullahs/storm drains may be carried out well before the onset of monsoon season so that blockage in these nullahs/storm drains can be avoided.
iv) Government of Sindh may carry out necessary legislation to stop further dumping of garbage into these nullahs by the local inhabitants.
v) Removal of encroachments in these Nullahs needs to be carried out on top priority.
vi) Carryout mass campaign among the public to raise the awareness of the flood hazards and its consequences.
vii) Government of Sindh needs to invest in the rehabilitation of storm drains and carry out proper maintenance of the system.

1.7 Institutional Flood Management Mechanism

Flood management is a multifunctional process involving number of stakeholders/organizations. Following organizations plays major role in the flood management:

Table 1.10: Flood Management Mechanism

Organization	Responsibility
Federal Flood Commission (FFC)	Planning & Execution
NDMA	National level Contingency Planning
PMD, FFD	Forecast Generation
PCIW	Cross Border Data Management
WAPDA	Regulation of Dams
IRSA	Canal Water Regulation
PIDs	Barrage Operation
	Maintenance of Flood Infrastructure
PIDs & Pak Army	Flood Fighting
DDMAs/PDMAs/NDMA	Management of Resulting Disasters

1.7.1 Role of Federal Flood Commission in Flood Management

Federal Flood Commission (FFC) is a forum which primarily serves as a coordinating body among Federal Line Agencies and Provincial Governments involved in flood management across Pakistan. While overall flood coordination and strategic planning rest with FFC, operational responsibilities for flood response, including the management of floodwaters, lie with the respective Provincial Irrigation Departments (PIDs) and Federal Line Agencies. FFC's role focuses on proactive planning and real-time coordination from the perspective of flood protection measures. Following are the Pre-Monsoon, during Monsoon and Post Monsoon actions taken by FFC:

Pre-Monsoon Season Action Taken by FFC

- 1st Pre-Monsoon 2024 meeting of FFC was held on March 04, 2024 to review the progress on Post 2023 flood activities and preparatory works for Monsoon Season 2024. Accordingly, necessary directions regarding pre-emptive measures for Monsoon Season 2024 were issued to concerned organizations.

- 2nd Pre-Monsoon 2024 meeting of FFC was held on April 26, 2024 to further evaluate the preparedness of all flood management organizations.

Role of FFC during Monsoon Season

- 59th Annual meeting of FFC was organized on June 10, 2024 under the Chairmanship of CEA/CFFC wherein all stakeholders presented their status of preparedness. Necessary directions were issued to concerned organizations for assuring the safe passage of flood flows during Monsoon Season 2024.

- Additionally, FFC held five (05) online review meetings during the monsoon season to monitor ongoing preparedness and issue immediate directions in response to emerging flood risks on 4th July, 15th July, 30th July, 12th August and 27th August 2024.

- Flood Communication Cell (FCC) at FFC was activated on 15th June 2024 and operated round-the-clock until 15th October 2024. Its functions included:
    - Continuous collection and monitoring of hydro-meteorological data (rainfall, river flows, reservoir levels, inflows/outflows)
    - Coordination with key organizations such as FFD Lahore/PMD, PCIW, WAPDA, PIDs, NDMA, PDMAs, GBDMA, FDMA, and SDMA.
- FFC issued daily Flood Situation Reports (DFSR) from 1st July to 30th September 2024 to higher ups and Flood Management related agencies. The reports included:
    - River discharges and gauge readings at key control points on the Indus River System (Indus, Jhelum, Chenab, Ravi, Sutlej, and Kabul);
    - Reservoir levels and storage status (Tarbela, Chashma, Mangla);
    - 24-hour weather forecasts and meteorological summaries from FFD, Lahore;
    - Updates on embankment breaches or canal overflows as reported by field agencies;
    - Technical analyses and recommendations for real-time flood and reservoir management.
- In addition to DFSRs, Press Releases, Weather Advisories, Flood Alerts, and Significant Flood Warnings were issued as required through the FCC.

- Response actions to alerts and warnings issued by PMD/FFD Lahore and FFC were the responsibility of the concerned Federal/Provincial agencies, including local District Administrations.

Post Monsoon Season Role of FFC

- Post Monsoon 2024 meeting of FFC was convened on October 09, 2024 to assess the outcomes of the monsoon season. Key decisions were made to address gaps in flood response and initiate timely rehabilitation and improvement measures. Necessary instructions were issued for implementation of the agreed actions.

1.8 Recent FFC Initiatives

1.8.1 National Master Plan for Flood Telemetry

In Pakistan, the rational prevention of natural disasters, such as floods and droughts, is strongly connected with a forecasting technology which cannot be achieved without hydro-meteorological observations. Adequate and accurate hydro-meteorological data at fine time scale is very important and it is essential to improve the monitoring infrastructures by taking advantage of modern technologies for remote control and data management for performing a range of hydrological studies.

The existence of a dense telemetry network of instruments is required in order to be able to model, predict and plan for catastrophic events which have obvious negative impacts on public health and socioeconomic aspects in the country. Federal Flood Commission (FFC) formulated and approved NFPP-IV on May 02, 2017 that aimed at improving the country-wide comprehensive flood management plan with focus on acquiring real time hydro-meteorological information through telemetry network for better flood forecasting. Accordingly, all stakeholders, Indus River System Authority (IRSA), the Federal Flood Commission (FFC), the Pakistan Commissioner for Indus Waters (PCIW), the Pakistan Meteorological Department (PMD), Provincial Irrigation Departments (PID's), Federal Line Agencies (LFAs) and different formations within WAPDA, came up with proposals on up-gradation of existing flow networks to telemetric systems and installation of additional telemetry networks.

Asian Development Bank (ADB) showed interest to provide funds for this proposed telemetry system. The Mission suggested FFC to prepare a joint proposal through WAPDA and come up with a National Master Plan of Flood Telemetry System, comprising inventory of existing telemetry facilities with respect to Gauging Stations/ Telemetry Network within each Province/ FLAs and new proposed stations.

Accordingly, National Master Plan for Flood Telemetry (NMPFT) Network has been prepared by WAPDA, under the overall coordination of FFC and with the technical assistance of Asian Development Bank (ADB) in the form of Technical Expert. The Plan is proposed to be implemented in five (05) years period with estimated cost of Rs 13,591 Million. Its purpose is to bring improvement in the Flood Early Warning System on country-wide basis including four provinces, GB and AJ&K. Details are given in **Table 1.11** given as under:

Table 1.11: Region-Wise Summary of Proposed Telemetric Stations Under Phase-I & II

Sr. No.	Province/Region	Phase-I	Phase-II	Total
		No. of Stations	No. of Stations	No. of Stations
1.	Punjab	114	37	151
2.	Sindh	30	16	46
3.	Khyber Pakhtunkhwa	90	46	136
4.	Balochistan	149	58	207
5.	Gilgit Baltistan	48	36	84
6.	AJ&K	26	57	83
	Total:	**457**	**250**	**707**

After 2022 floods, WAPDA was directed to prepare PC-I for flood telemetry prioritizing the installation in calamity hit areas. Accordingly, PC-I was prepared containing total 457 sites all over Pakistan in the Phase-I costing Rs 14,824 million.

1.8.2 Follow up on Encroachments Removal

The critical and long outstanding issue of encroachments in the flood plains/ waterways that hindered the smooth flow of water had been discussed in several meetings of the Senate Standing Committee on Water Resources, wherein the Honourable members had shown their dis-satisfaction over the presence of encroachments in the waterways of the rivers and had directed to remove all the illegal construction within the flood plain. As a follow-up, FFC obtained information about encroachments from Provincial Irrigation Departments (PIDs) and forwarded the same to SUPARCO for verification. SUPARCO conducted verification and submitted its report/ input to FFC, which was shared with PIDs for compliance.

1.8.3 Preparation of Bill for FFC

The forum of Federal Flood Commission (FFC) was created in 1977. After 2010 floods, on the directions of the Supreme Court of Pakistan under Constitution Petition No. 62/2010, the then Ministry of Water and Power reconstituted the Commission vide Notification No. 3(22)/2015-Water dated 9th July 2015.

Under the Climate & Disaster Resilience Enhancement Program (CDREP), one of the policy actions required preparation and submission of Bill for the institutional restructuring of the Federal Flood Commission and its approval by the Government. In this regard, the Asian Development Bank (ADB) had extended Technical Assistance for drafting of the Bill by hiring two institutional reforms consultants (foreign & local). Earlier prepared draft Bill was circulated among PIDs & FLAs. The response received from all stakeholders had been incorporated in the present draft prepared by the Institutional Reform Consultants appointed by the ADB. The final draft of the Bill had been submitted to the Ministry of Water Resources on 24th June 2025 for further processing and necessary approvals.

The functions and composition of the proposed re-structured FFC's Bill remained largely consistent with the earlier notified structure. However, under the new arrangement, the FFC would be legally empowered to issue No Objection Certificates (NOCs) for the construction of structures along and across the rivers to ensure safety of public and to avoid bottlenecks in the smooth river flows.

1.8.4 Projects under JICA Grant-in-Aid Programme

Following projects are being implemented under JICA Programme:

I. Technical Advisors on Flood Management in the Islamic Republic of Pakistan **(Technical Cooperation)**

II. Flood Management Enhancement Project in Indus Basin to Islamic Republic of Pakistan (Flood and Telemetry) Improvement of River Dike and Installation of Telemetry System) **(Grant Aid Project)**

III. Capacity Development of Effective River Dike Management Response to 2022 Floods in Islamic Republic of Pakistan **(Technical Cooperation)**

Following proposed projects are being processed for implementation under JICA Programme:

I. Project for Flood Protection and Dike Improvement in Southern Indus River in Sindh Province **(Grant Aid Project)**

II. Project for Capacity Development of Government Agencies to promote development of Flood Control Infrastructures **(Technical Cooperation)**

1.8.5 Technical Advisors on Flood Management in the Islamic Republic of Pakistan (Technical Cooperation)

Pakistan is hit by natural flood disaster frequently, and caused tremendous damages, such as 2010 floods, when approximately 2,000 people died and more than 20 million people effected badly. Under the circumstances Government of Pakistan prepared forth National Flood Protection Plan IV (NFPP-IV) during 2015. It's true that the office of CEA/CFFC has played a pivotal role since 1977 for flood managements in Pakistan however, due to low budgetary resources for the office of CEA/CFFC, it could not work smoothly and efficiently as it was originally supposed to be. Therefore, the Government of Pakistan requested the Government of Japan to provide advice and technical assistance in solving the perennial flooding problems in Pakistan.

In response to the above request, the Japan International Cooperation Agency (JICA) decided to dispatch a Technical Advisory Team on flood management to promote the implementation issues and provide the advice on the future flood control projects plans to identify priority flood control projects under NFPP-IV and strengthen the capacity of FFC to manage flood projects. The overall goal of the advisory services was importance of appropriate plan and implementation of flood control measures and consequently the investment in flood control measures can be expanded to a level where human and economic losses can shift to a declining trend.

To defuse the situation, the JICA Advisory Team recommends and proposed to the Government of Pakistan for the establishment of a Flood Management Authority and simultaneously also trying to manage and provide technical assistance through Japan International Cooperation Agency (JICA), Government of Japan. It has also been supposed that after the constitution of the Authority, the working capability, quality of work and performance of the office of CEA/CFFC will surely be improved at a large extent and it can play its vital role for flood management in Pakistan as it was originally supposed to do so. JICA Technical Advisors completed their task in August 2023 for which minutes of the meetings have already been signed.

1.8.6 Flood Management Enhancement Project in Indus Basin to Islamic Republic of Pakistan (Flood and Telemetry) Improvement of River Dike and Installation of Telemetry System) (Grant Aid Project)

In response to a request from the Government of the Islamic Republic of Pakistan, the Government of Japan signed the Minutes of Discussion for the subject project on July 23, 2023, in Islamabad. Following initial research and consultations, JICA dispatched an Expert Survey Team to carry out the outline design of the project. Expert Team held a series of meetings with officials of the Government of Pakistan. During these discussions, both sides agreed that the project would comprise two major components: Flood Management and Telemetry. Regarding the flood-related component, site surveys were conducted exclusively in the Hazara region of Khyber Pakhtunkhwa (KPK). The Government of KPK had proposed a total of 19 sites located in the districts of Haripur, Abbottabad, and Mansehra. JICA team visited and assessed all proposed sites, ultimately shortlisting four (04) sites—classified as high and medium priority—located in Haripur and Mansehra districts.

During the planning for the installation of 45 telemetry stations, it was confirmed that the stations would be established in both Punjab and Khyber Pakhtunkhwa (KPK). The components requested by the Government of Pakistan under this initiative includes i) Hydrological and Hydraulic Observation Network, ii) Central Data Management Centers: One at the FFC, Ministry of Water Resources, Islamabad and the other at WAPDA's existing facility in WAPDA Town, Lahore, iii) Automatic Weather Observation System (AWS) & iv) Training Component.

Concept Clearance Proposal (CCP) was considered during the pre-CDWP/CCC meeting held on June 21, 2023 and was subsequently recommended for approval by the CDWP/CCC. To move forward with the project, JICA deployed a team of consultants to conduct the preparatory survey from September to November 2023. Following detailed field surveys and stakeholder consultations, the Minutes of Discussion (MoD) for the final preparatory survey were signed in July 2024. CCP for the project was approved in the CDWP/CCC meeting held on June 27, 2024. The PC-I of the project, with a total cost of Rs. 5,178.41 million—including a JICA grant of Rs. 4,110.398 million and a

Government of Pakistan (GoP) share of Rs. 1,068.014 million—was submitted to the Planning Commission for CDWP approval. It was reviewed during the pre-CDWP meeting held on September 2, 2024, where it was recommended for approval and subsequently approved by the CDWP. The project has been included in the Public Sector Development Programme (PSDP) for FY 2024–25, with an initial allocation of Rs. 10.00 million.

1.8.7 Capacity Development of Effective River Dike Management Response to 2022 Floods in Islamic Republic of Pakistan (Technical Cooperation)

Pakistan has experienced several devastating flood events, with the 2010 and 2022 floods being the most catastrophic. In response to the 2022 floods, the Japan International Cooperation Agency (JICA) dispatched a Disaster Management Advisory Team to Pakistan from October 31 to November 11, 2022.

At the request of the Office of the Chief Engineering Adviser/Chairman Federal Flood Commission (O/o CEA/CFFC), Government of Pakistan, JICA approved a Technical Cooperation Project aimed at enhancing the capacity of technical staff from the O/o CEA/CFFC and the Irrigation Departments of Punjab and Sindh. A Record of Discussions (RD) was signed between JICA and the O/o CEA/CFFC in February 2023.

The project focuses include i) Assessing climate change impacts on flood management, ii) Developing diagnostic mechanisms for existing river dikes, iii) Formulating a dike operation and management plan, iv) Identifying and conducting pre-feasibility studies for priority projects & v) Strengthening institutional capacity in dike management. The project officially commenced on December 1, 2023, and will conclude in January 2025. Following are the key activities of the project:

Training in Japan:

- *First Batch (Nov 18–29, 2024):* Nine participants from the Ministry of Water Resources, FFC, and Irrigation Departments of Punjab and Sindh received training on dike management.
- *Second Batch (Apr 15–25, 2025):* Eight participants from the same institutions are scheduled for training in Japan.

Equipment Provision and Training:

- *Punjab:* Equipment including 3 desktop workstations, 2 laptops (including 1 workstation), surface wave exploration equipment, echo sounder, and dynamic cone penetrator were handed over to the Irrigation Department. Hands-on training for 16 professionals will be conducted in February 2025.
- *Sindh:* Similar equipment was handed over, and hands-on training for 30 professionals will be conducted in February 2025.

1.8.8 Project for Flood Protection and Dike improvement in Southern Indus River in Sindh Province (Grant- In- Aid Project)

The Office of the Chief Engineering Adviser/Chairman Federal Flood Commission (CEA/CFFC) submitted a formal request to JICA Pakistan on October 17, 2023, for the launch of a flood protection project under the Japanese Grant-in-Aid Program, following JICA Pakistan Office's initiative.

The proposed project aims to reduce flood-related damages and human suffering in both urban and rural areas by rehabilitating existing flood protection infrastructure along the River Indus. The primary focus is on enhancing protection in high-risk flood-prone zones and strengthening national resilience against future flood events. Key objectives include i) Minimize loss of life, livelihoods, and damage to public and private infrastructure, ii) Improve the efficiency of flood dike management by Provincial Irrigation Departments (PIDs) & iii) Support the maintenance and strengthening of flood protection dikes to safeguard communities, cities, and towns along the River Indus. The proposal is

currently under review by JICA Headquarters in Tokyo and is expected to be launched in the near future.

1.8.9 Project for Capacity Development of Government Agencies to promote Development of Flood Control Infrastructures (Technical Assistance Project)

This Technical Cooperation Project, titled *"Project for Capacity Development of Government Agencies to Promote Development of Flood Control Infrastructures"*, is being proposed under JICA assistance. The project's main objective is to strengthen FFC's technical and coordination capacity with stakeholders and promote investment in flood risk reduction, in line with updated NFPP-IV and the Sendai Framework for Disaster Risk Reduction. Scope of the project include i) Comprehensive flood risk assessments based on historical data, hydrology, and climate projections, ii) Identification of vulnerable areas and critical infrastructure, iii) Socio-economic and environmental impact analysis, iv) Stakeholder consultations and participatory planning, v) Evaluation of structural and non-structural investment options & vi) Development of a monitoring and evaluation framework with clear performance indicators. Formal request submitted to JICA in July 2024 via the Ministry of Water Resources.

1.9 National Master Plan on Drainage

Pakistan experienced devastating rains and floods in 2022. The country received unprecedentedly abnormal rains from July – August 2022 period, especially in the lower half of the country, which generated high flood flows in various hill torrents on a countrywide basis. Among those, some of the hill torrents of D.G Khan in the Koh-e-Suleiman range (Sanghar, Vehova, Kaura, Sori Lund etc.) received historically high floods which resulted into high flood situation in Taunsa Barrage (Indus River) and downstream. The hill torrents of Kirthar Range in Sindh and various hill torrents in Khyber Pakhtunkhwa and Balochistan also received high flood flows. As a result, extreme hydro-meteorological events (torrential rainfall) generated flash floods in hill torrents areas of Punjab (D.G. Khan), Balochistan (Lasbela, Barkhan), Khyber Pakhtunkhwa, and Azad Jammu & Kashmir.

