MUNIR GHAZANFAR

KALABAGH DAM AND THE WATER DEBATE IN PAKISTAN

Abstract

Kalabagh Dam (KBD) project holds a unique place in Pakistan's policy making history. It has generated significant heated debate and controversy for a very long time. Three out of the country's four provinces have refused to go along with this project. However, in spite of the heated debate facts on KBD are not transparent, and the case of smaller provinces has not been highlighted in mainstream media debates. This paper investigates key issues like how much Indus river water is available, the annual wastage of 35 MAF water and the negative consequences of interventions with nature. On the face of it, at present, water is available for storage and expanded irrigation but the question is whose water and at what expense? Will it remain available in future when India utilizes all that has been acceded to it under the Indus Basin Treaty of 1960? Second, all that is ours is not available on regular basis. The average availability includes the occasional superfloods. Unless we can store the superfloods the average availability is simply not there for, sometimes, years on end; but KBD cannot store the superfloods. It is not a carryover dam. Finally while more irrigation water will be made available to Sindh, it will come at the expense of what is already passing through it and required for flood irrigation and as essential environmental outflows.

Introduction

Amongst the many national level water issues the Kalabagh Dam (KBD) project has come up as the most significant and well known water issue in Pakistan. In fact, there has never been a more controversial construction issue since the shifting of the capital of India by Muhammad Shah Tughlaq in 1326. It is a paradox that in spite of the controversy surrounding KBD many basic facts remain obscure. This paper aims to bring some of these into the debate.

Sixty years after the creation of the country over fifty per cent of the people in Pakistan are still illiterate and have been kept so, ostensibly, to keep them out of the decision making process and an informed policy debate. No wonder on many important national issues there is hardly any debate and likewise on Kalabagh Dam issue the media continues to project a one sided viewpoint and panic the people into believing the sky is going to fall if KBD is not immediately constructed. Fear in this case has been used as an instrument to win over public opinion.

Conventionally there are three groups which aim to educate and inform the people on national issues. One is political parties, the other is media and the third,

intellectuals. About the political parties the less said the better. As for the media, we can write off television, which all over the world is controlled in one way or another. Of the print media, especially in the Urdu press accessed by 99 per cent readership, there is little tradition of research and debate necessary to develop a perspective for issues and create understanding and interest. Finally, as for the intellectuals, they have always been a rare breed in Pakistan. That is apparent from the diminutive contribution of the universities in the sphere of social science. Research on social issues has also been restricted and constrained by the fear of security agencies and the establishment (Zaidi 2004), whose predetermined conclusions are always declared as the supreme national interest, and to debate that in Pakistan has been considered subversion. More recently World Bank, ADB, and other donors have commissioned various Pakistani NGOs and consultants to collect facts on issues related to gender, education, health, human rights, devolution etc. Many of these commissioned reports are for limited circulation, some are published, a few are confidential. They are in the form of reports and not research articles.

Kalabagh Dam is the first issue, which has given rise to a major debate and a degree of research to support positions. The motive force for all this debate and research has been the political resistance and refusal of the smaller provinces to come on board. The provincial assemblies of the three smaller provinces have repeatedly passed unanimous resolutions against it (referenced in a section below), mammoth public meetings have been held to oppose it, and especially in Sindh there have been numerous sit-ins, teach-ins and strikes.

The Kalabagh Dam Issue: Federal government's point of view

However limited the number of people involved or whatever the quality of debate, the KBD issue remains the most debated of the water issues. To sum up the position of the federal government, four purposes will be served by the construction of the Kalabagh Dam:

1. Storage (6.1 MAF) of excess water now going down the Kotri Barrage
2. Canal irrigation of 2.4 million acres of new lands
3. Generation of 3600 MW of hydroelectric power
4. Flood control

The benefits are substantial. The quantity of water stored in the Tarbela and Mangla Dam reservoirs is gradually decreasing due to sedimentation. Another dam on Indus will not only replace the loss of storage but substantially increase the total quantity of stored water enabling additional and timely releases for irrigation purposes to increase food grain production.

