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MANAGEMENT OF HIGH FLOODS

Dr. Izhar ul Haq

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GENERAL

It is an irony that the nation, which was complaining about years-long shortage of water, till the month of June 2010, fell prey to unprecedented floods that damaged towns, villages and vast agricultural lands. Pakistan faced drought from 1996 till 2002 which was considered worst in last 50 years. In the past Pakistan experienced severe floods in 1973, 1992, 2006 and 2010. But 2010 floods broke all past records. This rotation of two extremes has plagued the nation with heavy economic losses and human sufferings.

The 2010 Floods began in late July 2010 following heavy monsoon rains in the Khyber Pakhtunkhwa, Sindh, Punjab and Balochistan regions of Pakistan and affected the Indus River Basin. Approximately, one-fifth of Pakistan's total land area was underwater. According to Pakistani Government data, the floods directly affected about 20 million people, mostly by destruction of property, livelihood and infrastructure, with a death toll of close to 2,000.

The Pakistani economy suffered an extensive damage to infrastructure and crops. Structural damages have been estimated to exceed USD 4 billion, and wheat crops damages are estimated to be over USD 500 million. Officials have estimated the total economic impact to be as much as USD 43 billion.

The agricultural damages are more than 2.9 billion dollars, according to an estimate, over 700,000 acres of cotton crops, 200,000 acres of sugar cane and 200,000 acres of rice crops are lost.

The power infrastructure of Pakistan also took a severe blow from the floods, which damaged 10,000 KM transmission lines and transformers, feeders and power houses in different flood-hit areas. Flood water inundated Jinnah Hydro Power Project and 150 small power plants in Gilgit. The damage caused a power shortfall of 3.135 Gigawatt.

India received comparatively less rains, managed much of the water with the help of its newly constructed dams and reservoirs and caused minor flood in Satluj River, along with borders of Kasur district of Pakistan. The disastrous natural calamity could have been further destructive; had India released the surplus water in case of heavy rains there.

In early August, the heaviest flooding moved southward along the Indus River from severely affected northern regions toward western Punjab, where at least 1,400,000 acres of cropland were destroyed, and then towards Sind and Baluchistan. By mid-September the floods had begun to recede.

FLOOD HAZARDS

In Pakistan, the Floods are caused by Monsoon rains and melting of snow and glaciers in the north. The country is commonly exposed and vulnerable to Monsoon rains which come every year during the months of June, July and August. With modern satellite weather forecast, we can take affective measures to minimize the damages. The early warning system can inform the vulnerable community about hazard.The Hazard assessment comprising of amount of

precipitation, river capacity and the water spread area, announcements can help to minimize the damages.

Melting of glaciers in northern Pakistan due to global warming is also potential hazard, which can generate floods. We can reduce its affect by constructing Dams. Hydro meteorological hazards include: floods, debris and mud flows; tropical cyclones, storm surges, thunder/hailstorms, rain and wind storms, blizzards and other tsunamis.

Depletion of Existing Storages Capacity

Reservoir Sedimentation is one of the major problem, as the available capacity of existing reservoirs continues to diminish with accumulation of sediment in the storage space. Tarbela Dam stores about 1/9 of the average flows of river Indus at that site while most of the sediment is retained due to 95% trap efficiency. The storage lost is about 0.11 MAF per year. Tarbela has lost 30% of its gross storage. Similarly the per year storage loss in Mangla Dam is 0.019% MAF and it has lost 15 % of its gross storage. Table –I gives the loss of storage in reservoirs.

PRESENT WATER AVAILABILITY

Pakistan is a water scarce country. According to Falcen Mark, Global Water Scarcity Indicators, if a country has less than 1700 m^3 / capita water availability, it faces seasonal or regular water-stressed conditions. Pakistan per capita water availability is 1038 m^3 which would reduced to 800 m^3 / capita in the year 2025. (Fig-1).