Damages caused by Floods 2022 were mostly due to floods peaks on hill torrents of Koh-e-Suleman and Khirther range in Punjab and Balochistan. It was observed that during 2022 monsoon season, hill torrents generated almost 9 MAF of flood water. Considering the interprovincial concerns related to drainage of torrential flood water, Federal Minister for Water Resources convened a preliminary discussion on July 07, 2023 in Parliament House Islamabad. Therein, he directed to formulate a comprehensive and all-inclusive National Drainage Master Plan to holistically address the Inter-Provincial drainage issues of Sindh, Balochistan, Khyber Pakhtunkhwa & Punjab in the context of 2022 torrential flash flooding. The Minister directed Chairman FFC to lead the process for stakeholders consultation for formulation of Master Plan on Drainage.

1.10 Meetings/ Workshops/ Seminars organized by FFC during the Calendar Year 2024

Meetings/ Workshops/ Seminars organized by Flood Wing during the Calendar Year 2024 are given below in **Table 1.12**.

Table 1.12: Meetings organized by FFC during the Year 2024

Name of Meetings
Meetings regarding FFC Interface on NATCAT Model were held in O/o CEA/CFFC on 2nd January, 1st February, 14th February 2024
5th Virtual Meeting of Joint Working Group (JWG) on Pakistan-Hungary Water Management MOU to review the progress made towards Implementation of Work Programme was held in O/o CEA/CFFC on January 11, 2024.
16th Progress Review Meeting of FFC (to review progress on Honourable Supreme Court of Pakistan's directions related to Constitution Petition No.62 of 2010, filled by Miss Marvi Memon versus Federation of Pakistan) was held in O/o CEA/CFFC on January 24, 2024.

Name of Meetings
A meeting with ADB was held on 16 February 2024 in relation to revised NFPP-IV.
Pre Monsoon Meetings of FFC for Monsoon Season 2024 were held on March 04 & April 26, 2024.
A series of meetings with stakeholders in relation to the JICA sponsored "Flood Management Enhancement Project" were held on March 05, March 06, March 7-8, March 11 and March 12-13, 2024.
Training regarding Preparation of Sub-Projects forms under Updated Umbrella PC-I of FPSP-III/NFPP-IV (updated) was organized by FFC with the support of ADB from March 26 to 28, 2024.
Consultative meetings of the stakeholders on the project titled "Capacity Development of Effective River Dike Management Response to 2022 Floods" were held on May 17, May 31 & June 25, 2024.
One-day Seminar on issues and Challenges on Design, Construction and O & M of flood protection bunds under the titled 'Capacity Development of Effective River Dike Management Response to 2022 Floods'' was held on June 03, 2024.
59th Annual Meeting of FFC was held on June 10, 2024 to review the Status of Preparedness for Monsoon Season 2024.
On-Line Meetings of FFC to review the status of preparedness during Monsoon Season 2024 were held on July 04, July 15, July 30, August 12, August 27, 2024.
Meeting regarding formulation of work plan for sub-projects proposed for implementation under ECNEC approved umbrella PC-1 updated FPSP-III was held on August 07, 2024.
4th & 5th meetings of the Technical Committee of Ministry of Water Resources on Water Sector SDG indicators were held on August 23 & September 30, 2024 to evaluate the progress made on the SDG-6 Indicators to pursue achieving the desired SDGs within 2030.
2nd Joint Coordination Committee (JCC) Meeting regarding the Project titled "Capacity Development Effective River Dike Management Response to 2022 Floods" was held on October 07, 2024 to include assessing climate change impacts, developing diagnostic mechanisms for river dikes, formulating a dike operation management plan, identifying priority projects, and conducting necessary feasibility studies.
Post Monsoon 2024 Review Meeting of FFC was held on October 09, 2024 to assess the impact of the monsoon season and review the preparedness and response of various government agencies and stakeholders involved in disaster management. This meeting is an important tool in ensuring that lessons learnt would be applied to improve disaster management and reduce loss of life and property.

1.11 Monsoon Season 2024

1.11.1 Climate Change-Monsoon Seasonal Precipitation

The year 2024 has been marked by particularly significant climatic events. It will most likely be the hottest year ever recorded since the instruments were put in place. Severe global floods have affected parts of Central Asia, East Africa, West Africa, Southeast Asia and Central Europe and everyone was struck by the terrible images of Spain's flood-stricken east coast. In Kazakhstan, rapid snowmelt caused spring flooding, while typhoons like Gaemi and Yagi brought heavy rains to the Philippines and Southeast Asia. In countries such as Pakistan, India and Bangladesh, seasonal monsoons contributed to recurrent flooding.

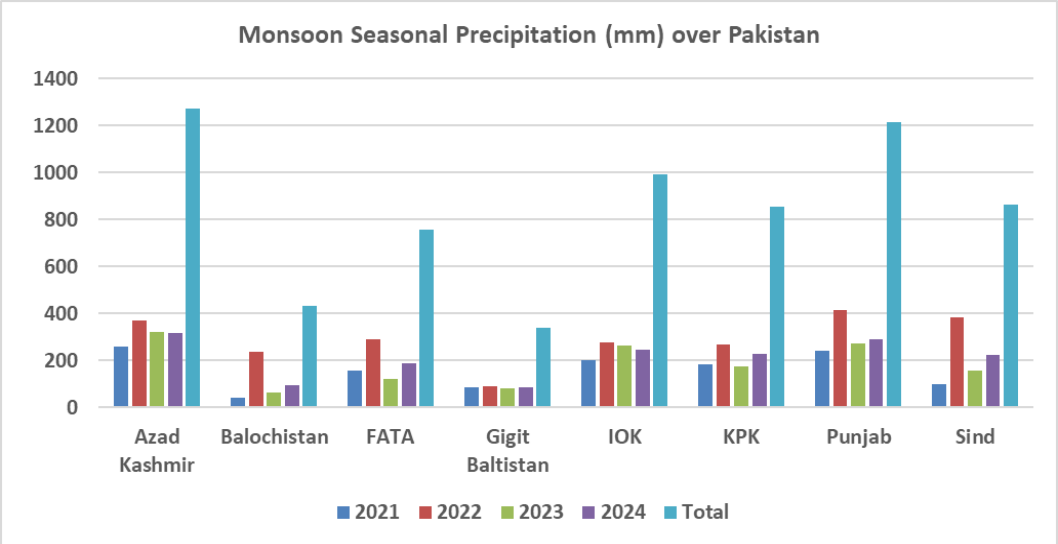
Pakistan faces mounting economic and social challenges due to the complex impacts of climate change, particularly through increased variability and unpredictability in weather patterns. The country's climate is influenced primarily by the summer monsoon and western disturbances, with an annual area-weighted rainfall of approximately 238 mm. Of this, about 57% (137.5 mm) falls during the summer months, 30% (74.9 mm) during winter, and the remaining 13% (25.6 mm) across transitional periods (Source: CDPC, PMD).

Precipitation in Pakistan is both spatially and seasonally variable, ranging from less than 100 mm annually in the arid southern regions to over 1500 mm in the Himalayan foothills. The majority of rainfall—roughly 60–70%—occurs during the southwest monsoon season (July to September), bringing intense, short-duration downpours, especially in northeastern regions such as Punjab, Azad Jammu & Kashmir, and Khyber Pakhtunkhwa. Western disturbances primarily contribute to winter rainfall in the northern highlands and Balochistan.

Monsoon Seasonal Precipitation (mm) over Pakistan (2021–2024)

The monsoon in Pakistan typically spans from July to September, driven by the southwest monsoon winds originating from the Arabian Sea and the Bay of Bengal. Seasonal intensity and spatial coverage can vary significantly, influenced by synoptic-scale systems, ENSO phases, and regional topography. The figure 1.3 reflects these dynamics, highlighting how some regions consistently receive higher rainfall, while others experience sharp variability.

Figure 1.3: Monsoon Seasonal Precipitation (mm) over Pakistan



This graph is based on latest gridded precipitation data from the Climatic Research Unit (CRU) model, extracted and analyzed specifically over Pakistan for the monsoon seasons of 2021 to 2024. The data provides an observationally consistent baseline to evaluate regional rainfall variability under a changing climate.

This grouped bar chart presents the monsoon seasonal precipitation (in mm) over various administrative regions of Pakistan — including Azad Kashmir, Balochistan, FATA, Gilgit Baltistan, Indian Occupied Kashmir (IOK), Khyber Pakhtunkhwa (KPK), Punjab, and Sindh — for the years 2021, 2022, 2023, and 2024, along with their cumulative totals.
Key Observations Azad Kashmir received the highest total monsoon rainfall (~1270 mm), with consistently strong monsoon activity across all four years, particularly high in 2022. Punjab and IOK follow closely behind in cumulative precipitation (both near or above 1000 mm), with 2022 showing a prominent peak in Punjab (~400 mm). These areas are typically high-monsoon zones due to orographic lifting effects near the foothills of the Himalayas. Sindh and Balochistan show sharp spikes in 2022, which corresponds with the historic floods of 2022 caused by anomalous monsoon patterns. This aligns with PMD and NDMA reports noting 2022 as one of the wettest years on record due to monsoon intensification and persistent low-pressure systems. Merged Area Khyber Pakhtunkhwa and Khyber Pakhtunkhwa show moderate but steady rainfall across all four years, reflecting their transition zone status between high-monsoon and arid zones. Gilgit Baltistan, while located in the northern mountains, received the least total monsoon rainfall, consistent with its semi-arid to alpine climate, which is less influenced by the southwest monsoon system.

Climate Implications The chart reflects a regional disparity in monsoon impact, underscoring the importance of location-specific adaptation and forecasting. 2022 stands out across almost all regions, indicating an extreme event year, corroborated by FFC and NDMA flood damage reports. The cumulative totals emphasize Pakistan's growing reliance on monsoon rainfall, which poses a risk to water and food security in years of delayed or deficient monsoons. Regions like Sindh and Balochistan, historically drier, experienced abnormal monsoon precipitation in 2022, highlighting the shifting spatial patterns of monsoon dynamics.

1.11.2 PMD Forecast and Actual Observation

The Pakistan Meteorological Department (PMD), in its seasonal forecast issued prior to the onset of Monsoon 2024, predicted normal to above-normal rainfall across most parts of the country, particularly in southern Pakistan. PMD anticipated that the monsoon rains would begin slightly earlier than usual and persist with increased intensity during July and August due to prevailing El Niño-Southern Oscillation (ENSO) neutral to La Niña conditions and positive Indian Ocean Dipole (IOD). These climatic factors were expected to enhance moisture influx from the Arabian Sea and the Bay of Bengal, leading to potentially higher rainfall episodes and localised extreme weather events, including urban flooding and flash floods in vulnerable regions.

In line with PMD's forecast, the country experienced active monsoon spells throughout the season, with multiple synoptic systems developing over the Bay of Bengal and moving westward.

As per PMD, during 2024 Monsoon Season, rainfall amounted to 212.1 mm, significantly above the Long Period Average (LPA) of 140.9 mm, marking a 51% increase from normal levels. The country witnessed above-average rainfall throughout the season.

- Punjab received **+48%** above-average rainfall
- Sindh experienced **+108%** above-average rainfall
- Balochistan recorded **+111%** above-average rainfall
- Gilgit-Baltistan (GB) experienced a marginally above-normal rainfall with a **+2%** deviation.
- Khyber Pakhtunkhwa (KP) and Azad Jammu & Kashmir (AJ&K), however, recorded below-average rainfall with **-5%** and **-21%** deviations respectively.

A total of nine (09) monsoon lows/depressions developed in the Bay of Bengal and adjoining areas during the season. Out of these, only five (05) systems approached or impacted Pakistan, contributing significantly to the rainfall, particularly in southern and southwestern regions of the country. The overall performance of the Monsoon 2024 validates the PMD's seasonal forecast, especially regarding enhanced precipitation trends in Sindh and Balochistan. These rains provided some relief to drought-

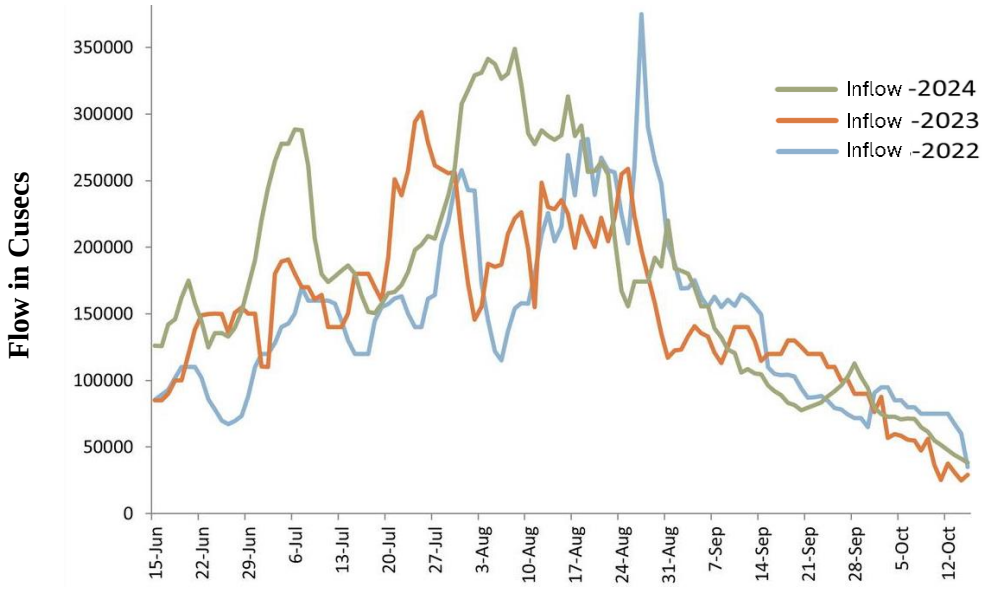
prone areas but also brought challenges in terms of urban flooding and water management in low-lying regions.

1.11.3 Comparative Analysis of Inflows at Rim Stations (2022–2024)

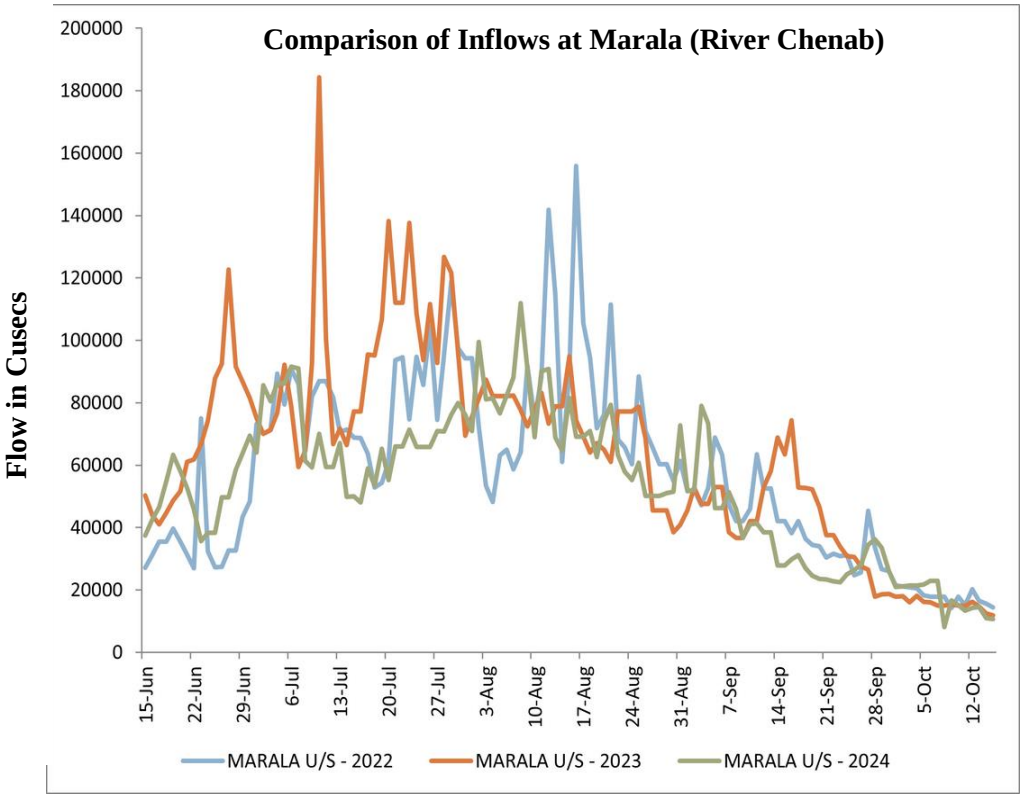
During Monsoon 2024, the situation in rivers remained mainly normal. There was not a single major flood event (High to Exceptionally High Flood) in any of the Indus River System's rivers. Medium Flood Levels were noted in River Indus at the Kalabagh-Chashma-Taunsa-Guddu-Sukkur-Kotri Reaches. At Marala-Khanki Reach, River Chenab recorded a Medium Flood Level, while at Nowshera-Warsak Reach, River Kabul recorded the same. River Jhelum remained at Low Flood Stage near Mangla while River Ravi flowed at Normal Flow Stage.