The KBD will eventually generate 3600 MW of cheap hydro-electricity or 11,750 million kilowatt hours of electricity in an average year. While the reservoir will be located largely in NWFP, the power generation station will be situated in Punjab. As

such the royalties from hydropower generation will accrue to Punjab. The dam will also help reduce the effects of floods by storing peak flood flows.

Last but not least, the federal government points out that every year 35 MAF water is going waste into the sea, downstream of Kotri. The same water could be used to bring a vast amount of new land under cultivation to produce more food for the increasing needs of a growing population.

Finally, the federal government says, it is not just a question of expanding storage, we are, in fact, losing the existing storage due to siltation of previous reservoirs and we desperately need more dams just to replace the lost storage of existing dams.

But there is no medicine without side effects. However, the costs, we are told, are relatively small at the loss of 24500 acres of land, including only 2900 acres of irrigated land to submersion, and displacement of 48500 persons (44000 in Punjab and only 4500 in the NWFP). Concerns of the provinces regarding water logging and salinity have been addressed in the dam design and allegations of ecological damage are simply not true. The opposition to the dam, therefore, it is alleged, is only political and malicious.

Are the Opponents of KBD Malicious?

The 6.1 MAF water stored at Kalabagh is planned to be distributed as follows: NWFP 1.1 MAF, Punjab 2.1 MAF, Sindh 2.1 MAF and Balochistan 0.7 MAF. A total of 2.4 million acres of additional land will be irrigated with the smaller provinces getting far more than their proportionate share of water. Likewise the 11750 million kWh (3600 MW) electricity generated will be fed into the national grid and used by all the provinces. Why on earth then are the smaller provinces against the construction of the dam when even the land to be lost to submergence (24500 acres) and the population to be displaced (48000) is located mostly in the Punjab. The dam is going to neither submerge any land in Sindh or Baluchistan nor displace any people. Yet all three smaller provinces are dead set against the construction of the KBD. No wonder the media has highlighted the opponents of KBD as irrational, politicized and malicious. Only one explanation has been put forth for this apparently irrational attitude of the smaller provinces i.e., the three smaller provinces do not want Punjab to receive the royalties from power generation and that the issue has been politicized and, therefore, not being decided on merit. It is indeed a very highly personalized explanation of their apparently odd behaviour, unsubstantiated by technical or economic argument. It is like looking at the problem from a villager's eye, a rural and feudal approach based on the concept of rivalry. Punjab is the only province siding with the Centre on the issue of the Kalabagh Dam. Most people in Punjab feel strongly self-righteous and even offended. They are concerned about delay not about debate.

It is obvious we do not know the full case of the smaller provinces. But before we explore the facts on KBD it is important to understand that KBD by and large is not an engineering issue. It is a political issue.

Is Kalabagh Dam Project a Technical Question?

The Punjabis often reflect the federal refrain that there is no dispute about the need and feasibility of Kalabagh Dam from the technical point of view but that some people in the smaller provinces have made it into a political issue.

Because we are uninitiated in debating social issues we do not realize that all technical issues at the national or international level are political issues and it is not necessary to be a part of the Kalabagh Dam technical feasibility team to have an opinion on Kalabagh Dam. Every person literate or illiterate has a right to have an opinion on political issues just as all spectators have the right to criticize the handling of a particular ball in cricket even when the critic himself/herself may not know how to even hold a bat. Kalabagh Dam Project affects the people, obviously, much more than cricket.

Kalabagh Dam, therefore, being a national issue is a political issue and all provinces, parties, and individuals have a right to an opinion on it even if they were only indirectly affected by it. The nation has a right to debate a gigantic national project like the Kalabagh Dam.

Water Availability in the Indus River System: The real bone of contention

When an upper riparian decides to build a storage-dam the first idea that crosses the mind of the lower riparian is that someone is planning to steal its water and where is the water for storage going to come from? Even when everyone is promised an enhanced supply, the water will have to be taken out of what is flowing to or through the lower riparian at the moment. It could be argued that the water passing through the lower riparian is by and large wasted. However, if the lower riparian, in this case Sindh, does not accept the argument, the water budget of the system would need to be scrutinized. It is this scrutiny of the water availability, which has caused one of the bitterest rancour between the provinces leading to charges of manipulation against WAPDA and the Federal Government. In all the meetings of the inter-provincial technical, economic, and political committees water availability is a bone of contention. It is, therefore, in the fitness of things to examine this question first.