In Pakistan the available storage per capita is about 100 m^3 which is very low as compared to other semi-arid countries (Fig-2). The water storage capacity of Pakistan is very small and can store only 30 days of average flows (Fig-3).

NEED FOR NEW STORAGE DAMS AND THEIR ROLE IN FLOOD MITIGATION

The existing storage capacity is reducing while more water is required to meet the growing demand due to increase in population.

During flood 2010 about 55 MAF of water passed through Kotri Barrage and went to sea. About 17.87 MAF flood water did not reach the sea, submerging areas in Sindh and Balochistan for several months. Fig-4 shows that on the average 31.25 MAF of water/year goes to sea unutilized.

In an agricultural country like Pakistan, the storage dams are life line to the nation. These reservoirs store water and regulate releases for irrigation supplies after saving precious river water from going into Sea and play an important role in mitigating floods. Low cost hydro electric power is secondary benefit of such multi purpose projects. While Pakistan has hydro-electric potential more than 50,000 MW, but we are not equally fortunate to have many large storage sites. Egypt has Aswan high dam with storage capacity of 90 MAF which saved the country not only from floods but also from 7 year drought. Three Gorges dam in China has storage of 30 MAF which produces 22000 MW of electricity in addition to flood mitigation and navigation. Pakistan does not have large yearly carry over sites. We have sites only for seasonal carry over i.e from Kharif to Rabi season. It is also necessary because of climate; rains during June, July & August and snow melt also during this period. We have 70% river flows during the three months of June, July & August while during the remaining nine months the flows are only 30%. There is no storage site on river Chenab and Jhelum. On river Indus the d/s most site is Kalabagh before the river debouches into plains. About 320 KM U/S of Tarbela, the site is Diamer Basha Dam with a gross storage of 8.4 MAF. Upstream of this, there is a site near Skardu. Any sizeable storage at the site would drown the entire valley of Skardu and Shiger with great environmental consequences. There is a site on Shiger river with about 6 MAF

of storage. Except these on line storages, we have limited off-channel storages such as Akhori Dam off-taking water from river Indus and Rohtasfort dam off-taking water from river Jhelum. These off-channel storages have considerable environmental problems.

After raising Mangla Dam, its storage capacity increased by 2.9 MAF, there would be little surplus water and less flood hazard. On river Indus, we have Bungi, Dasu, Pattan and Thakot run of river projects, which can also store water about 1.15 MAF. We have to explore run of river sites with some storages on rivers Hunza, Gilgit and their tributaries.

Nowshera and Peshawar valley are flooded by river Kabul and Swat. We have Warsak hydropower project or river Kabul which is silted upto spillway crest and now run off the river project. There is no storage site on river Kabul d/s of Warsak. Munda dam is being designed on river Swat which would store about 1 MAF of water and produce 760 MW of electricity. This has 50 ft of free board to absorb the flood peaks and stagger it with the Kabul river peaks thereby mitigating floods in Nowshera.

On Gomal Zam river, we have built Gomal Dam project which would store about 0.9 MAF water, produce 17 MW and mitigate floods in addition to irrigation of 163 thousands of Acres of agriculture land.

We have to harness the hill torrents for irrigation and flood mitigation. Govt. of Pakistan plans to build 36 small dams in the four provinces of Pakistan which would help to mitigate floods in addition to Irrigation.

We have constructed three flood canals; Greater Thal Canal, Kachi Canal and Rainee Canal which helped to mitigate floods.

Construction of dams, channels, levees and diversion of water to side channel storage or other watersheds, provide tools to reduce flood damages.

Fig-5 shown the hydrograph during 2010 floods. Tarbela Dam project absorbed a peak of 2 lac cusecs of river Indus on 30th July without which the intensity of flood would have been very server. Had Kalabagh been there, it would have also stored more than 2 MAF of water as shown in (Fig-6), and there would have been no floods.

No Mega storage dam was constructed after Tarbela and Mangla. The need for new water storage reservoirs must be realized to fulfill the water requirement and mitigate the floods.