A comparative overview of inflows at Rim Stations for the years 2022 to 2024 is shown in the following graphs:

Comparison of Inflows at Tarbela (River Indus)

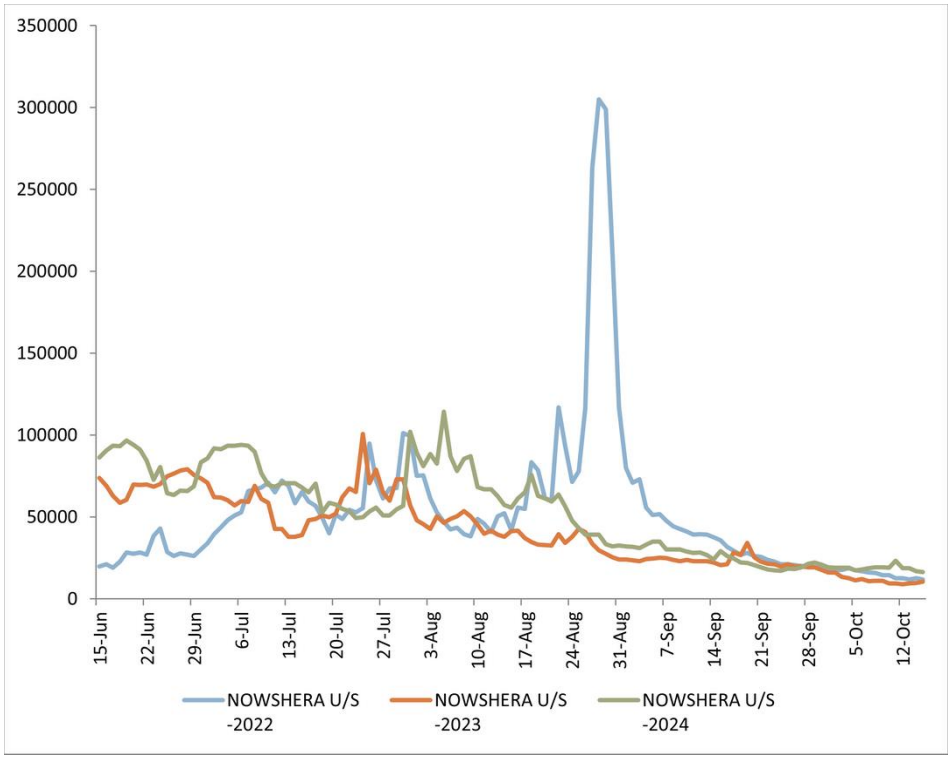


Monsoon Season (15th June to 15th October)

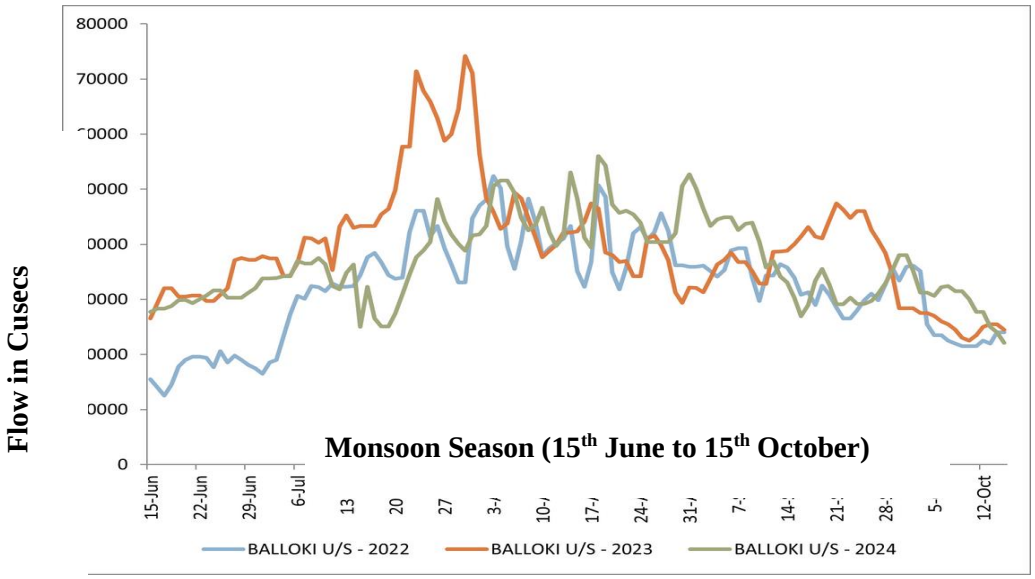


Monsoon Season (15th June to 15th October)

Comparison of Inflows at Nowshera (River Kabul)

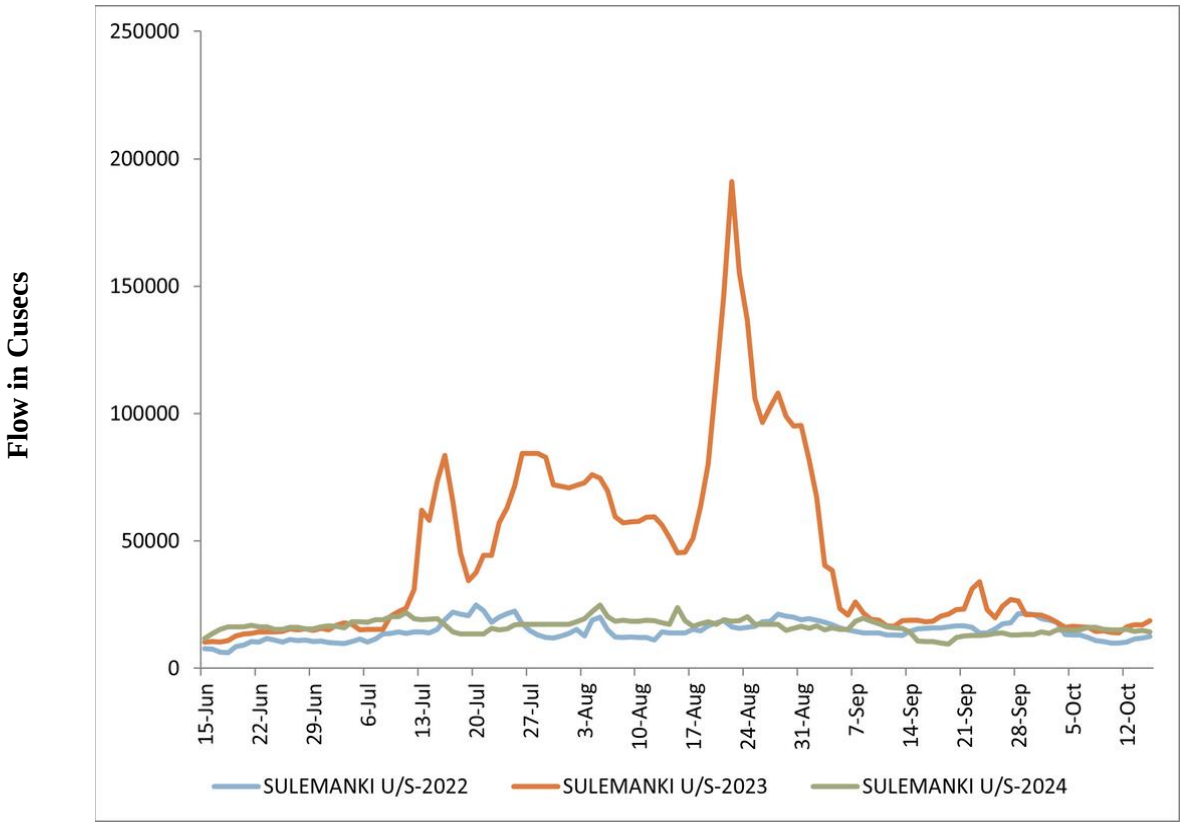


Comparison of Inflows at Balloki (River Ravi)



Monsoon Season (15th June to 15th October)

Comparison of Inflows at Suleimanki (River Sutlej)



1.11.4 Storage Trends at Major Dams over the Monsoon Period

Table 1.13: Tarbela Average Flows (15th June To 15th October-2024)

TARBELA AVERAGE FLOWS (15th JUNE TO 15th OCTOBER-2024)		
Parameter	**Inflow**	**Outflow**
Mean	174,885 (Cusecs)	157,594 (Cusecs)
Peak (Data)	350,000 (Cusecs) {08-08-2024}	329,000 (Cusecs) {07-08-2024}
KHARIF 2024 {1st MARCH 2024 to 30th SEPTEMBER 2024}		
Total Volume	50.456 MAF	41.488 MAF

Fig 1.3: Storage Trends at Tarbela Reservoir

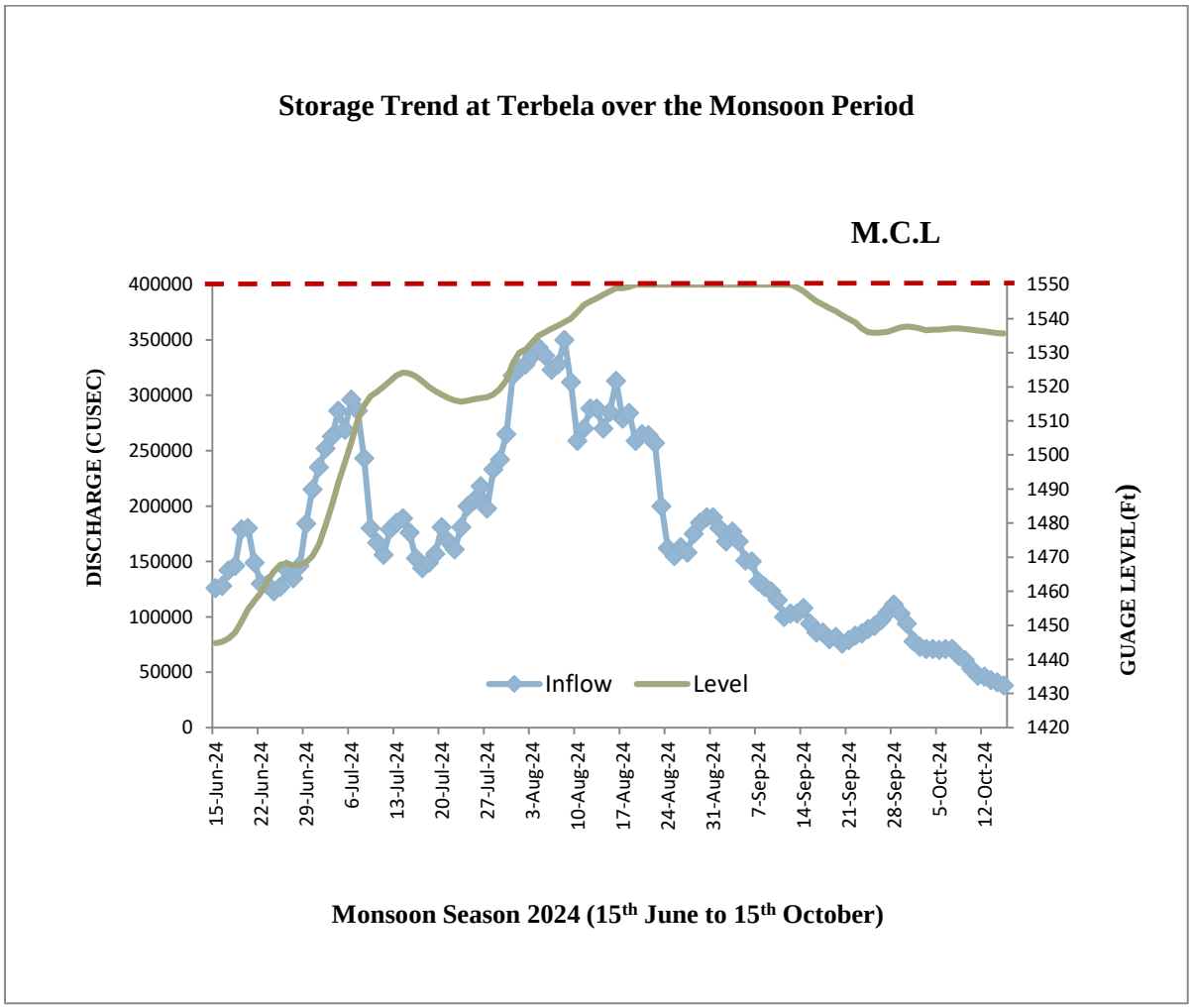
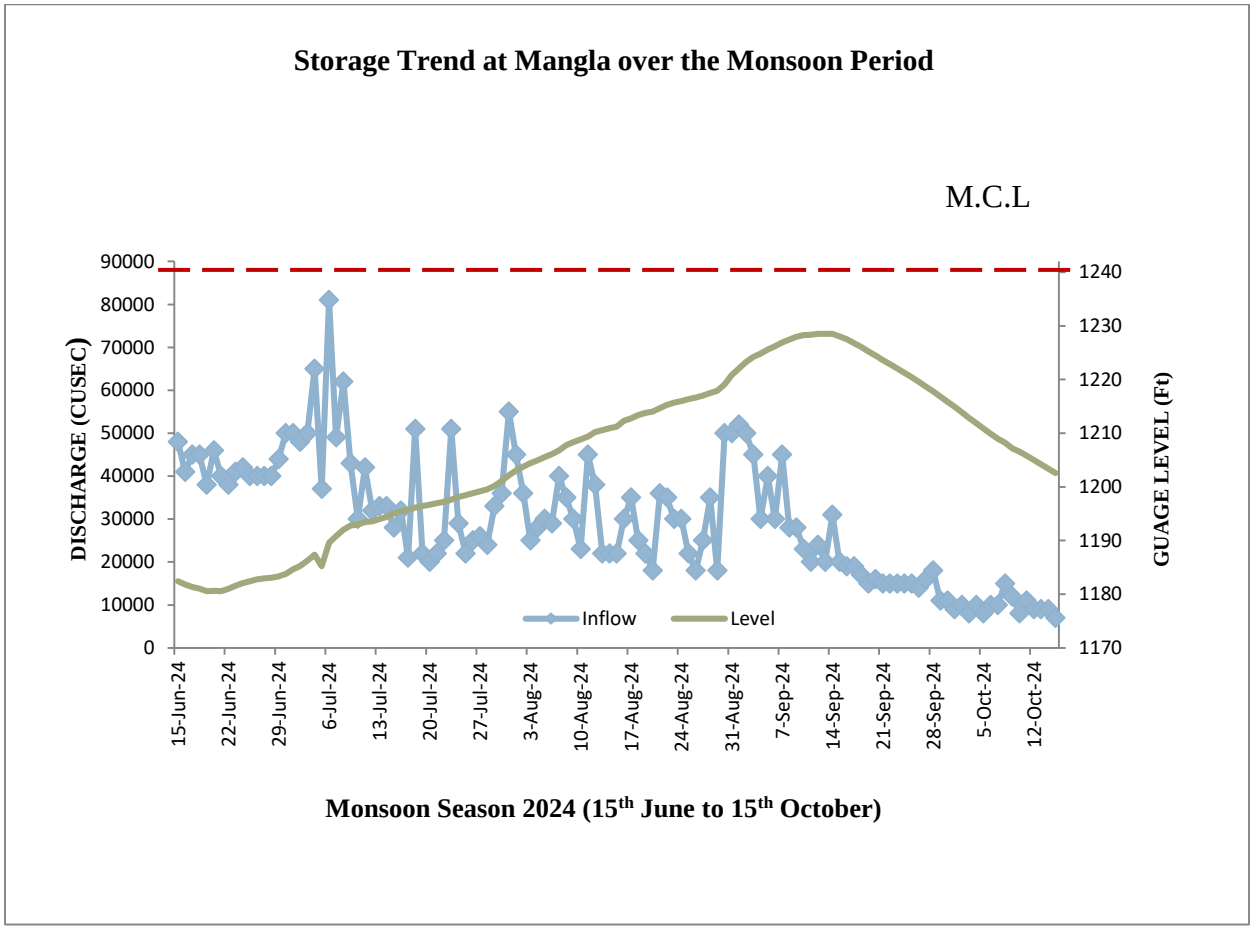


Table 1.14: Mangla Reservoir Average Flows (15th June To 15th October-2024)

MANGLA AVERAGE FLOWS (15th JUNE TO 15th OCTOBER-2024)		
Parameter	**Inflow**	**Outflow**
Mean	28,615 (Cusecs)	23,908 (Cusecs)
Peak (Data)	176,000 (Cusecs) {30-08-2024}	78,558 (Cusecs) {16-06-2024}
KHARIF 2024 {1st MARCH 2024 to 30th SEPTEMBER 2024}		
Total Volume	15.141 MAF	9.915 MAF

Fig 1.4: Storage Trends at Mangla Reservoir



1.11.5 Hill Torrent Flood Peaks 2022-24

Table 1.15: Hill Torrents Flood Peaks

District D.G.Khan				
Hill Torrents	**Out Fall in Indus River**	**Peak 2022 Discharges (Cusecs)**	**Peak 2023 Discharges (Cusecs)**	**Peak 2024 Discharges (Cusecs)**
Kaura	U/s Taunsa Barrage	**105,668** (24.8.22)	**57,348** (02.4.23)	**39,337** (03.9.24)
Vehova	U/s Taunsa Barrage	**154,362** (14.8.22)	**44,091** (28.7.23)	**84,485** (27.8.24)
Sanghar	U/s Taunsa Barrage	**268,149** (14.8.22)	**35,081** (27.6.23)	**47,403** (11.7.24)
Sori Lund	D/s Taunsa Barrage	**135,544** (21.8.22)	**64,304** (29.7.23)	**51,460** (03.9.24)
Vidore	D/s Taunsa Barrage	**174,360** (21.8.22)	**39,254** (30.7.23)	**75,589** (18.8.24)
Sakhi Sarwar	D/s Taunsa Barrage	**32,345** (21.8.22)	**14,388** (24.7.23)	**32,643** (12.8.24)
Mithawan	D/s Taunsa Barrage	**42,632** (21.8.22)	**22,935** (23.7.23)	**26,615** (18.8.24)
District Rajanpur				
Kaha	D/s Taunsa Barrage	**108,941** (14.8.22)	**35,968** (29.7.23)	**105,276** (18.8.24)
Chachar	D/s Taunsa Barrage	**75,900** (21.8.22)	**15,000** (29.7.23)	**63,940** (18.8.24)
Pitok	D/s Taunsa Barrage	**5,000** (25-8-22)	**1,200** (18.4.23)	**14,600** (18.8.24)
Sori Shumali	D/s Taunsa Barrage	**7,000** (28.8.22)	**1,000** (24.7.23)	**5,845** (18.8.24)
Zangi	D/s Taunsa Barrage	**9,000** (25.8.22)	**3,500** (24.3.23)	**33,600** (18.08.24)
Sori Janubi	D/s Taunsa Barrage	**17,000** (25.8.22)	**3,500** (24.3.23)	**16,560** (18.8.24)

Escapages below Kotri during 2022-24

Escapages below Kotri Barrage observed during the Monsoon Season 2024 are given in **Table 1.16**

Table 1.16: Downstream Kotri Escapages Kharif 2022-24 (April-September)

Month	Releases (MAF)		
	2022	2023	2024
April	0.008	0	0.032
May	0.01	0	0.031
June	0.01	0.056	1.101
July	1.99	2.215	1.152
August	13.95	9.073	10.665
September	22.35	2.448	8.541
Total	**38.315 MAF**	**13.792 MAF**	**21.522 MAF**

Source: IRSA

1.11.6 Lessons learnt from 2024 Floods

- Effective coordination among Tarbela, Mangla, Chashma Dam authorities, IRSA and FFC enabled optimal reservoirs filling and downstream flow management.
- Tarbela Dam operated at maximum conservation level for 25 days as per revised SOP-2018, ensuring additional water availability for irrigation and hydropower.
- The three-year average Kotri escapage of 36.815 MAF highlights climate-induced glacial melt, reinforcing the need for large dams to address future droughts and flood extremes.
- A total of 21.522 MAF released downstream of Kotri supported the Indus Delta ecosystem.
- PMD should enhance quantitative forecasts upstream of Mangla by including total expected inflows to aid dam operations.
- District-level weather and flood forecasts are needed from PMD for more targeted evacuation and risk reduction.
- WAPDA needs to upgrade its 6-hourly manual gauges to telemetry-based real-time stations for more accurate flood forecasting.
- Regular FFC-led coordination meetings during the monsoon enhanced inter-agency response and decision-making.
- Closer collaboration between FFC and provincial irrigation departments on secondary/tertiary river flows improved flood handling.
- The JICA-supported early warning system in Lai Nullah effectively prevented casualties despite critical water levels on August 8, 2024.