For a proper debate facts should be known, but traditionally only a heated debate can bring out the facts. Ask anyone in government or the water field how much water is actually available. There is no single figure. The federal government and WAPDA may come up with a huge surplus in the system while Sindh contends there is an equally big deficit. What then is the total amount of water in the Indus

water system. Obviously there can be no single figure on that because the different figures represent different years. The quantum of water flowing in the Indus and its tributaries varies widely from year to year depending on snowfall in the Himalayan and Karakoram ranges and rainfall in the catchment areas as can be seen in Appendix I, which gives the annual western rivers inflows at the rim (River Inflow Monitoring) stations from 1922-23 to 2002-03. Flows of western rivers are highly erratic with a maximum of about 186 MAF to a minimum of 97 MAF. There is also seasonal variation with 84% in Kharif (summer) (GoP 2005a). In 1987 and again in 1990 and 1992 WAPDA had informed us that 137.27 MAF was the total surface water available in Pakistan. The figure was the mean of 64 years flows (1922-23 to 1986-87) of 3 western rivers Indus (Sindh), Jhelum and Chenab, because the government of Pakistan had signed off the eastern rivers, Ravi, Sutlej and Beas under the World Bank arranged Indus Water Treaty with India in 1960. The average was calculated on the basis of flows measured at the rim stations set up on the 3 rivers at Tarbela, Mangla and Head Marala (near Sialkot) respectively.

Here, before we proceed further some explanation of the measure of water is required:

> What is 1MAF? One Million Acre Feet is the quantity equal to one foot deep water standing over one million acre area. One MAF is equal to 1.3 billion cubic meters. One cusec is water flowing at the rate of one cubic foot (28.3 litres) per second. One cusec of water flowing continuously for 24 hours equals 1.98 Acre Feet of standing water.

In 1994 the rim station inflow was raised to 143.1 MAF in WAPDA calculations. Now WAPDA uses a general figure of 145 MAF for the total surface water availability in Pakistan, which needs to be looked into further if we want to know why there is such a bitter issue between Punjab and smaller provinces on the net availability figures of water for further storages. For this, some analysis of the method of calculation is called for, and follows in the next section.

Water Availability Statistics: An Analysis

Here it needs to be remembered that figures and statistics while they are meant to be exact can be most deceptive. This character of statistics was well captured by the British Prime Minister Disraeli in his famous saying, "Lies, damn lies, and statistics."

It is therefore necessary to analyse deeper. A study of the calculations on which Table 1 is based is quite revealing:

Table 1: WAPDA's calculations of water availability from western rivers on pre-Accord* and post-Accord conditions (figures in MAF)

Sr. No.	Description	Pre Accord (1987)		Post Accord	
		Mean Year	4 Out of 5 years	Mean Year	
				1992	1994
1.	Western River Rim Station Inflows	137.27	123.59	137.91	143.1
2.	Eastern River Contribution	2.00	1.50	1.30	4.0
3.	Uses above Rim Station	5.50	5.50	5.70	5.3
4.	Losses and Gains (inclusive of flows) below Rim Station	10.00	8.00	10.00	10.0
5.	Outflow to sea	5.00	3.00	10.00	5.8
6.	Net Available for utilization (1+2+3-4-5)	129.77	119.59	124.91	136.1
7.	Canal Withdrawals/ Accord Allocations	106.79	103.44	117.35	117.4
8.	Balance Available (6-7)	21.98	16.15	7.56	18.7
9.	Authorized uses by India out of Western Rivers	2.00	2.00	2.00	2.0
Net Available (8-9)		19.98	14.15	5.56	16.7

* Accord 1991 refers to the water apportionment agreement reached between the four provinces and ratified by the council of common interests (CCI) on March 21, 1991

- *Changing averages*. Table 1 shows three markedly different figures for the western rivers inflow at rim stations. WAPDA uses the maximum availability figure. Calculating averages is a methodological issue and is highly contentious. It has been discussed below under the subtitle 'the issue of averages'.