The consequences we are facing for not building large Dams:

- Progressive loss of existing storage capacity with resultant shortfall in committed irrigation supplies and flood mitigation.
- Sustained colossal losses due to uncontrolled super floods.
- Recurring inter-provincial disputes on water sharing, particularly during early Kharif.
- Serious undermining of national food security.
- Stinted growth of domestic, industrial and agricultural sectors.
- Enhanced dependence on thermal power generation through imported fuel causing prohibitive rise in the power tariff.

PROPOSED FLOOD MITIGATION PLAN

Following plans are suggested / being implemented for mitigation of future floods:

1. By constructing Mega Reservoirs:
   (i) Mangla Dam Raising Project
   Additional flood storage capacity of 2.9 MAF.
   (ii) Constructing Munda Dam on the Swat River will be helpful in mitigating the flood in Swat River by absorbing 1.29 MAF.
   (iii) Constructing Kurram Tangi Dam to mitigate the flood to the volume of 1.20 MAF.
   (iv) Diamer Basha Dam, which can absorb a huge volume of 6.4 MAF will save downstream area upto Tarbela from any type of flood in Indus.
   (v) 32 Medium Dams will be constructed in four provinces of Pakistan in two phases. In Phase-I, 12 dams and in Phase-II, 20 dams will be constructed from 2010 to 2013 & 2011 to 2016 respectively. These 32 dams will control and absorb the flows coming from the rivers/streams in their respective areas.
   (vi) Construction of off-channel Akhori Storage Project.
2. Feasibility of re-routing floods in desert areas.
3. By constructing fuse plugs and by pass channels upstream of barrages allowing the flow to return back to the rivers.
4. By strengthening and maintaining Flood Protection Bunds with at least 100 years return period.
5. Conversion of MNVD (Main Nara Valley Drain) into flood carrying drain.
6. Feasibility for rehabilitation of Hamal and Manchar Lakes to absorb more flood volume.
7. Creation and development of lakes and wet lands wherever possible to control the flood.
8. Management of Hill Torrents by constructing checks and delay action dams.
9. Updating the existing flood plain maps and preparation of flood maps in other affected areas like Kabul and Swat Rivers. No construction below maximum flood level in Malakand, D.G. Khan, Hazara should be allowed.

Conclusions:

The overall water scarcity, escalating future demand and stagnating water availability, large annual and seasonal fluctuations in river flows, inadequate storage capacity and progressive reduction in the capacity of the existing reservoirs due to sedimentations, over exploitation of fresh aquifers and degradation of water quality are the emerging threats.

The 2010 flood was attributed to heavy rainfall, climate changes and monsoon pattern. There is great need for better management of Indus River System, emergency warning and evacuation systems and flood management.

We need to develop our limited number of storage sites to obtain maximum benefit of water, power and flood mitigation.

References:

- Tarbela Dam Project Annual Sedimentation Report.
- Wapda Vision 2025 projects.
- Media Reports on 2010 Flood.

- "Pakistan Economy running dry" World Bank Report 2009.

Table-1: Loss of Storage in Reservoirs in Pakistan

RESERVOIR	ORIGINAL	PRESENT	LOSS DUE TO SEDIMENTATION
TARBELA	9.69 (1976)	6.77	2.92 30%
MANGLA	5.34 (1968)	4.54	0.80 15%
CHASHMA	0.72 (1971)	0.26	0.46 63%
TOTAL	**15.75**	**11.57**	**4.18 27%**