1.11.7 Flood Peaks Recorded during Historical Floods

Highest ever recorded flood peaks at various control points of Indus Basin including Monsoon 2024 are given in the **Table 1.17.**

The rainfall data of Monsoon Season 2024 is attached as **Appendix-III**.
Historic Escapages below Kotri Barrage (1976 to 2024) as received from IRSA are also attached as **Appendix-IV.**

Table: 1.17: Historic Peak Discharges (Cusecs) in Major Rivers During Flood Years

River	Site	Design Capacity	Historic Max.Flood	1973	1975	1976	1988	1992	1994	1995	1995	2010	2011
INDUS	**Tarbela**	**15,00,000**	**6,04,000**	4,20,000	----------	3,04,000	4,50,000	5,00,000	4,20,000	4,80,000	4,80,000	6,04,000	2,68,500
			30-7-2010			3-8-76	4-8-88	10-9-92	24-7-94	26-7-95	26-7-95	30-7-2010	16-9-2011
	Kalabagh	**9,50,000**	**9,50,000**	5,64,000	6,02,541	8,61,965	6,05,000	8,49,245	5,03,946	5,51,553	5,51,553	9,36,453	2,68,400
			14-7-42	20-7-73	21-8-75	2-8-76	2-8-88	10-9-92	13-7-94	27-7-95	27-7-95	30-7-2010	26-7-2011
	Chashma	**9,50,000**	**10,36,673**	5,10,000	555,300	7,86,600	5,80,000	6,68,336	5,46,636	5,76,709	5,76,709	1,036,673	3,49,700
			2-8-2010	22-7-73	23-8-75	3-8-76	3-8-88	11-8-92	11-8-94	28-7-95	28-7-95	2-8-2010	28-7-2011
	Taunsa	**11,00,000**	**9,59,991**	5,67,623	5,24,495	6,75,233	5,60,000	6,55,079	5,73,520	6,07,884	6,07,884	9,59,991	2,23,200
			28-8-2010	29-7-73	26-8-75	7-8-76	28-7-88	14-9-92	15-7-94	29-7-95	29-7-95	2-8-2010	31-8-2011
	Guddu	**12,00,000**	**11,99,672**	10,83,742	10,02,496	11,99,672	11,62,653	10,86,919	7,73,305	9,88,665	9,88,665	1,148,200	2,72,200
			15-8-76	18-8-73	30-8-75	15-8-76	30-7-88	18-9-92	29-7-94	3-8-95	3-8-95	8-8-2010	4-9-2011
	Sukkur	**9,00,000**	**11,61,000**	10,77,000	10,25,000	11,61,000	11,18,856	10,68,072	7,57,350	9,58,929	9,58,929	1,108,795	2,60,800
			16-8-76	21-8-73	2-9-75	16-8-76	31-7-88	20-9-92	2-8-94	7-8-95	7-8-95	10-8-2010	6-9-2011
	Kotri	**8,50,000**	**9,81,000**	7,86,000	4,76,000	7,65,000	6,48,290	6,89,309	8,26,369	7,99,447	7,99,447	9,39,442	2,60,400
			14-8-56	30-08-73	09-09-75	24-8-76	11-8-88	30-9-92	25-8-94	18-8-95	18-8-95	27-8-2010	16-9-2011
JHELUM	**Mangla**	**10,60,000**	**10,90,000**	2,20,000	1,09,000	4,80,060	4,25,515	10,90,000	2,91,550	3,02,322	3,02,322	2,49,100	7,200
			10-9-92	9-8-73	29-8-75	3-8-76	16-7-88	10-9-92	4-8-94	27-7-95	27-7-95	10-8-2010	12-8-2011
	Rasul	**8,50,000**	**9,52,170**	2,69,976	1,25,597	2,69,330	2,61,664	9,52,170	1,48,135	2,86,076	2,86,076	2,25,496	1,31,300
			10-9-92	9-8-73	30-8-75	4-8-76	17-7-88	10-9-92	28-7-94	28-7-95	28-7-95	30-7-2010	16-9-2011
CHENAB	**Marala**	**11,00,000**	**11,00,000**	7,70,000	5,82,600	5,49,400	7,50,975	8,45,090	4,12,520	4,39,970	4,39,970	2,63,795	9,69,00
			26-8-57	9-8-73	16-7-75	1-8-76	25-9-88	10-9-92	20-9-94	27-7-95	27-7-95	30-7-2010	17-9-2011
	Khanki	**8,00,000**	**10,86,460**	10,00,496	6,66,241	6,15,043	8,64,220	9,10,512	4,25,160	6,30,517	6,30,517	2,82,418	1,42,500
			27-8-57	10-8-73	16-7-75	2-8-76	26-9-88	10-9-92	20-7-94	28-7-95	28-7-95	6-8-2010	16-9-11
	Qadirabad	**9,00,000**	**9,48,530**	8,54,341	6,69,819	6,28,741	8,92,299	9,48,530	4,37,067	6,44,697	6,44,697	3,27,637	1,42,500
			11-9-92	10-8-73	17-7-75	2-8-76	26-9-88	11-9-92	21-7-94	29-7-95	29-7-95	7-8-2010	17-9-2011

River	Site	Design Capacity	Historic Max.Flood	1973	1975	1976	1988	1992	1994	1995	1995	2010	2011
	Trimmu	**6,45,000**	**9,43,225**	7,52,910	4,58,247	7,06,433	5,84,110	8,88,117	3,33,499	6,29,561	6,29,561	3,19,733	1,66,400
			8-7-59	12-8-73	20,7,75	10-8-76	19-7-88	14-9-92	23-7-94	1-8-95	1-8-95	7-8-2010	17-9-2011
	Panjnad	**7,00,000**	**8,02,516**	8,02,516	4,77,846	7,10,000	5,07,345	7,44,152	2,66,949	6,05,523	6,05,523	3,23,026	1,27,800
			17-8-73	17-8-73	29-7-75	12-8-76	27-7-88	18-8-92	25-7-94	5-9-95	5-9-95	11-8-2010	20-9-2011
RAVI	**Madhopur**	----------	**9,20,000**	----------	----------	----------	9,20,000	1,55,000	1,75,000	3,32,000	3,32,000	3,10,117	1,38,300
			25-9-88				25-9-88	10-9-92	7-7-94	5-9-95	5-9-95	13-8-2010	24-9-2011
	Jassar	**2,75,000**	**6,80,000**	2,27,500	2,06,300	1,70,150	1,21,800	1,48,543	1,73,000	2,20,000	2,20,000	21,100	24,300
			5-10-55	10-8-73	17-7-75	9-8-76	25-9-88	11-9-92	21-7-94	5-9-95	5-9-95	21-8-2010	13-8-2011
	Ravi Syphon	**4,50,000**	**6,59,000**	2,16,000	1,66,000	1,82,000	3,25,040	80,683	1,01,791	2,57,000	2,57,000	41,200	42,300
			6-10-55				27-9-88	12-9-92	22-7-94	6-9-95	6-9-95	21-8-210	14-8-2011
	Shahdara	**2,50,000**	**5,76,000**	2,37,380	1,83,330	1,70,175	5,76,000	62,641	54,101	1,71,520	1,71,520	41,900	43,000
			22-9-88	11-8-73	18-7-75	10-8-76	27-9-88	12-9-92	22-7-94	7-9-95	7-9-95	21-8-2010	14-8-2011
	Balloki	**2,25,000**	**3,36,200**	2,43,908	1,80,205	2,53,974	3,89,845	1,12,157	1,15,635	2,22,800	2,22,800	41,200	44,000
			28-9-1988	13-8-73	20-7-75	11-8-76	28-9-88	13-9-92	12-8-94	8-9-95	8-9-95	23-8-2010	15-8-2011
	Sidhani	**1,50,000**	**3,30,210**	2,10,339	1,22,251	2,44,348	3,30,210	95,510	1,06,321	2,12,340	2,12,340	16,800	2,39,00
			2-10-88	18-8-73	25-7-75	15-8-76	2-10-88	16-9-92	28-8-94	12-9-95	12-9-95	28-7-2010	2-9-2011
SUTLEJ	**Sulemanki**	**3,25,000**	**5,98,872**	1,77,081	48,688 21-	1,18,582	3,99,453	1,97,293	1,37,854	3,01,865	3,01,865	44,300	76,200
			8-10-55	15-8-73	9-75	6-9-76	30-9-88	3-9-92	27-8-94	10-9-95	10-9-95	30-9-2010	29-8-2011
	Islam	**3,00,000**	**4,92,581**	1,66,453	46,996 23-	1,11,427	3,08,425	1,82,637	92,630	1,83,902	1,83,902	28,900	49,900
			11-10-55	17-8-73	9-75	8-9-76	4-10-88	7-9-92	31-8-94	14-9-95	14-9-95	20-9-2010	4-9-2011

Table: 1.17: Historic Peak Discharges (Cusecs) in Major Rivers During Flood Years

River	Site	Design Capacity	Historic Max.Flood	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
INDUS	**Tarbela**	**15,00,000**	**6,04,000 30-7-2010**	278000 05-8-12	3,38,100 14-8-13	240,100 15-8-14	4,86,900 26-7-15	3,02,900 17-7-16	3,36,000 03-8-17	2,42,300 2-8-18	3,11,700 9-8-19	3,35,800 02-9-20	2,70,000 22-7-21	418,600 26-8-22	319,400 24-7-23	329,000 07-8-24
	Kalabagh	**9,50,000**	**9,50,000 14-7-42**	277000 17-7-12	4,72,303 13-8-13	249,992 25-7-14	5,28,698 02-8-15	3,51,490 05-7-16	4,19,460 03-8-17	3,11,154 15-8-18	3,54,830 15-8-19	4,57,031 02-9-20	2,91,309 01-8-21	423,000 28-8-22	365,549 25-7-23	393,739 09-8-24
	Chashma	**9,50,000**	**10,36,673 2-8-2010**	285500 08-7-12	6,20,672 14-8-13	257,632 22-6-14	6,36,512 3-8-15	3,73,659 05-7-16	4,46,361 05-8-17	3,19,912 15-8-18	3,70,823 2-8-19	4,73,447 04-9-20	3,44,907 02-8-21	523,937 28-8-22	415,651 25-7-23	417,763 09-8-24
	Taunsa	**11,00,000**	**9,59,991 28-8-2010**	235400 10-9-12	5,16,017 17-8-13	233,110 18-7-14	6,04,714 5-8-15	3,43,024 05-7-16	4,23,861 06-9-17	2,76,215 17-8-18	3,78,194 14-8-19	4,79,866 06-9-20	3,06,489 04-8-21	622,000 30-8-22	439,908 27-7-23	440,296 08-8-24
	Guddu	**12,00,000**	**11,99,672 15-8-76**	236100 10-9-12	5,42,100 20-8-13	34,0864 18-9-14	7,35,246 3-8-15	2,97,928 11-7-16	4,28,640 09-8-17	2,27,270 20-8-18	3,86,041 21-8-19	5,40,750 09-9-20	2,66,344 07-8-21	576,000 23-8-22	461,353 30-7-23	405,430 22-8-24
	Sukkur	**9,00,000**	**11,61,000 16-8-76**	210000 14-9-12	4,54,995 24-8-13	26,8935 20-9-14	6,60,216 5-8-15	2,25,205 19-8-16	3,33,108 11-8-17	1,56,025 21-8-18	3,03,625 22-8-19	4,58,390 10-9-20	1,93,045 07-8-21	580,000 25-8-22	410,860 31-7-23	385,010 23-8-24
	Kotri	**8,50,000**	**9,81,000 14-8-56**	138800 21-9-12	3,44,866 30-8-13	11,0345 25-9-14	6,03,084 5-8-15	1,38,455 10-8-16	2,10,923 18-8-17	60,740 26-8-18	1,98,579 29-8-19	2,83,910 19-9-20	95,085 12-8-21	600,000 10-9-22	220,908 9-8-23	335,618 04-9-24
KABUL	**Nowshera**			1,00,700 8-7-12	1,55,100 15-6-13	1,18,100 4-7-14	1,65,800 02-8-15	80,700 04-7-16	87,000 12-7-17	1,05,300 24-7-18	1,05,000 29-8-19	1,51,000 02-9-20	87,400 22-7-21	336,461 28-8-22	100,600 24-7-23	114,200 05-8-24
JHELUM	**Mangla**	**10,60,000**	**10,90,000 10-9-92**	44700 05-8-12	45,214 13-8-13	500,000 5-9-14	1,09,232 26-7-15	62,701 07-8-16	67,882 22-8-17	69,127 7-7-18	1,25,171 17-6-19	1,25,803 28-8-20	80,315 01-8-21	139,086 27-8-22	35,741 24-8-23	78,558 16-6-24
	Rasul	**8,50,000**	**9,52,170 10-9-92**	31400 05-8-12	23,610 19-9-13	516,000 06-9-14	99,100 27-7-15	46,562 27-8-16	39,230 22-9-17	39,230 8-7-18	90,554 19-6-19	1,26,951 28-8-20	43,135 15-6-21	40,720 01-7-22	236,10 24-8-23	66,960 30-8-24
CHENAB	**Marala**	**11,00,000**	**11,00,000 26-8-57**	149200 04-8-12	3,69,690 15-8-13	858,000 6-9-14	1,53,408 12-7-15	3,93,690 07-8-16	1,87,472 19-7-17	1,68,278 13-8-18	2,11,000 31-7-19	2,98,884 27-8-20	1,71,150 29-7-21	23,610 22-6-22	192,960 19-7-23	160,950 15-8-24
	Khanki	**8,00,000**	**10,86,460 27-8-57**	186400 04-8-12	4,10,331 15-8-13	947,000 07-9-14	1,52,000 13-7-15	4,18,736 07-8-16	1,70,021 13-7-17	1,82,025 13-8-18	1,81,944 31-7-19	2,86,230 28-8-20	1,83,688 29-7-21	210,936 28-7-22	204,041 20-7-23	163,215 15-8-24
	Qadirabad	**9,00,000**	**9,48,530 11-9-92**	180800 05-8-12	4,03,403 15-8-13	904,000 07-9-14	1,61,100 13-7-15	4,05,542 08-8-16	1,57,842 19-7-17	1,72,031 14-8-18	1,59,544 1-8-19	2,67,540 28-8-20	1,67,812 29-7-21	210,945 12-8-22	185,749 20-7-23	145,219 16-8-24

River	Site	Design Capacity	Historic Max.Flood	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
	Trimmu	**6,45,000**	**9,43,225 8-7-59**	73700 07-8-12	2,67,609 20-8-13	703,000 10-9-14	1,35,000 13-7-15	1,53,339 10-8-16	89,345 05-8-17	81,680 16-8-18	93,021 22-8-19	1,96,077 01-9-20	1,06,967 31-7-21	202,000 12-8-22	116,786 25-7-23	87,030 19-8-24
	Panjnad	**7,00,000**	**8,02,516 17-8-73**	65600 17-9-12	3,17,261 25-8-13	45,3570 16-9-14	1,35,866 30-7-15	1,16,029 13-8-16	63488 8-8-17	87383 27-8-18	70,556 26-8-19	1,33,646 05-9-20	59,725 03-8-21	112,891 14-8-22	145,404 05-8-23	64,320 22-8-24
	Jassar	**2,75,000**	**6,80,000 5-10-55**	30500 26-8-12	67,700 16-8-13	67,700 7-9-14	36,100 15-8-15	38,400 08-8-16	46,439 10-8-17	66,641 25-9-18	51,000 18-8-19	30690 28-8-20	20,200 27-8-21	112,564 03-8-22	71,010 20-7-23	40,440 16-8-24
	Ravi Syphon	**4,50,000**	**6,59,000 6-10-55**	39800 24-8-12	73,600 18-8-13	93,300 8-9-14	39,200 24-9-15	45,081 28-7-16	46100 2-8-17	37,936 14-8-18	37,936 19-8-19	34,531 28-8-20	37,288 14-7-21	63,720 16-8-22	38,800 29-7-23	28,660 17-8-24
	Shahdara	**2,50,000**	**5,76,000 22-9-88**	40800 22-8-12	74,880 17-8-13	91,400 8-9-14	38,400 24-9-15	44,595 08-8-16	39,313 02-8-17	37,587 14-8-18	37,200 19-8-19	34,308 28-8-20	36,477 14-7-21	31,415 02-8-22	39,780 24-7-23	28,014 17-8-24
	Balloki	**2,25,000**	**3,36,200 28-9-1988**	29300 23-8-12	97,970 18-8-13	118,000 09-9-14	57,700 24-9-15	37,165 09-8-16	36,790 11-8-17	39,310 16-8-18	34,900 19-8-19	37,250 29-8-20	32,200 22-7-21	35,235 03-8-22	58,870 29-7-23	31,080 18-8-24
	Sidhani	**1,50,000**	**3,30,210 2-10-88**	24600 14-9-12	73,504 23-8-13	71,112 12-9-14	38,500 28-7-15	12,325 1-8-16	26,954 7-8-17	8,857 1-8-18	15,384 2-9-19	28,800 31-8-20	11,215 25-8-21	21,642 27-7-22	43,758 02-8-23	24,711 30-8-24
SUTLEJ	**Sulemanki**	**3,25,000**	**5,98,872 8-10-55**	16900 9-9-12	78,846 22-8-13	21,383 7-9-14	49,600 17-8-15	24,492 31-8-16	20,893 15-8-17	34,772 19-8-18	66,459 24-8-19	11,897 24-7-20	7,212 15-9-21	17,462 19-7-22	191,053 21-8-23	12,559 04-8-24
	Islam	**3,00,000**	**4,92,581 11-10-55**	12700 13-9-12	70,932 25-8-13	17,807 8-9-14	43,300 21-3-15	11145 31-8-16	14,221 16-8-17	16,460 3-10-18	52,355 31-8-19	6,609 26-8-20	3,971 18-9-21	12,501 23-7-22	191,904 25-8-23	11,145 18-8-24