- *Eastern rivers flows*. WAPDA has also added the eastern rivers flow of 4.00 MAF (see Table 2) to availability. In 1987 WAPDA put the eastern river flow at 2 MAF but in 1994 it suddenly raised it to 4.00 MAF and showing it as "flow generated within Pakistan". Again this issue has been discussed at length in another section below.

- *Indian claims on western rivers.* WAPDA has given a small figure of 2.0 MAF for the future Indian claim on the western rivers, which in fact, could be as high as 4.8 MAF. The Indian claim on the Western rivers is discussed in a section on the future Indian claims that, follows below.

- *Ungauged civil canals*. Table 1 shows some 5.5 MAF water is actually being used in ungauged civil canals in the NWFP province, shown as use above rim stations before being measured at the rim stations. WAPDA has started to use a figure of 3.00 MAF under the same title. This too has been discussed below.

- *System losses*. Construction of every high dam increases the system losses (see Appendix II). According to Abbasi and Kazi (2000) post Tarbela losses have already reached 14.7 MAF and that construction of KBD will increase the system loss by at least another 4.00 MAF, and thus total 18.7 MAF instead of the 10 MAF shown in the Table 1. Sindhis allege WAPDA has been playing down the system losses as listed in Table 1. Zaigham Habib (2008, pers.com) considers KBD addition to system losses would be about 1 MAF.

- *Contradictory availability figures*. As can be seen from Table 1, WAPDA has been arbitrarily altering its figures and post Accord calculations, showing the net availability anything from 5.56 (1992 calculation) to 16.7 MAF (1994 calculation, Table 1) by increasing the inflow figures and decreasing the required outflow figures when canal withdrawal had been fixed at 117.4 MAF.

  Sindh's viewpoint on this issue has been projected by Abbasi & Kazi (2000) who have worked out alternative water availability figures from WAPDAs own published data and give a post 1991 Accord water availability figure of minus 5.2 MAF for the average year and minus 15.3 MAF for 4 out of 5 year scenario. See Table 2.

- *Environmental outflows*. A major issue at all water availability discussions is the essentially required environmental outflows to sea. WAPDA has been using different figures at different times varying between 3 to 10 MAF (Table 1 at # 5). The issue of required outflows has been discussed at length below.

Table 2: Comparison of Actual Post Water Accord Availability with WAPDA Computations of 1994 (Figures in MAF)

Sr. No.	Description	WAPDA's Computations	Abbasi & Kazi (2000) from WAPDA's Published Data	
		Mean Year 1994 Post Accord	**Mean Year**	**4 out of 5 years** (80% probability)
1.	Western Rivers Rim Station in Flows	143.1 (1976-94)	138.7 (1922-94)	125.3 (1922-94)
2.	Eastern River Contribution	4.0	-	-
3.	Uses above Rim Station	5.3	3.0	3.0
4.	Loss and Gains inclusive of inflows below rim station (post Tarbela 1977-1994)	10.0	14.7	11.8
5.	Outflows to Sea	5.8	10.0	10.0
6.	Net available for Utilization(1+2+3-4-5)	136.6	117.0	106.5
7.	Water Accord Allocation	117.4	117.4	117.4
8.	Authorized uses by India on Western Rivers	2.0	4.8	4.8
	Net Available	+17.2	-5.2	-15.3

Source: Website article by ANG Abbasi, Chairman of the Technical Committee on Water Resources (TCWR) and Federal Minister of State, under President Pervaiz Musharaf, and AM Kazi, former Senator and Minister of irrigation, government of Sindh.