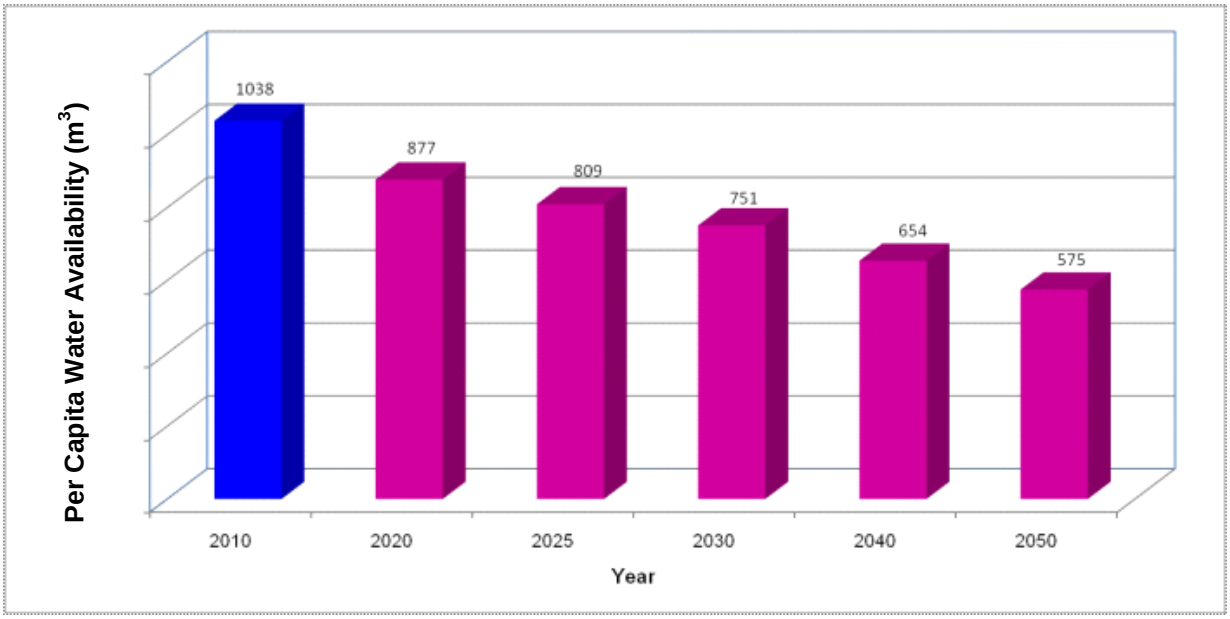

Figure 1: Water Availability - Pakistan Projected Scenario

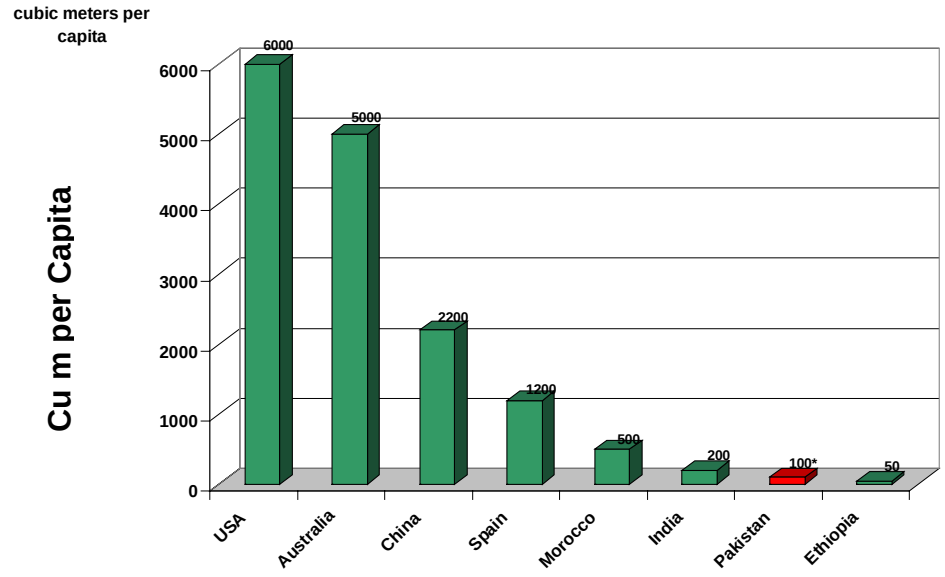

Figure 2: Storage Per Capita in Different Semi Arid Countries