Source: FFC/PIDs/WAPDA/IRSA

1.11.8 Country-Wide 2024 Flood Damages to Public & Private Infrastructure

No riverine flooding occurred in the country during the Monsoon Season 2024. However, several regions experienced intense torrential rains and flash flooding, particularly in hilly and urban catchments. These localized events led to significant human and material losses. Details of losses of lives and damage to public and private infrastructure in Punjab, Sindh, Khyber Pakhtunkhwa, Balochistan, Gilgit-Baltistan, and AJ&K are presented in **Table 1.18**

Table 1.18: Country-Wide 2024 Flood Damages

Province/ Region	Persons Died	Persons Injured	Houses Damaged	Roads (km)	Bridges	Livestock
Punjab (including ICT)	123	317	292	0	0	107
Sindh	77	159	39,145	293	3	1,125
Khyber Pakhtunkhwa (incl. Merged Areas)	112	146	979	0	14	152
Balochistan	42	19	17,388	206	7	799
AJ&K	10	26	221	0.283	4	20
Gilgit Baltistan	04	1	174	2.210	14	80
G. TOTAL	**368**	**668**	**58,199**	**501.49**	**42**	**2,283**

Source: NDMA

LIST OF APPENDICES

APPENDIX-I

SCHEMES UNDER
FLOOD PROTECTION SECTOR PROJECT-III

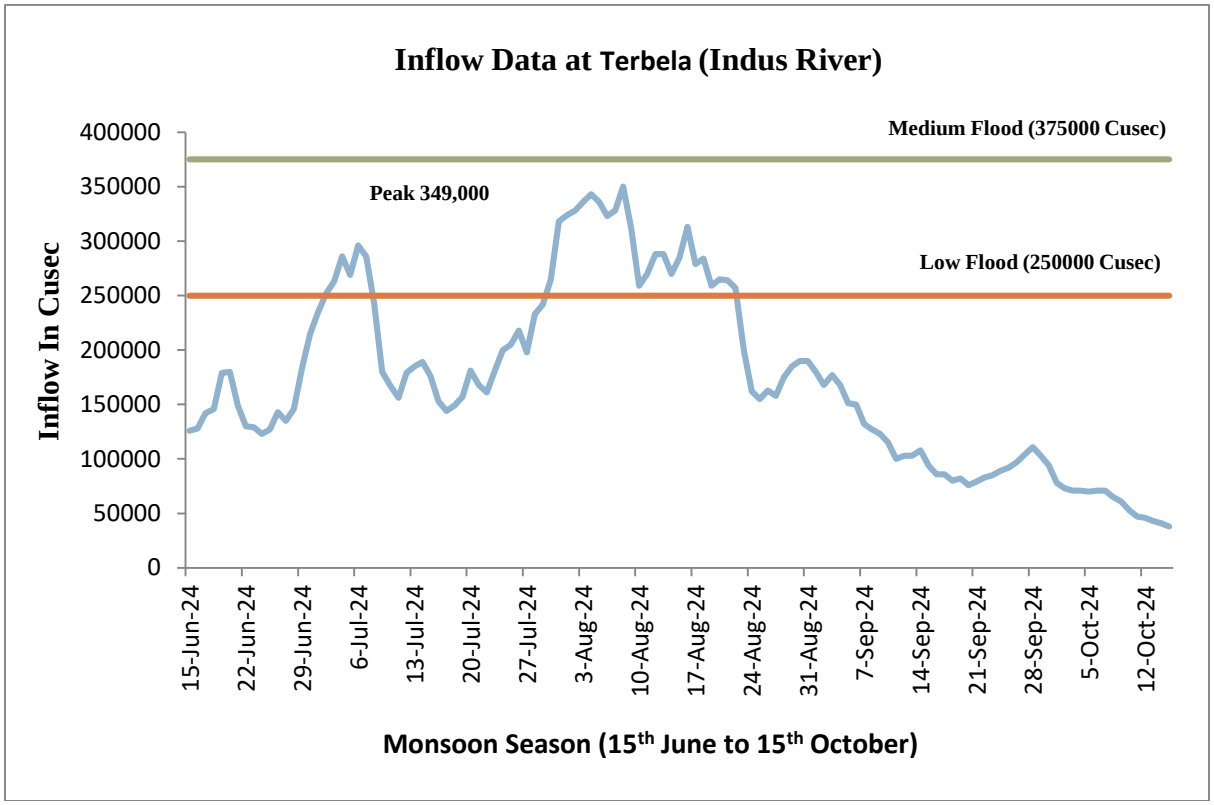
(Financial Year 2024-25)

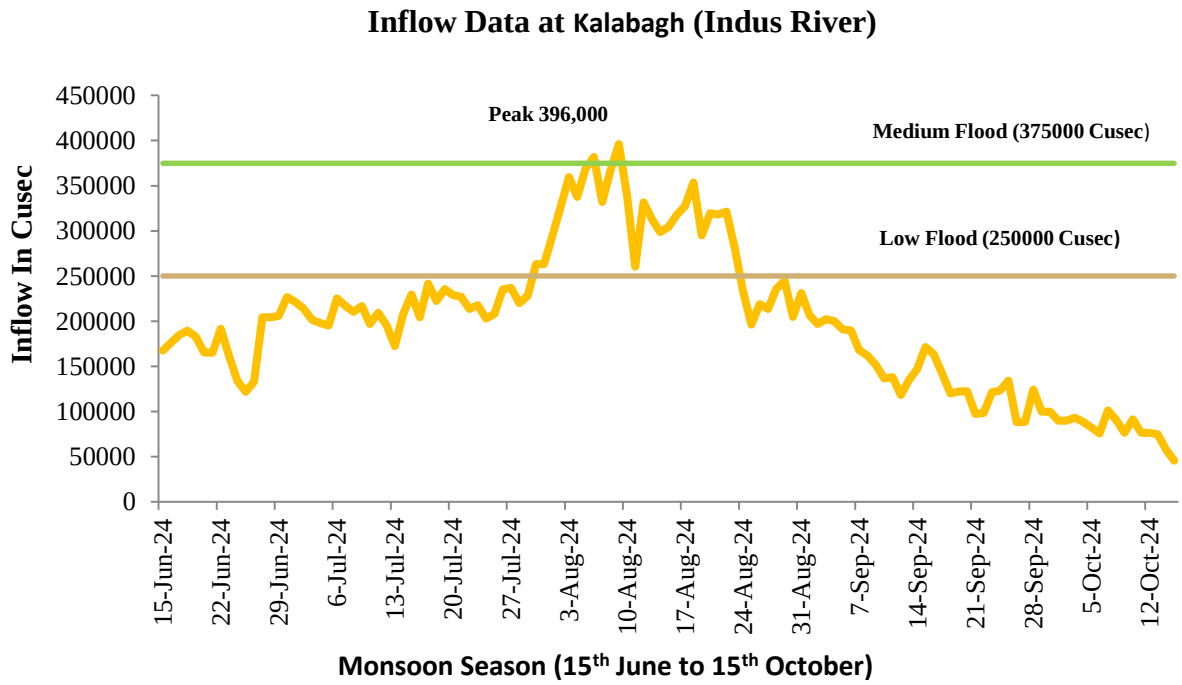
Table No.1.19: Schemes Proposed for Execution under Flood Protection Sector Project-III during Financial Year (2024-25)

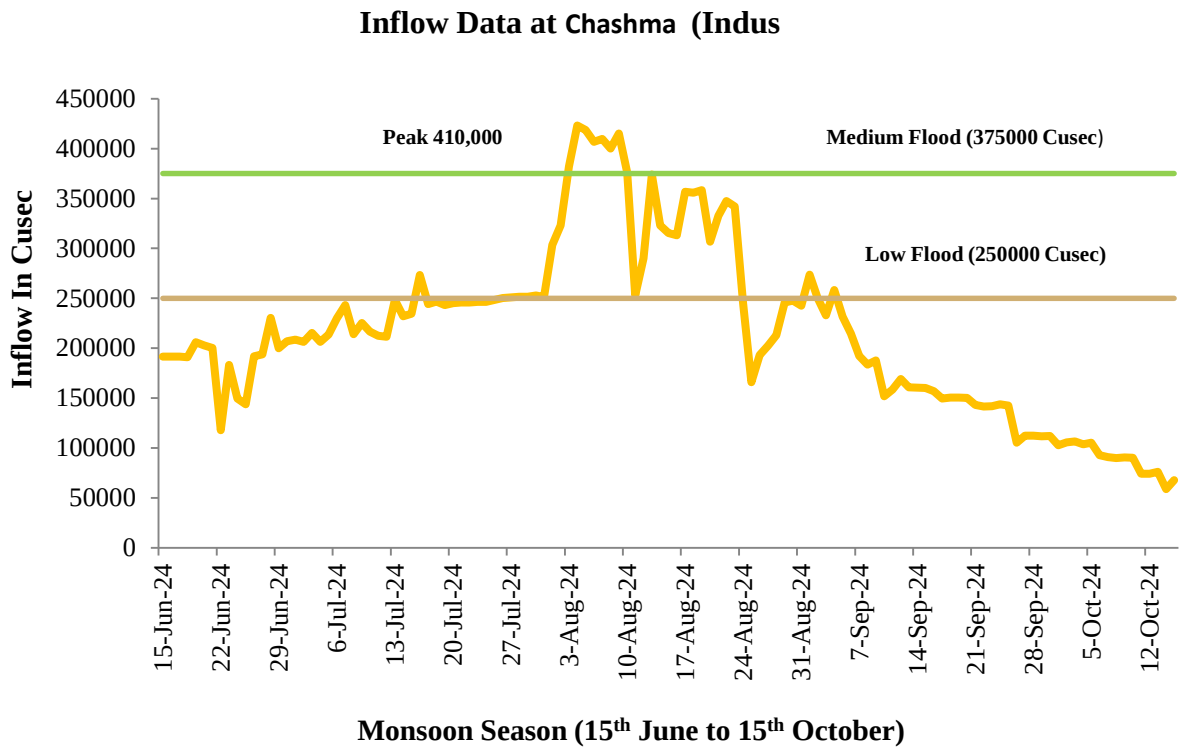
Sr. #.	Name of Scheme	Estimated Cost (Rs Million)
I	**WAPDA**	
1.	National Master Plan for Flood Telemetry Network (Phase-I)	15,496.00
2.	PC-I for Strengthening and O&M of Glacier Monitoring Research Centre.	350.00
3.	PC-I for Strengthening of the SWHP Network	380.31
4.	PC-I for Improvement of the High-Frequency Radio Network of the Water Resources Management Directorate	443.61
5.	Formulation of the National Watershed Management Plan	737.23
	Sub-Total (WAPDA):	**17407**
II	**Sindh**	
6.	Restoration/ Rehabilitation of Malir Weirs-I, II, III & Thado Dam.	16058
	Sub-Total (Sindh):	**16058**
III	**PCRWR**	
7.	Hydrological Assessment of Hill Torrent Potential and Strategies for Efficient Utilization to Mitigate Flooding in Southern Punjab, Upper Sindh and Northern Balochistan Regions. (PC-II)	63.160
8.	Improving Climate Resilience in Gilgit Baltistan through Headwater Management, Geochemical Assessment and Risks Characterization of Rivers, Springs & Lakes. (PC-II)	118.383
9.	Integrated Water Resources Development and Management through Rainwater Harvesting, Bio-Saline Agriculture and Aquaculture in the Thar Desert. (PC-II)	110.590
	Sub-Total (PCRWR):	**292.133**
IV	**PMD**	
10.	PC-I of Expansion of Meteorological Network by Installation of Automatic Weather Stations in Pakistan under FPSP-III; and Establishment of Regional Flood Forecasting and Early Warning System of PMD under FPSP-III	5,025.392
	Sub-Total (PMD):	**5,025.392**
	Grand Total:	**38,782**

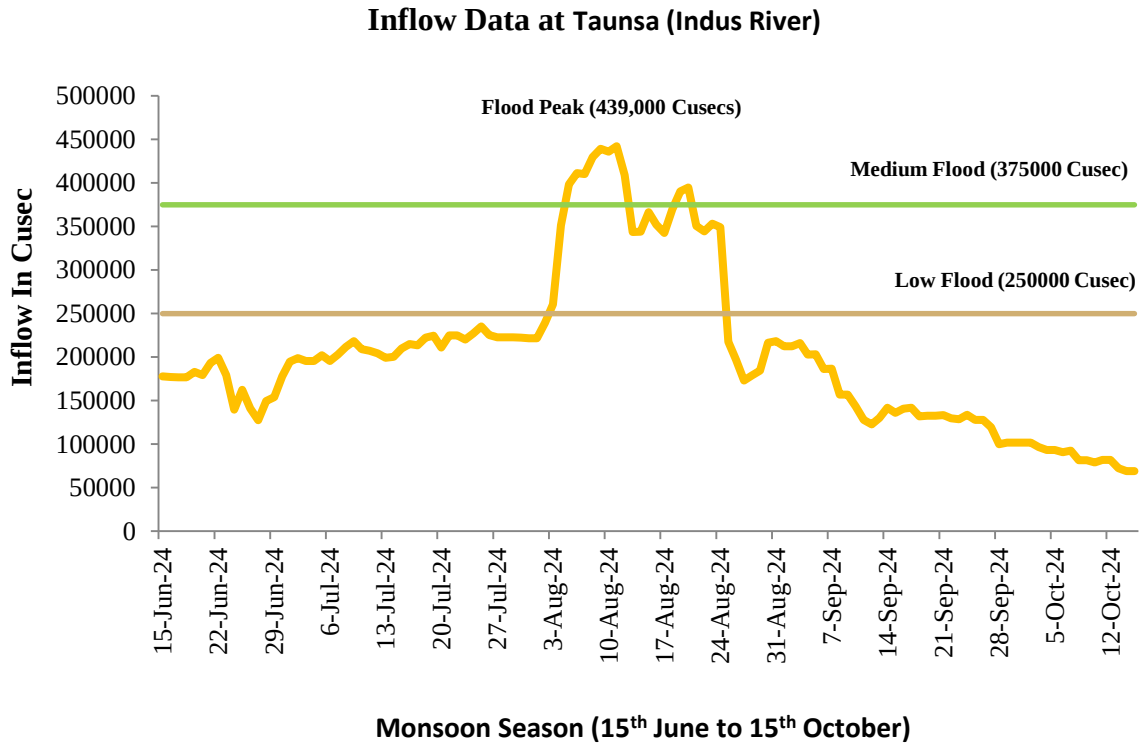
Appendix-II
(xi-Pages)

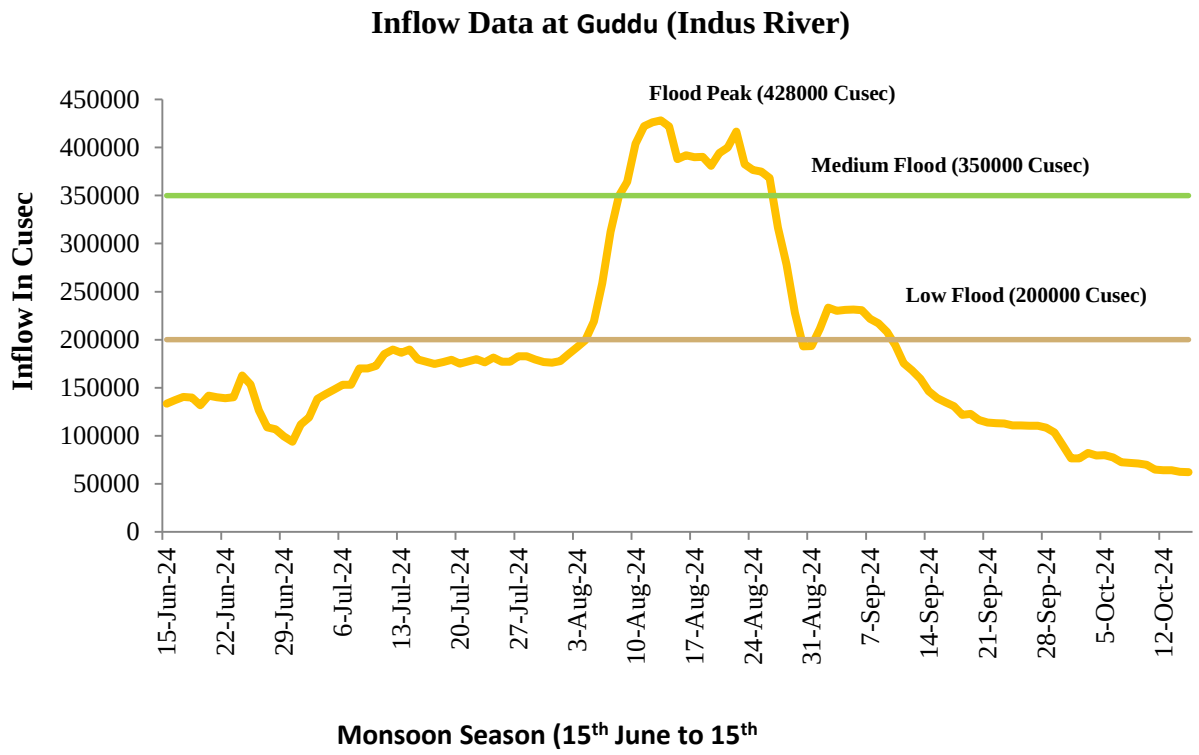
Graphs of Major Rivers' Inflows for Monsoon Season 2024