Background to the Figures

Below now we discuss the background reality for the figures in some of the categories (including eastern rivers' contribution, future Indian claims on western rivers, use by ungauged civil canals above rim stations, and the outflow to sea) shown in the two water availability tables (1&2) given above:

The issue of averages

A perusal of Appendix I, which gives the western rivers rim stations inflow from 1922-23 to 2002-03 shows that while the flows in the western rivers vary from year to year, from time to time there is a super flood. In 1987 WAPDA made computations for the Committee on Water Resources and Management of the

National Commission on Agriculture for the 64 year period starting from 1922-23. WAPDA's computation depicted two scenarios one representing the average availability and the other representing 4 out of 5 year availability or 80 per cent probability (see Table 1). The difference between the two scenarios was explained as follows:

"In considering the potentially available surface supply it has to be kept in view that the flows are quite variable from year to year and until there is storage capacity large enough to absorb the above flows for carry over into subsequent years, the development would have to be based on the levels of flows which can be relied upon at least 4 years out of 5. This would apply not only to the direct use of flows but also to the creation of additional surface storages."

The same criteria of 4 out of 5 years (80 percent probability) was reconfirmed in a 1990 report prepared under Farooq Ahmed Khan Laghari, the then federal minister of water and power and later the President of Pakistan. These two figures 137.27 and 123.59 MAF are the real bone of contention between Sindh and Punjab on the issue of KBD. In fact the federal government now gives a figure of average annual water availability at 145 MAF (GoP 2005:3) while the Sindhis stick to the 4 out of 5 years (80 percent probability) figure of 123.27 MAF, given by WAPDA in 1987 and 1990 but now sidelined and not quoted. Is the 145 MAF average availability figure given by WAPDA wrong? No, it is not wrong but neither is the 123.59 MAF figure projected by Sindhis.

We need to constantly remind ourselves that the average annual availability of water is actually much less than what WAPDA would make us believe if we take out what India can legally claim in future and if we consider what is available for 4 out of 5 years and not depend upon the once in a while super-flood that makes up the average but is not a continuous yearly availability. In the words of a US Supreme Court ruling in Wyoming versus Colorado (1922), "To be available in practical sense, the supply must be fairly continuous and dependable ……. Crops cannot be grown on expectations of average flows which do not come, nor on recollections of unusual flows which have passed down the stream in prior years." The general average is therefore a meaningless figure in this case.

Second, it is interesting to note that in Table 1 the average annual availability has been raised from 137.27 (1987) and 137.91 (1992) to 143.1 MAF in 1994. This was done by changing the basis of average calculation from a 64 years period (1922-23 to 1986-87) to a shorter and more hydrous 18 year period (1976-1994) taking the average from 138.7 (1922-23 to 1993-94 average) to 143.1 MAF (1976-1994 average, Appendix I). Thus WAPDA shifted from the established and more reliable practice of using the available data for the entire period involved. It should have used the more dependable 72 years average of 138.7 MAF.

The issue of eastern rivers contribution to the water availability in Pakistan

Let us assume that on an average, some 145 MAF (144 MAF, Government of Pakistan, National Water Policy, 2004) water annually arrives in Pakistan. But before we plan for any new storage we should look at how much of it is already being used and how much will be available on a sustainable basis.

Since after the Indus Water Treaty, IWT (1960), Pakistan is entitled only to the water flows from the three western rivers, Indus, Jhelum and Chenab. The three eastern rivers, Ravi, Sutlej and Beas now belong only and entirely to India. However, some water does enter Pakistan through the eastern rivers. The first question is: can this water be counted towards water availability in Pakistan on a sustainable basis? Obviously according to IWT it belongs to India, which is legally entitled to it and will use it soon.

The second question is how much is this water? WAPDA adopted a figure of 2 MAF and 1.5 MAF as the eastern rivers contributions for the mean year and 4 out of 5 years respectively in its computation of 1987 (see Table 1). In the 1994 computation WAPDA raised the average annual eastern river contribution from 2 to 4 MAF and referred to it as the flow generated within Pakistan i.e. between Madhopur and Ferozpur headworks in India and Balloki and Sulemanki headworks in Pakistan. However, Water Related Data issued as part of the Accord Documents by WAPDA in 1994 tell a different story. Pages 3 and 4 of sheet III(1)b (WAPDA 1994) tell us the average annual flow data between 1976 and 1994 as received from India was 3.00 MAF for Sutlej below Ferozpur and 1.5 MAF for Ravi below Madhopur.