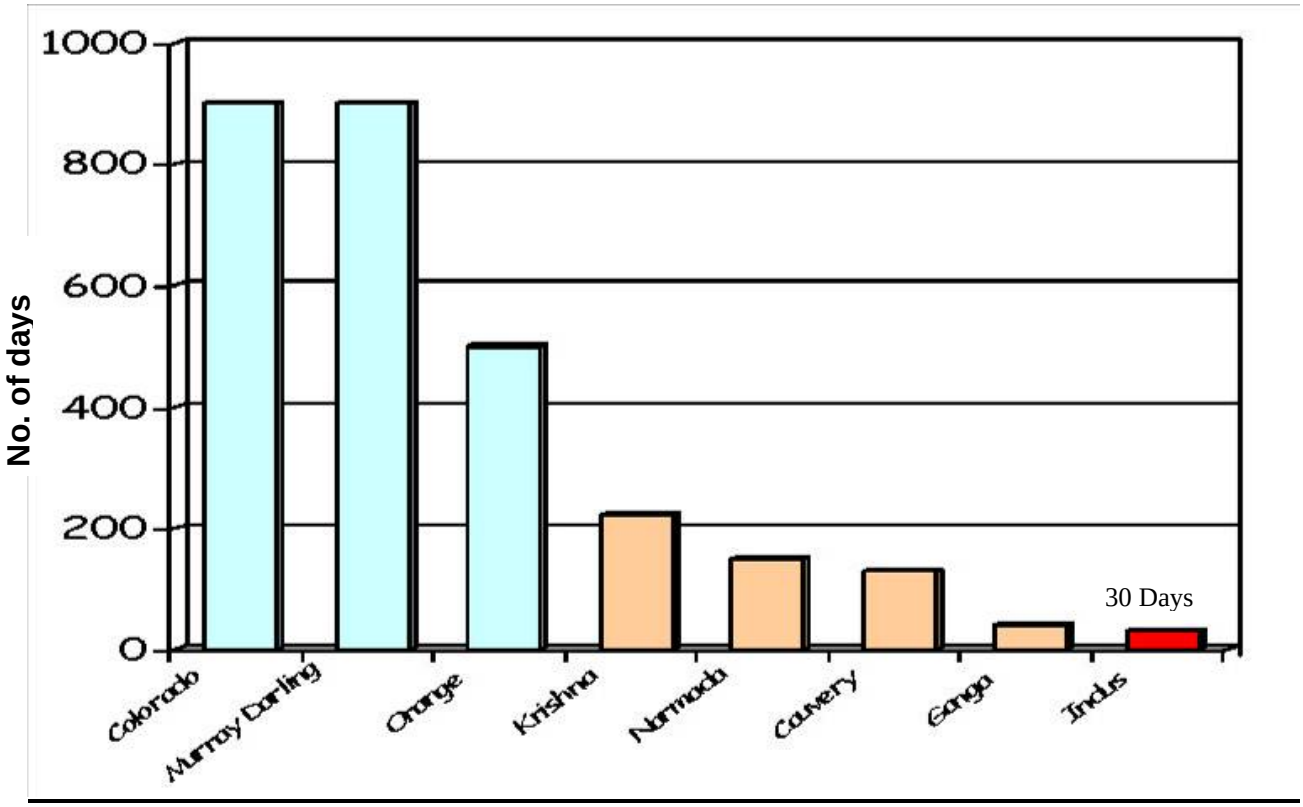

Figure 3: Days of Average Flow which Reservoirs in Semi-Arid Countries can Store in Different Basins

(***Source:*** World Bank analysis of ICOLD and GDRC data)