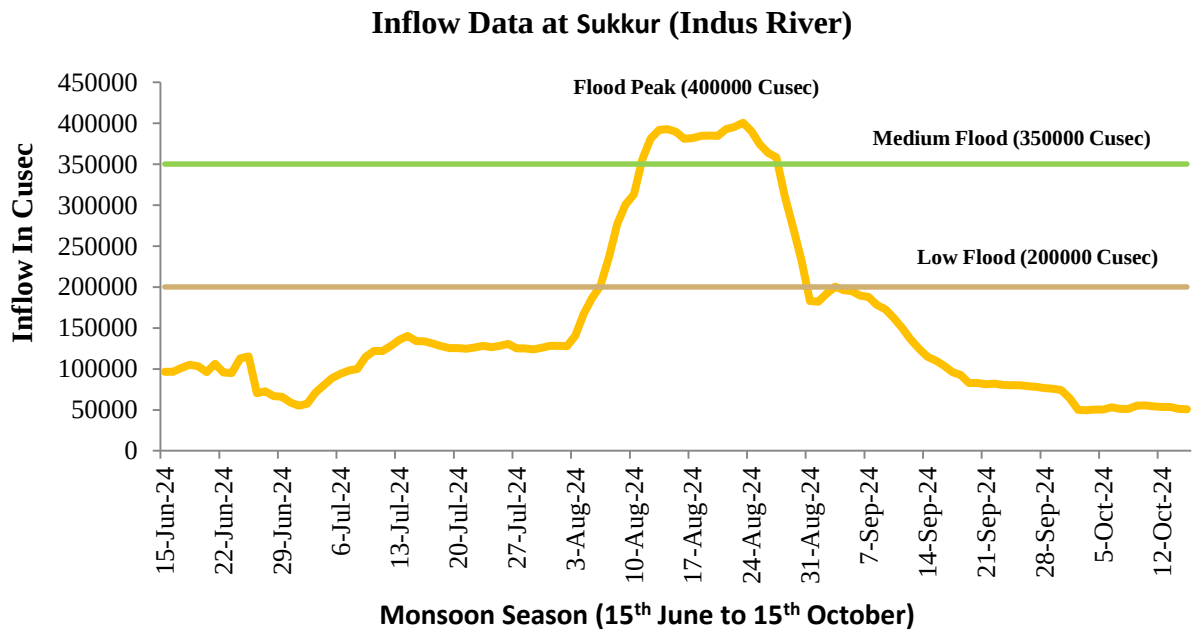

Inflow Data at Terbela (Indus River)
Medium Flood (375000 Cusec)
Peak 349,000
Low Flood (250000 Cusec)
Inflow In Cusec
400000
350000
300000
250000
200000
150000
100000
50000
0
15-Jun-24
22-Jun-24
29-Jun-24
6-Jul-24
13-Jul-24
20-Jul-24
27-Jul-24
3-Aug-24
10-Aug-24
17-Aug-24
24-Aug-24
31-Aug-24
7-Sep-24
14-Sep-24
21-Sep-24
28-Sep-24
5-Oct-24
12-Oct-24
Monsoon Season (15th June to 15th October)


Inflow Data at Kalabagh (Indus River)
Peak 396,000
Medium Flood (375000 Cusec)
Low Flood (250000 Cusec)
Inflow In Cusec
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
15-Jun-24
22-Jun-24
29-Jun-24
6-Jul-24
13-Jul-24
20-Jul-24
27-Jul-24
3-Aug-24
10-Aug-24
17-Aug-24
24-Aug-24
31-Aug-24
7-Sep-24
14-Sep-24
21-Sep-24
28-Sep-24
5-Oct-24
12-Oct-24
Monsoon Season (15th June to 15th October)

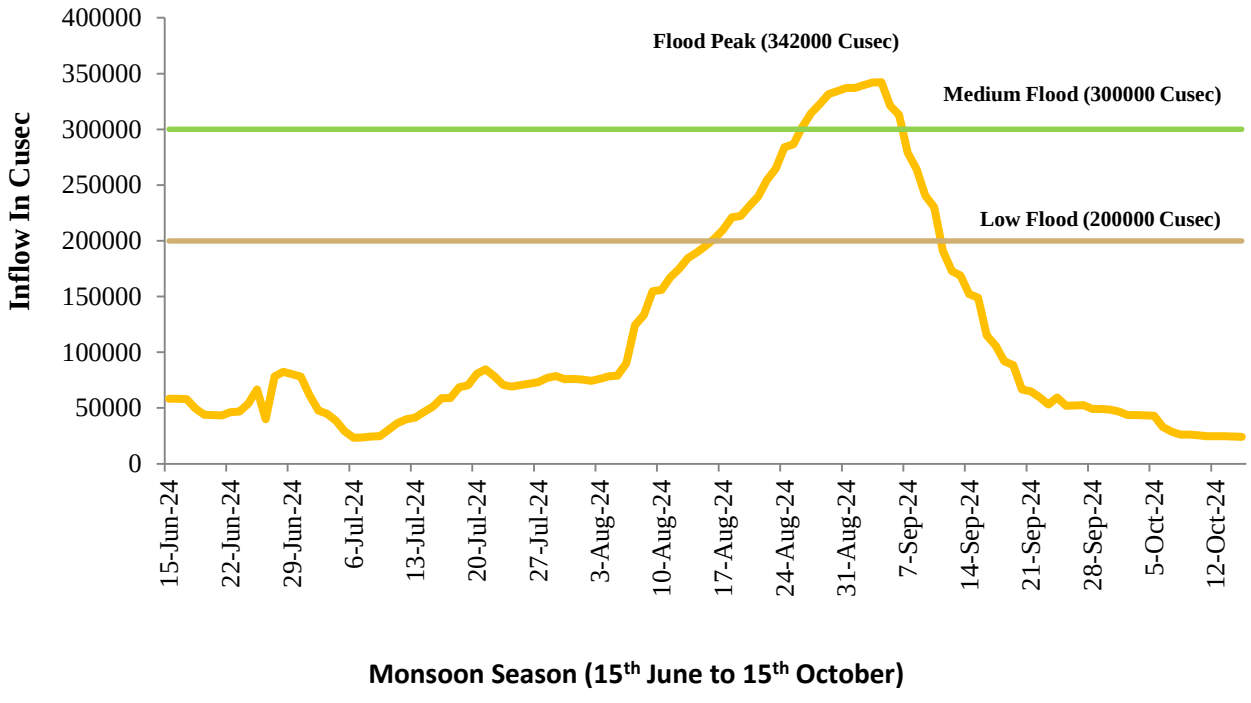

Inflow Data at Chashma (Indus
Peak 410,000
Medium Flood (375000 Cusec)
Low Flood (250000 Cusec)
Inflow In Cusec
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
15-Jun-24
22-Jun-24
29-Jun-24
6-Jul-24
13-Jul-24
20-Jul-24
27-Jul-24
3-Aug-24
10-Aug-24
17-Aug-24
24-Aug-24
31-Aug-24
7-Sep-24
14-Sep-24
21-Sep-24
28-Sep-24
5-Oct-24
12-Oct-24
Monsoon Season (15th June to 15th October)


Inflow Data at Taunsa (Indus River)
Flood Peak (439,000 Cusecs)
Medium Flood (375000 Cusec)
Low Flood (250000 Cusec)
Inflow In Cusec
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
15-Jun-24
22-Jun-24
29-Jun-24
6-Jul-24
13-Jul-24
20-Jul-24
27-Jul-24
3-Aug-24
10-Aug-24
17-Aug-24
24-Aug-24
31-Aug-24
7-Sep-24
14-Sep-24
21-Sep-24
28-Sep-24
5-Oct-24
12-Oct-24
Monsoon Season (15th June to 15th October)


Inflow Data at Guddu (Indus River)
Flood Peak (428000 Cusec)
Medium Flood (350000 Cusec)
Low Flood (200000 Cusec)
Inflow In Cusec
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
15-Jun-24
22-Jun-24
29-Jun-24
6-Jul-24
13-Jul-24
20-Jul-24
27-Jul-24
3-Aug-24
10-Aug-24
17-Aug-24
24-Aug-24
31-Aug-24
7-Sep-24
14-Sep-24
21-Sep-24
28-Sep-24
5-Oct-24
12-Oct-24
Monsoon Season (15th June to 15th

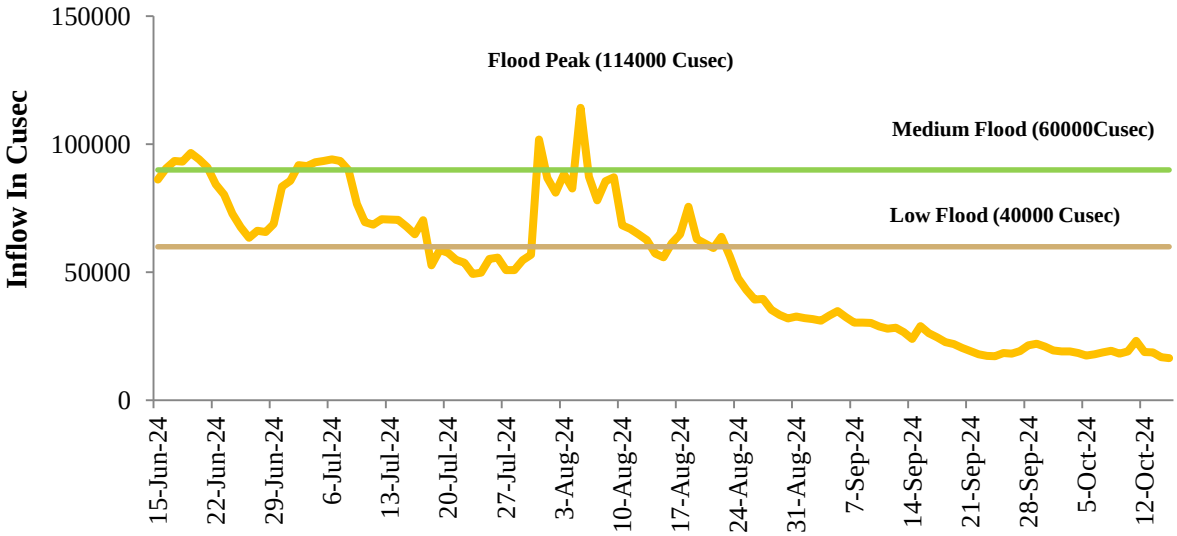

Inflow Data at Sukkur (Indus River)
Flood Peak (400000 Cusec)
Medium Flood (350000 Cusec)
Low Flood (200000 Cusec)
Inflow In Cusec
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
15-Jun-24
22-Jun-24
29-Jun-24
6-Jul-24
13-Jul-24
20-Jul-24
27-Jul-24
3-Aug-24
10-Aug-24
17-Aug-24
24-Aug-24
31-Aug-24
7-Sep-24
14-Sep-24
21-Sep-24
28-Sep-24
5-Oct-24
12-Oct-24
Monsoon Season (15th June to 15th October)

Inflow Data at Kotri (Indus River)



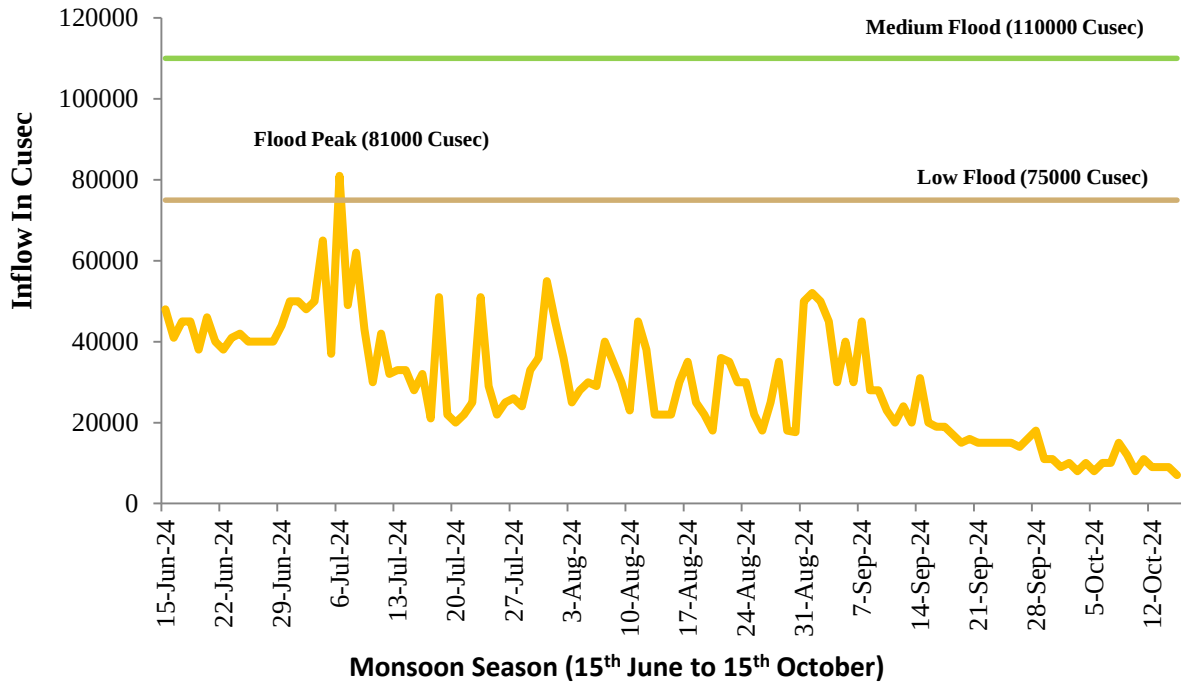
Monsoon Season (15th June to 15th October)

Inflow Data at Nowshehra (Kabul River)

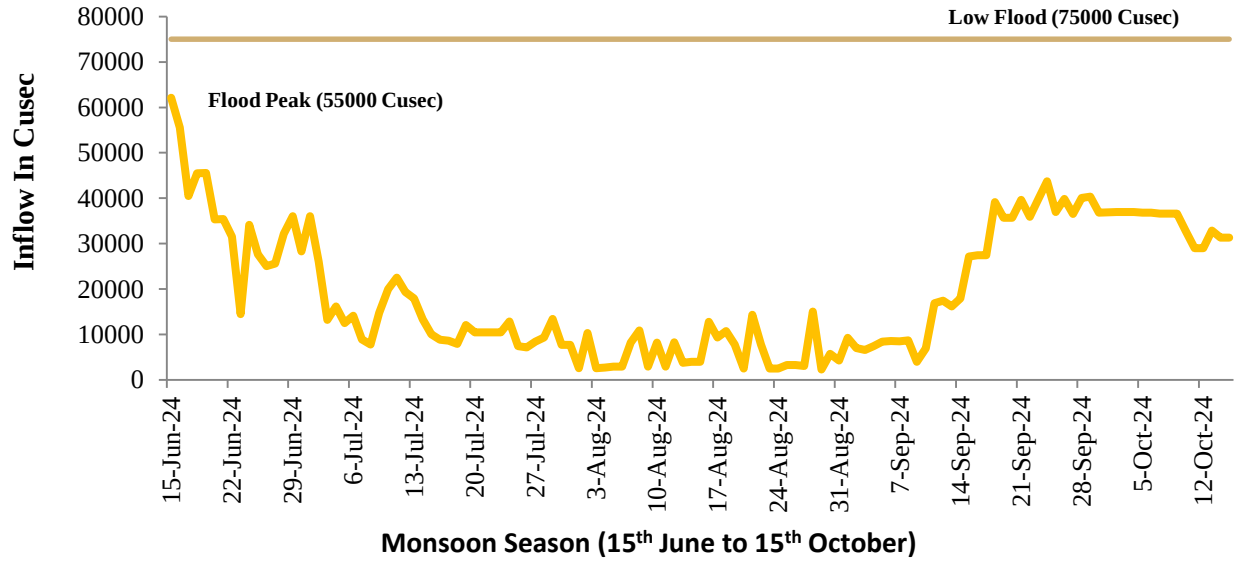


Monsoon Season (15th June to 15th October)

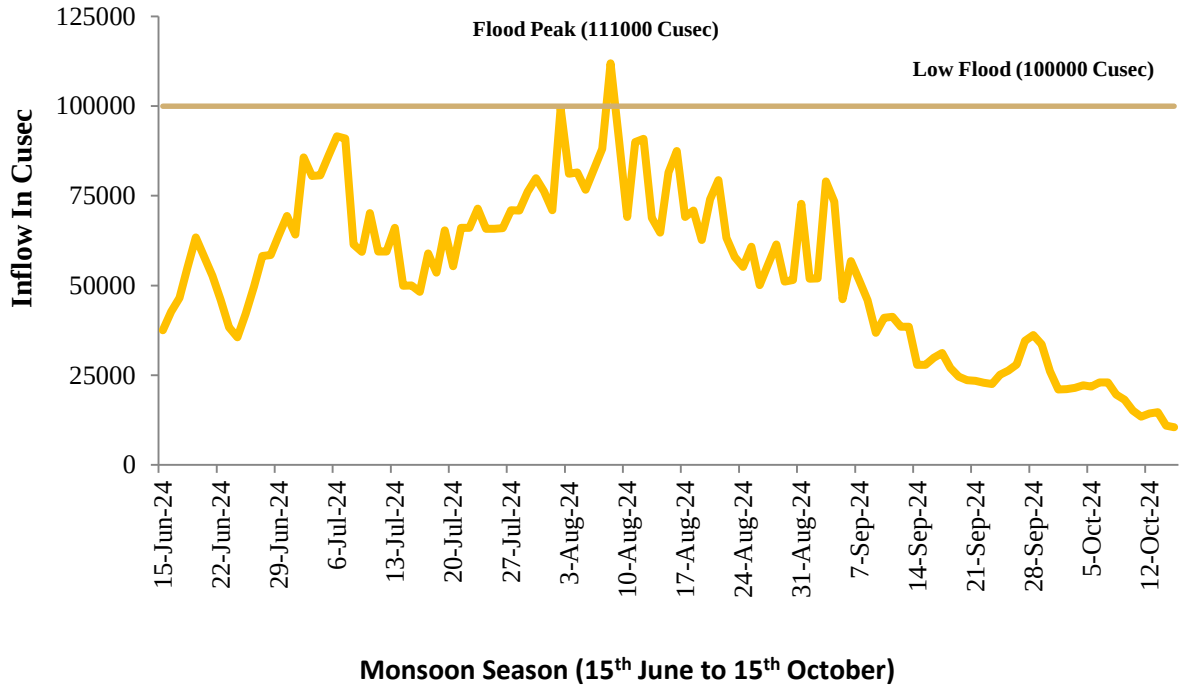
Inflow Data at Mangla (Jehlum River)