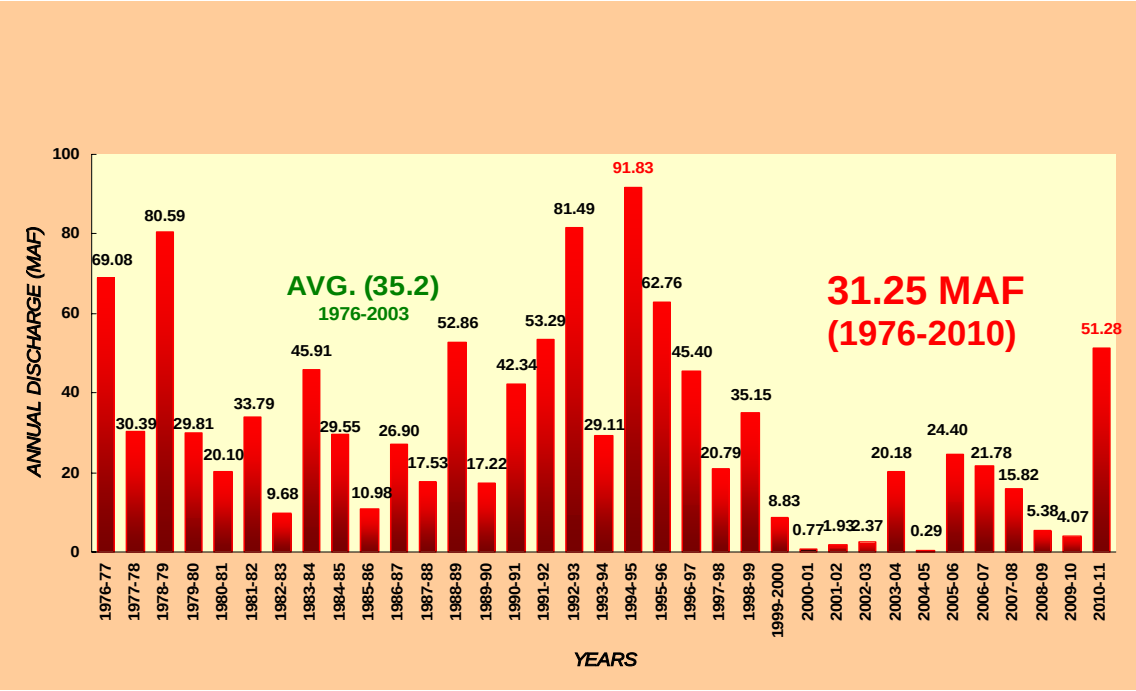

Figure 4: Escape Below Kotri

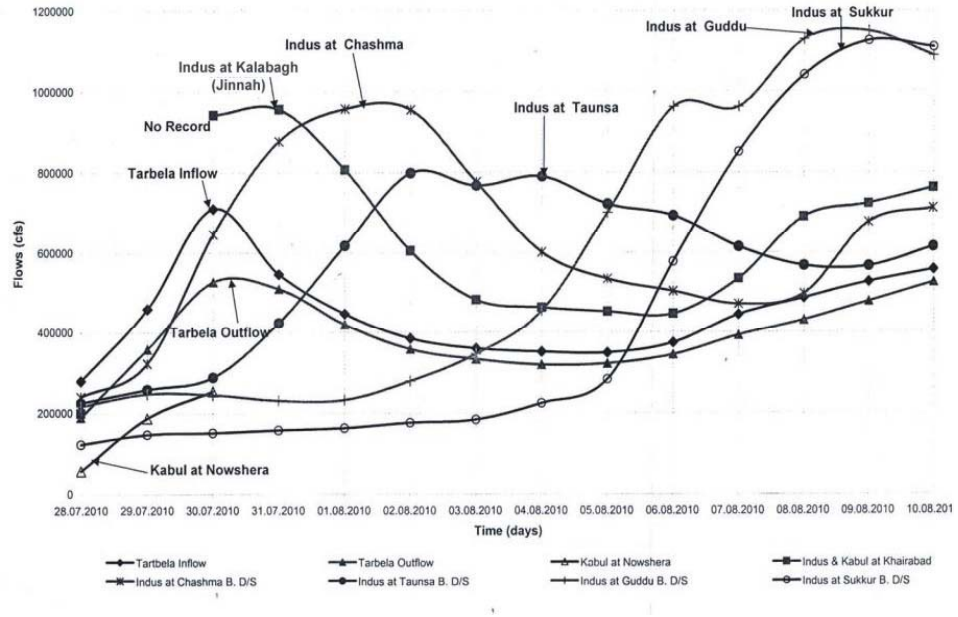

Figure 5: Indus & Kabul River Flood Hydrographs During 2010

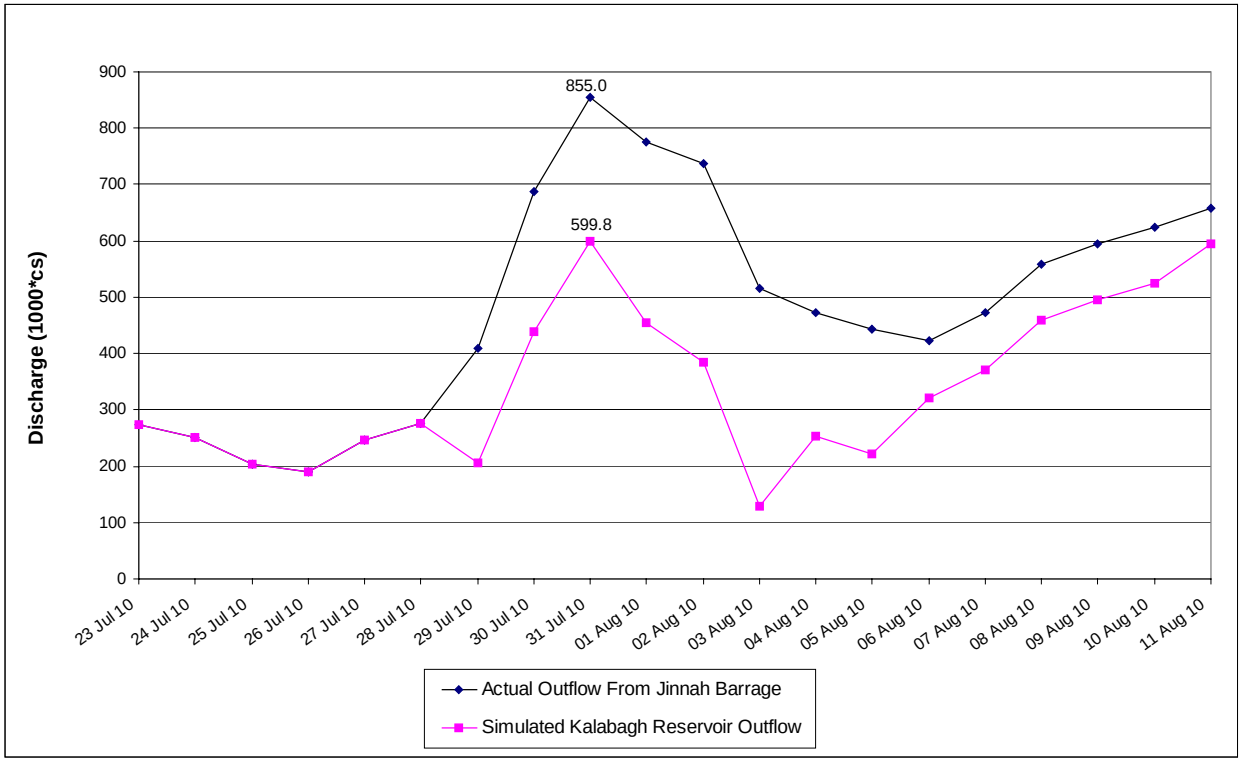

Figure 6: Flood Mitigation with and without Kalabagh Dam
During July And August 2010 Catastrophic Floods