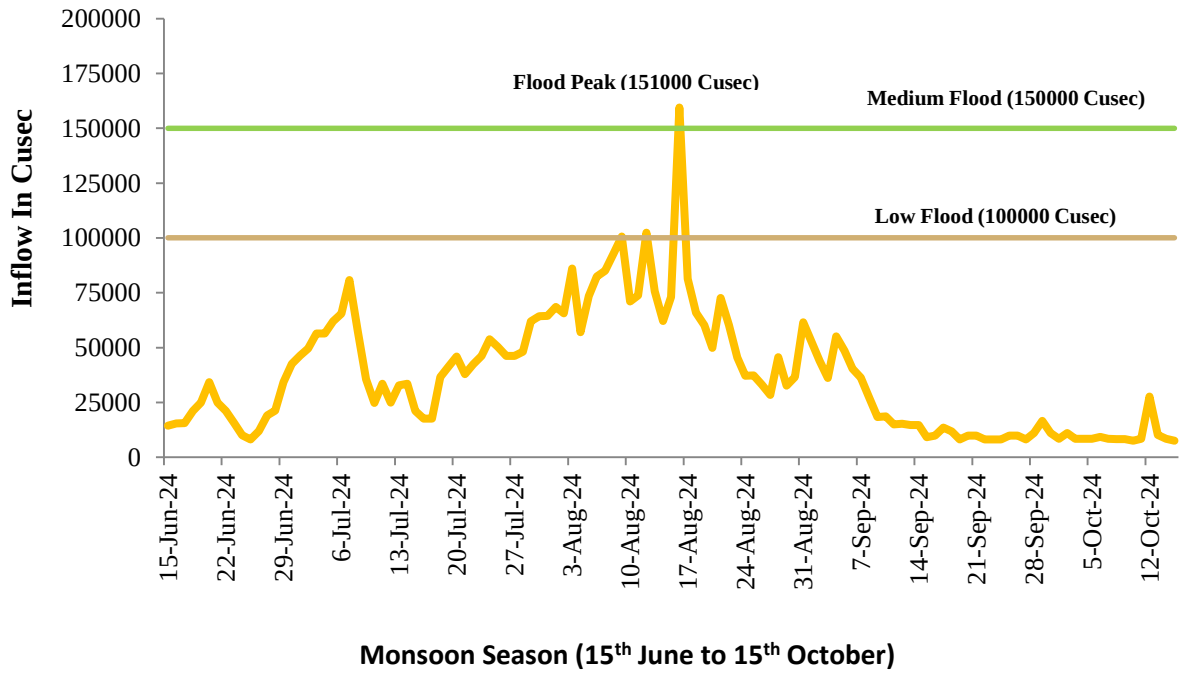
Inflow Data at Rasul (Jehlum River)

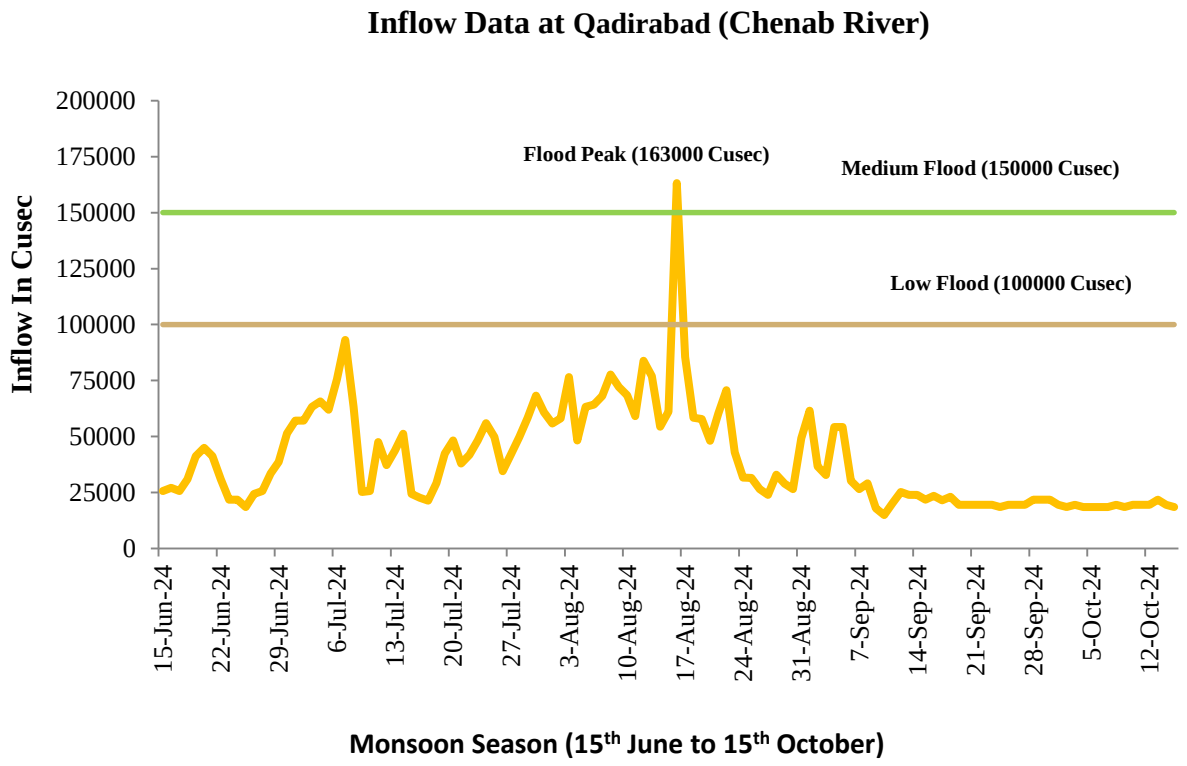


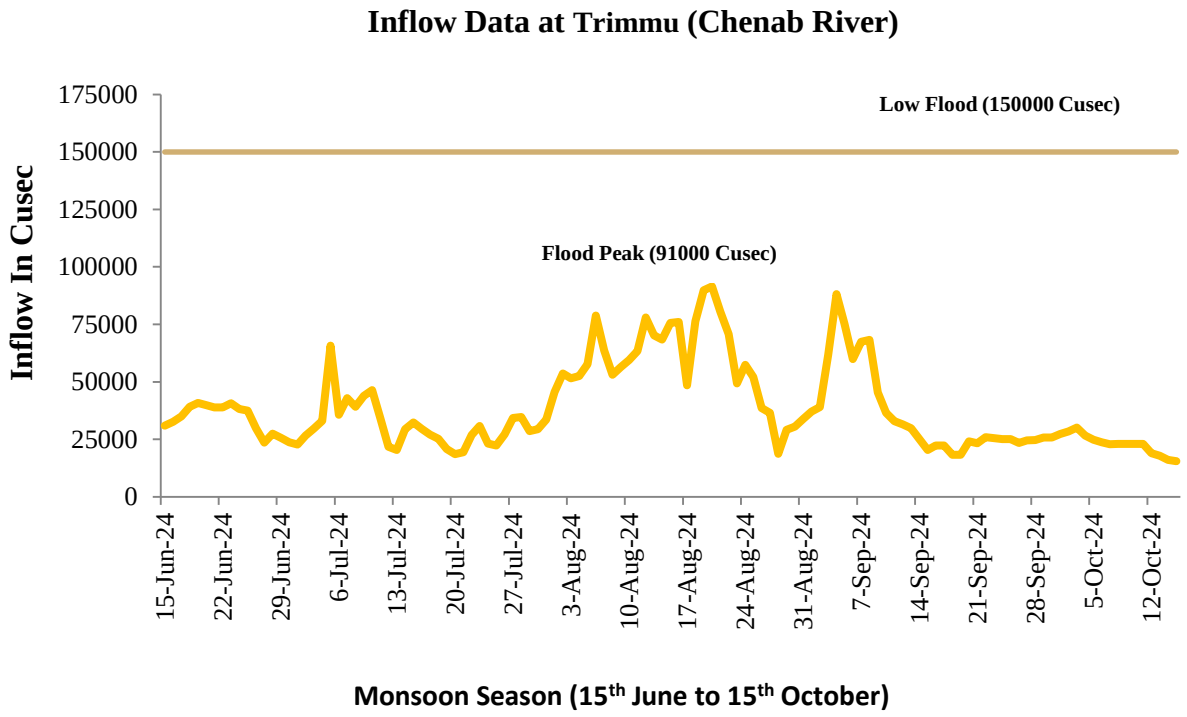
Inflow Data at Marala (Chenab River)



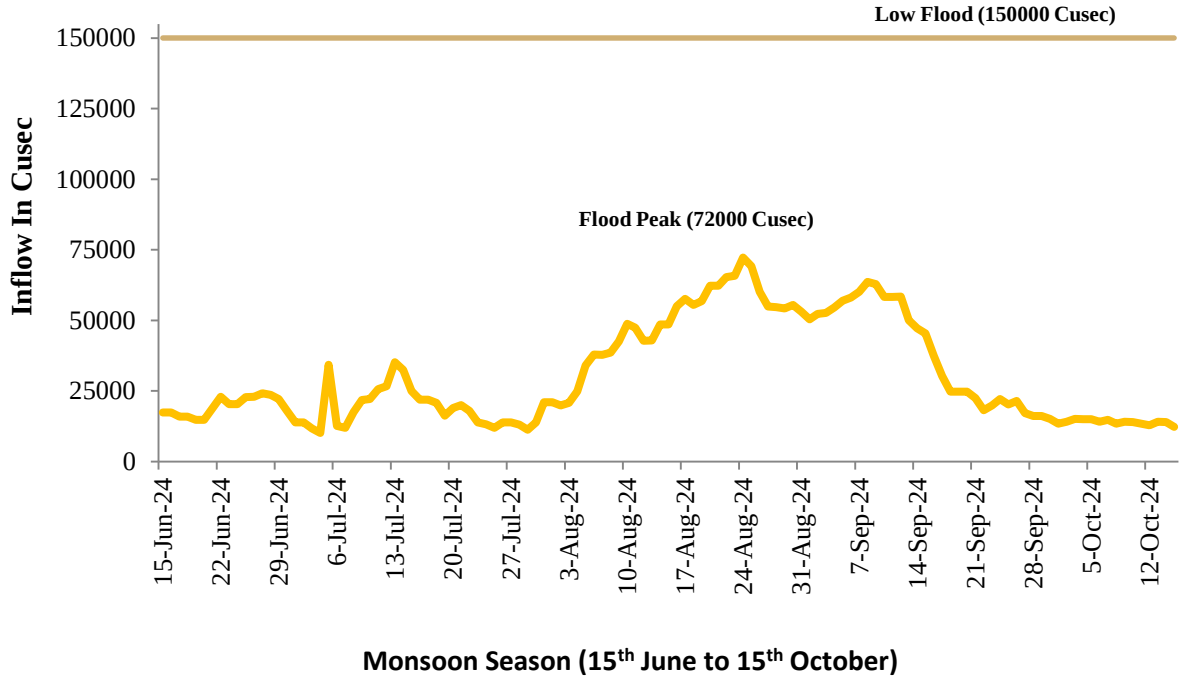
Inflow Data at Khanki (Chenab River)



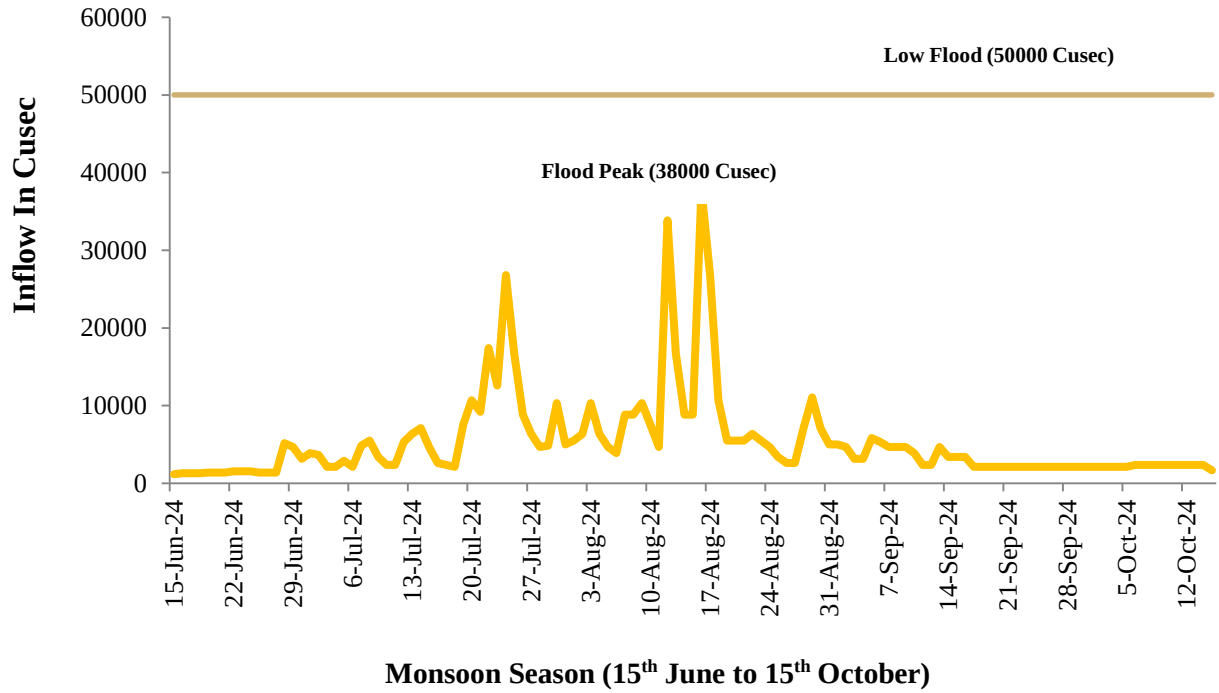

Inflow Data at Qadirabad (Chenab River)
Inflow In Cusec
200000
175000
150000
125000
100000
75000
50000
25000
0
Flood Peak (163000 Cusec)
Medium Flood (150000 Cusec)
Low Flood (100000 Cusec)
15-Jun-24
22-Jun-24
29-Jun-24
6-Jul-24
13-Jul-24
20-Jul-24
27-Jul-24
3-Aug-24
10-Aug-24
17-Aug-24
24-Aug-24
31-Aug-24
7-Sep-24
14-Sep-24
21-Sep-24
28-Sep-24
5-Oct-24
12-Oct-24
Monsoon Season (15th June to 15th October)


Inflow Data at Trimmu (Chenab River)
Inflow In Cusec
175000
150000
125000
100000
75000
50000
25000
0
Low Flood (150000 Cusec)
Flood Peak (91000 Cusec)
15-Jun-24
22-Jun-24
29-Jun-24
6-Jul-24
13-Jul-24
20-Jul-24
27-Jul-24
3-Aug-24
10-Aug-24
17-Aug-24
24-Aug-24
31-Aug-24
7-Sep-24
14-Sep-24
21-Sep-24
28-Sep-24
5-Oct-24
12-Oct-24
Monsoon Season (15th June to 15th October)

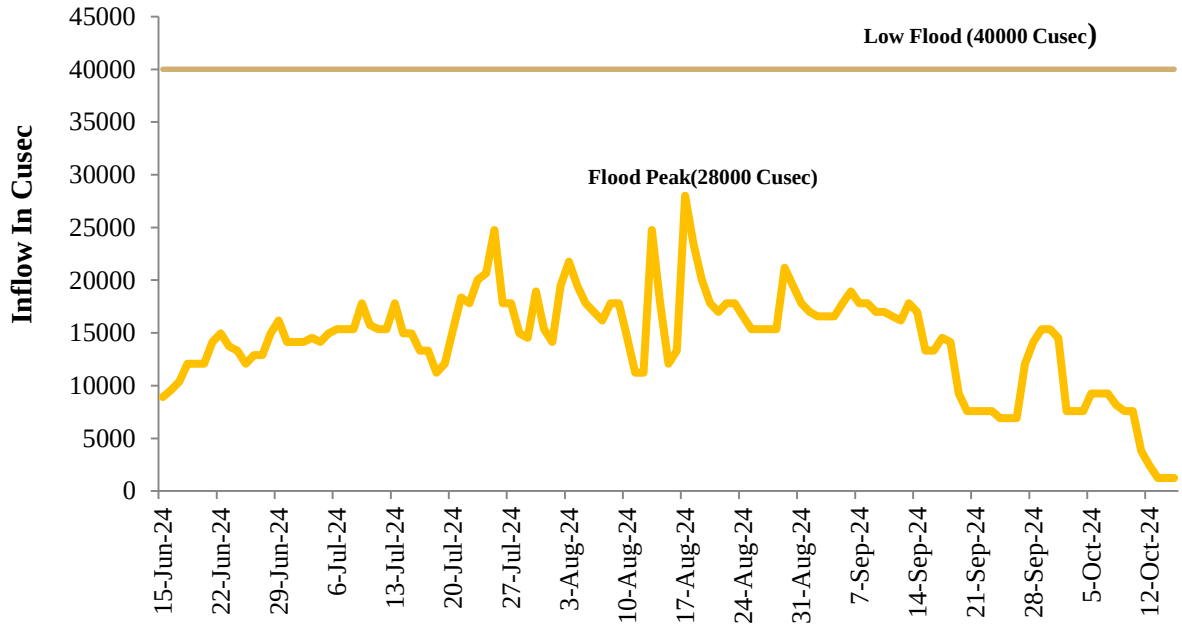
Inflow Data at Panjnad (Chenab River)



Inflow Data at Jassar (Ravi River)

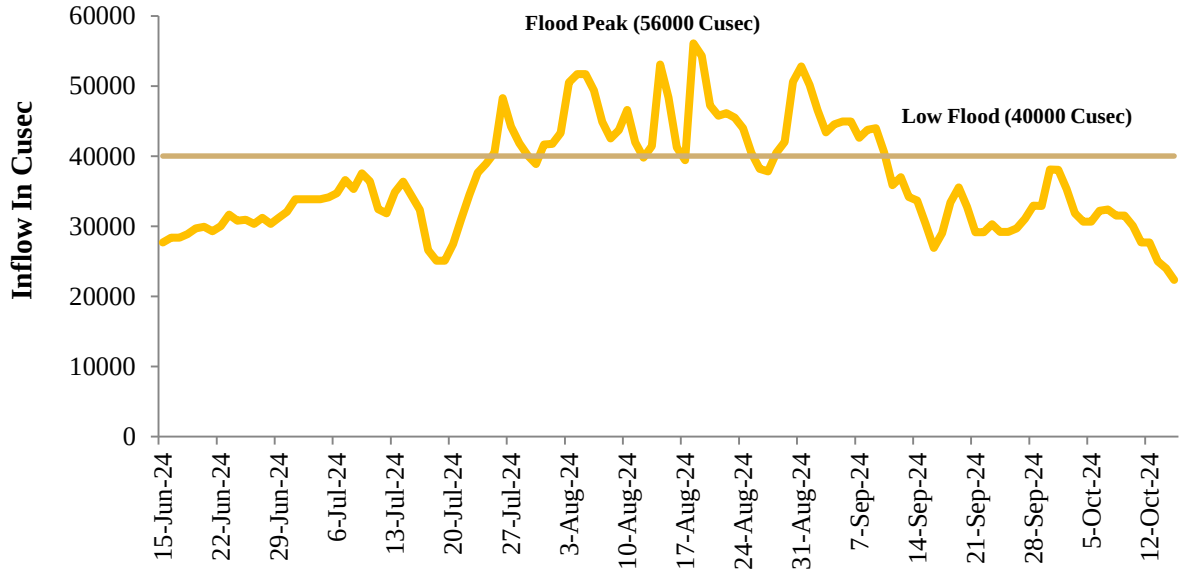


Inflow Data at Shahdara (Ravi River)



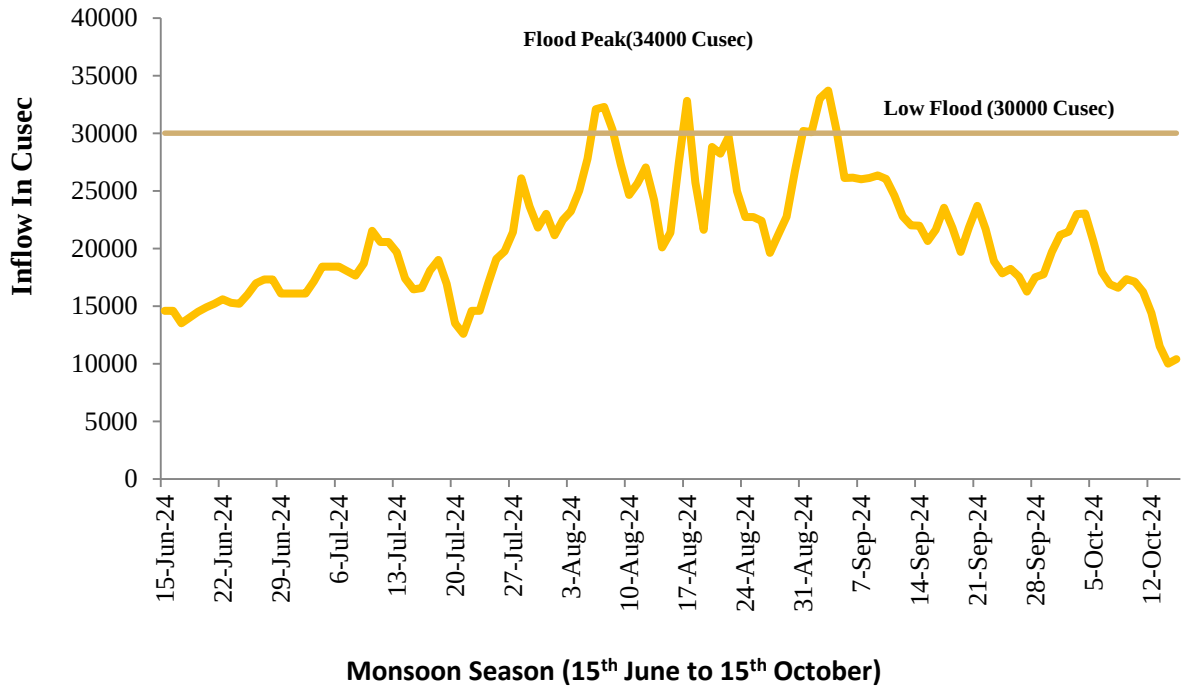
Monsoon Season (15th June to 15th October)

Inflow Data at Balloki (Ravi River)

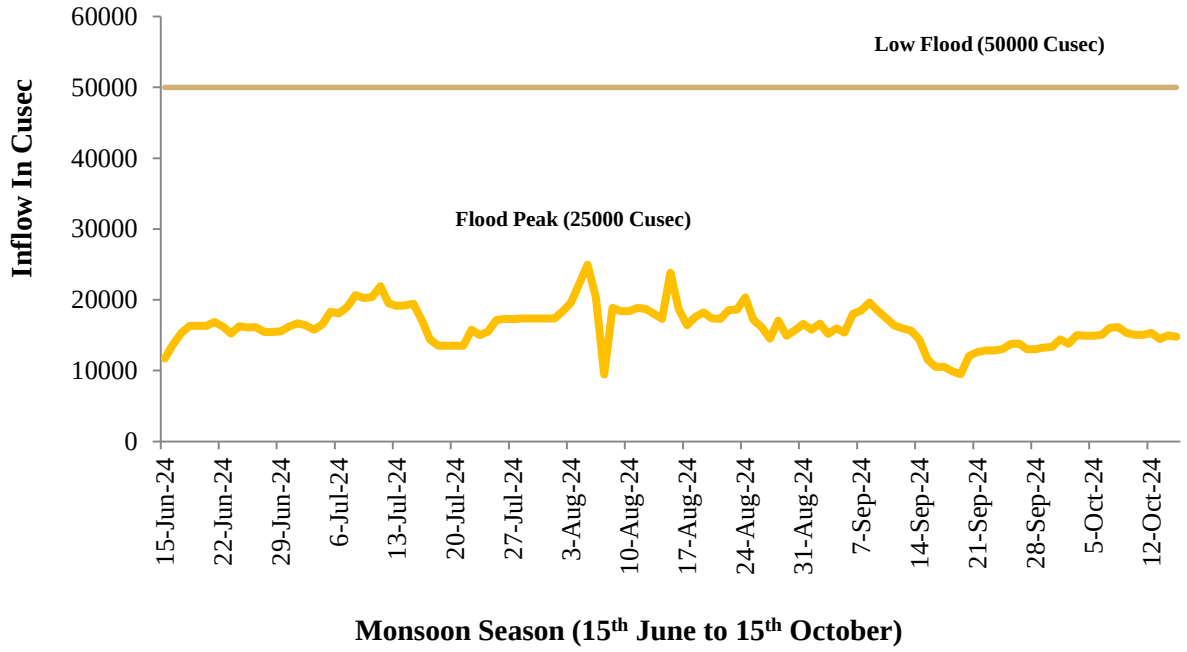


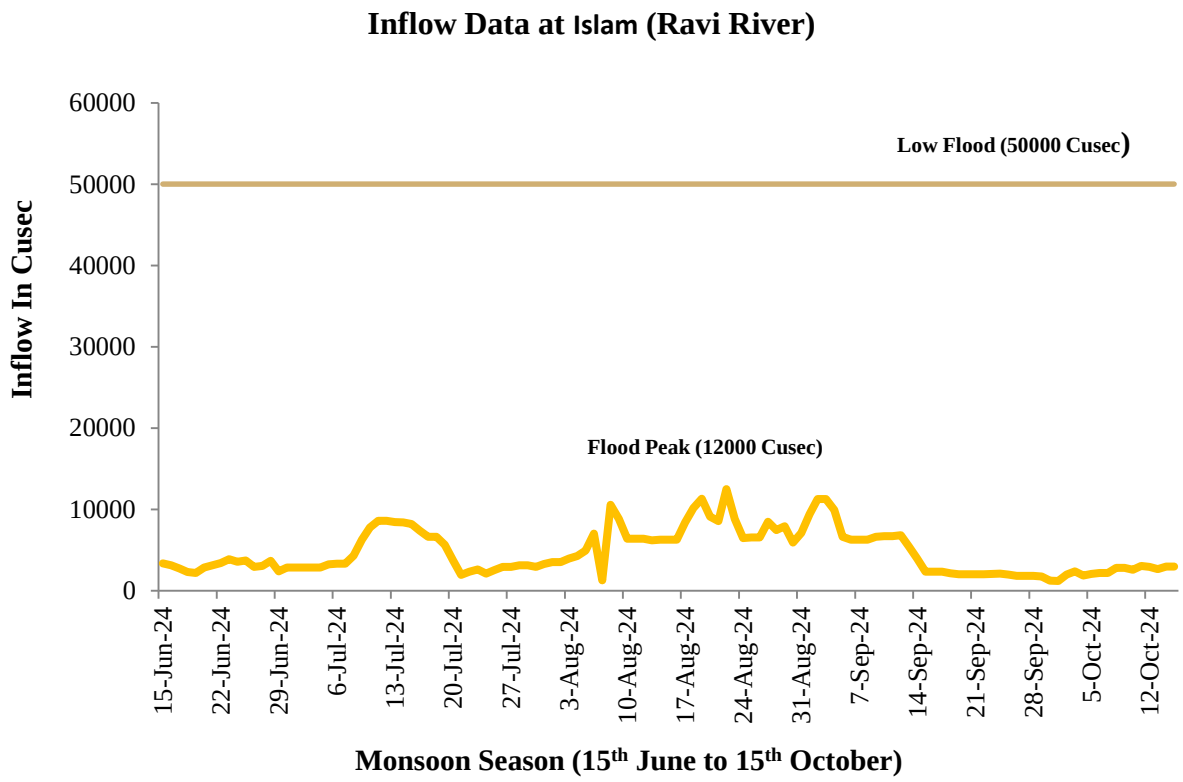
Monsoon Season (15th June to 15th October)

Inflow Data at Sidhnai (Ravi River)



Inflow Data at Sulemanki (Ravi River)




Inflow Data at Islam (Ravi River)
Inflow In Cusec
60000
50000
40000
30000
20000
10000
0
Low Flood (50000 Cusec)
Flood Peak (12000 Cusec)
15-Jun-24
22-Jun-24
29-Jun-24
6-Jul-24
13-Jul-24
20-Jul-24
27-Jul-24
3-Aug-24
10-Aug-24
17-Aug-24
24-Aug-24
31-Aug-24
7-Sep-24
14-Sep-24
21-Sep-24
28-Sep-24
5-Oct-24
12-Oct-24
Monsoon Season (15th June to 15th October)

Appendix-III
(3-Pages)

MONTHLY RAINFALL DATA

(JULY-SEPTEMBER 2024)

(Source: PMD)

Table No.1.20: MONTHLY RAINFALL DATA (JULY-SEPTEMBER 2024)

STATIONS	Monthly Total July-2024	Monthly Total August-2024	Monthly Total September-2024
PUNJAB			
Bahawalnagar	151	85.02	21.02
Bahawalpur,city	120.2	155.93	0.2
Bahawalpur,airport	87.11	150.42	0.01
Bhakkar	90.44	186.5	3
Chakwal	72.91	189.5	68.5
D.G. Khan	54.01	183.52	22
Faisalabad	129.5	188.04	65.21
Chaklala Airbase	385.06	359.07	188.01
Islamabad (Zeropoint)	289.73	424.16	191.1
Islamabad (Airport)	128.83	163.61	107.1
Jhang	123.63	203.61	15.41
Joharabad	88.71	121.71	26.2
Jhelum	221.8	356.61	104.51
Kasur	133.02	188.05	16.21
Khanpur	23.6	188.8	0.01
Kot addu	40	245.02	5.2
Kamra Airbase	155.82	226.55	50.02
Lahore (Airport)	302.04	603.14	46.02
Lahore (City)	282.04	290.74	84.6
Layyah	32.62	206.5	25.11
Mandi-Bahauddin	304.53	321.33	88.51
Mianwali Airbase	104.01	158.01	22.01
Multan	62.72	275.6	0
Mangla	275.81	320.3	134.8
Murree	271.52	264	95.01
Noorpur Thal	23.62	100.41	5.01
Okara	106.61	125.1	30.4
Rahim Yar Khan	4.01	258.22	0
Gujranwala	270.02	353.52	72.31
Gujrat	306	251.01	70.01
Sahiwal	48.22	191.03	15
Shorkot Airbase	17.13	166.03	49.01
Sargodha (Airbase)	182.03	197.23	77.02
Sargodha (City)	176.8	182.33	46.7
Sialkot (Cantt)	326.34	244.92	83.01
Sialkot (Airport)	468.21	284.02	123.91
Toba Teak Singh	118.81	229.7	0.01
Hafizabad	143.2	273.83	64.6
Khanewal	38.01	211.07	12
Narowal	183.63	436.72	88.33
Attock	76.62	209.81	74.61

STATIONS	Monthly Total July-2024	Monthly Total August-2024	Monthly Total September-2024
Multan (City)	42.22	234	3
Sheikhupura	157.51	189.51	47.51
SINDH			
Badin	49.22	242.61	9
Chhor	101.61	228.31	14.4
Hyderabad	28.82	165.2	1
Jacobabad	15	281.04	3
Karachi Airport	67.21	159.49	0.62
Larkana	24.01	194.04	3
Mithi	38	296.5	79
Shaheed Bwnwzair Abad	30.6	194.81	1
Padidan	14.7	136.71	15.7
Rohri	0.02	252.02	0
Sukkur	0.01	255.02	0
Moenjodaro	7.03	181.62	0
Thatta	22.4	169	22
Dadu	10	212.03	0
Mirpur Khas	28.8	384.9	2
Tandojam	60.91	208.6	0
Sakrand	8.2	221.01	0.01
Khairpur	18.42	303	0
KHYBER PAKHTUNKHWA			
Balakot	228	351	35
Bannu	30.02	103.01	0.02
Cherat	129	249	60
Chitral	20.1	3.4	20.4
D.I. Khan	52.45	123.61	16.81
Dir	125.01	118.01	10
Lower Dir	106.81	132.22	42.22
Drosh	24.4	8.8	9.8
Kakul	191.8	461	61
Kalam	30.02	51.61	32.5
Kohat Airbase	47.02	65.04	29
Malamjabba	188	255	28
Mirkhani	41.01	12.7	26.26
Parachinar	82	138	2
Peshawar Airbase	87.04	85.03	6.24
Peshawar City	56.3	84.04	2.03
Pattan	30	42	56
Risalpur	100.03	222.05	50.02
Saidu Sharif	114.7	79.6	55.8
Takht Bai	90.2	148.71	41.3
Bacha Khan Airport	64.62	85.14	4.03
D.I. Khan (Airport)	22.01	138	54

STATIONS	Monthly Total July-2024	Monthly Total August-2024	Monthly Total September-2024
BALOCHISTAN			
Barkhan	149.01	143	32
Dalbandin	0	4.04	0.01
Gawadar	0	10	3
Jiwani	0	5	1
Kalat	21	195	13
Khuzdar	7.65	237.7	1
Lasbela	39.52	70.2	8
Nokkundi	0	0	0
Panjgur	16.7	26	1
Pasni	0	10	6
Quetta (shmanda)	0.01	24.85	0.01
Quetta (samungli)	0.01	46.06	1.01
Sibbi	167.01	116.02	0.01
Turbat	0	16.8	0
Ormara	0.03	11.01	12
Zhob	81.03	35	0
GILGIT BALTISTAN/AJK			
Astore	6.1	92.2	12
Bunji	4.06	30.26	1.84
Bagrote	13.81	64.22	13.22
Chilas	6.23	20.24	4.02
Garhi Dopatta	71.8	192.9	105.8
Gilgit	9.36	24.35	7.02
Gupis	10	29	8
Kotli	102	241.01	28
Muzaffarabad (Aairport)	138	258.51	32.5
Muzaffarabad (City)	192	185.31	26
Rawalakot	102.61	157.91	81.7
Hunza	0	87.1	1
Skardu	1.08	22.94	1.75

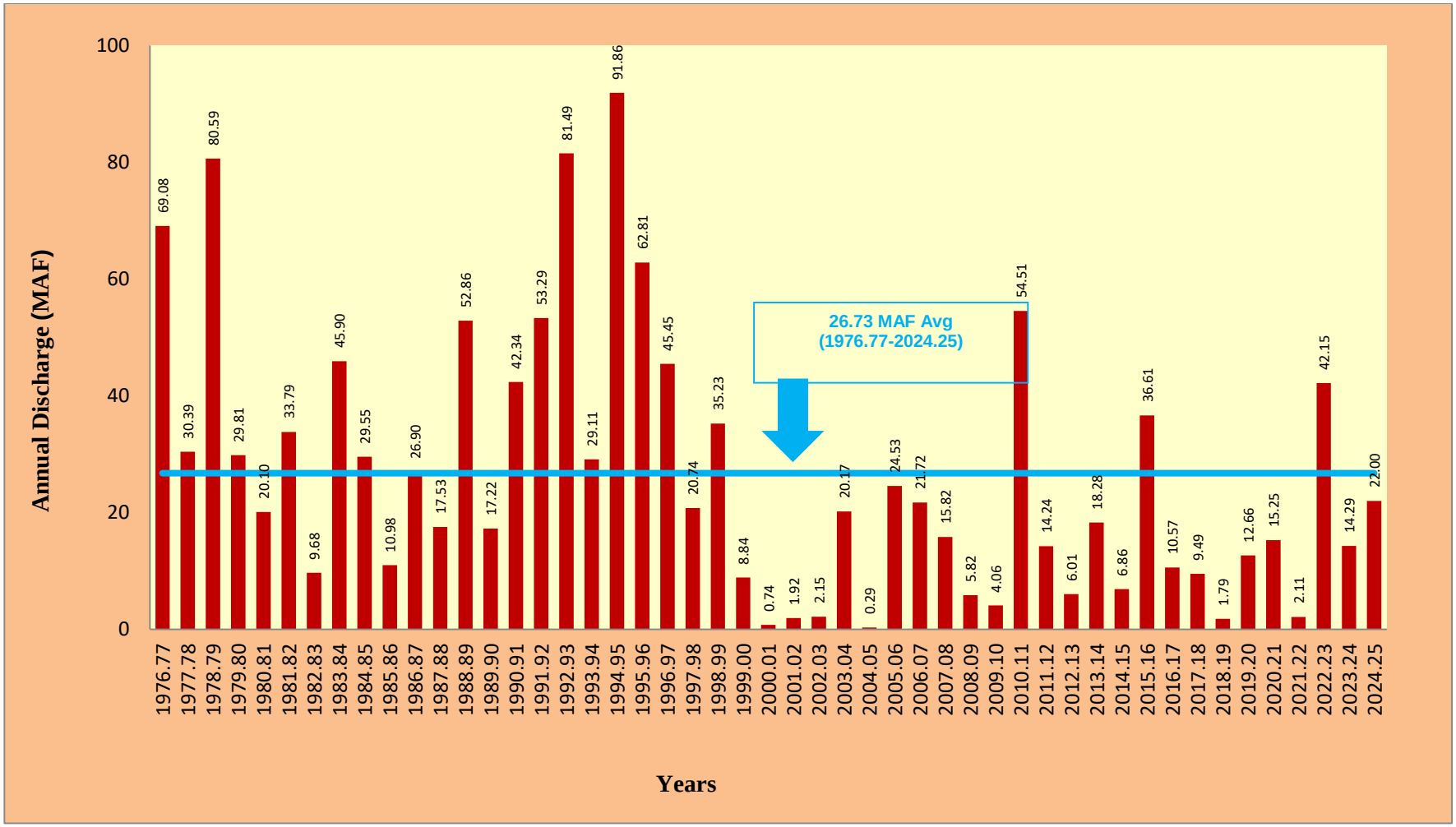
Appendix-IV

ESCAPAGES BELOW KOTRIBARRAGE

(Source: IRSA)

Appendix-IV

ESCAPAGES BELOW KOTRI HYDROLOGICAL YEAR FROM APRIL TO MARCH



Source: IRSA

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