According to the IWT (1960) this 4.5 MAF addition to the water availability in Pakistan actually belongs to India which country will use it sooner or later. It is for the reader to decide whether this 4.5 MAF can be counted towards sustainable water availability in Pakistan?

In addition it has been pointed out, that a number of link canals join Ravi and Sutlej rivers upstream of rim stations at Balloki and Sulemanki and transfer water to these barrages from the western rivers.

Future Indian claim on western rivers

Not so commonly known is the provision in the IWT under which we have conceded to India some rights on the western rivers also. This right of India on western rivers is recognized by WAPDA by showing 2.0 MAF as authorized use by India in all three computations of 1987, 1992 and 1994 (see Table 1). However, according to the provisions of IWT India is entitled to develop a total of 1,343,477 acres of cropped area on the western rivers allocated to Pakistan (IWT 1960). Out of the above area India has already developed 785,799 acres and utilized 6.75 MAF.

It has been estimated that for the development of the remaining 557,678 acres, India will require 4.79 MAF more on pro-rota basis (Abbasi and Kazi, 2000), they can use more water if they like as there is no such restriction on them about the quantity of water or the time period in which the area is developed. Therefore, for the future authorized use by India from the western rivers a figure of 4.79 MAF or at the minimum 4.0 MAF should be adopted instead of 2.0 MAF.

Discussing the World Bank expert's verdict on Baglihar Dam the federal government told the members of National Assembly that India could store 1.5 million acre feet (MAF) water in addition to 0.6 MAF storage India needs for Baglihar Dam under the Indus Water Treaty 1960……While displaying the charts, the federal secretary said, "we cannot stop India to go for hydropower generation projects and we have information that it plans eight power projects at Chenab Rivers tributary namely Davi". The secretary disclosed that India can store water up to 0.5 MAF for each of its planned eight projects on Chenab. (Nation, February 22, 2007)

Use by ungauged civil canals

In NWFP some ungauged civil canals above the rim stations have been using river water historically. WAPDA counts this water towards total availability below the rim stations.

In the 1994 WAPDA calculation, the amount of water used by the ungauged civil canals above the rim stations is given as 5.3 MAF (Table 1). This is consequently added to the water availability. However, the Water Accord documents show the use above rim stations as only 3.00 MAF (WAPDA 1994, II(1)a sheet 1 of 3). So WAPDA figure had inflated the net availability by 2.3 MAF on this account. So the gross availability fig should be decreased by 2.3 MAF.

Thus total availability as well as net availability are only exaggerated figures which are constructed partly by statistical manipulation of averages or by reducing the necessary environment outflow or system loss figures and partly by addition of water that legally belongs to India and will be used by that country in future.

Where then is the excess water for expanding irrigation as claimed? That is the question that Sindh raises. The Sindhi people are apprehensive that future storage and expansion of irrigation will be made out of the minimum allocation for environmental or irrigation use in Sindh. It was in this context that a high level inter-provincial committee on implementation of mega-water reservoirs on January 19, 2007 failed to reach a consensus among stakeholders. Sindh had already informed the committee that surplus water would be available only for 11 out 27 year (and for 24 out of 72 years as Kharif availability) and that too would be just enough to meet the existing provincial shares under the Water Accord and not for new dams (Dawn January 21, 2007; Nation, January 21, 2007).

The issue of 35 MAF outflow downstream of Kotri

Much has been made of the so-called huge average annual amount of 35 MAF river water flowing out to the sea below the Kotri Barrage in Sindh. Does it not show there is spare water in the system going waste into sea while peasants long for a drop of water upstream? It is this water that needs to be stored in the five proposed dams/reservoirs upstream. The issue of the annual wastage of 35 MAF water is the kingpin of the argument against the Sindh case. The real nature of the statistical figure of 35 MAF outflow is, however, highly erratic (See Appendix III).

Outflow averages are deceptive. A recent (2005) study of the Government of Pakistan, (Ministry of Water & Power and Federal Flood Commission) has to say the following about water escapages downstream of Kotri:

"The average annual discharge volume downstream of Kotri has decreased from 81 MAF in the pre-Kotri period to approx 35 MAF in the post-Tarbela period. The average annual discharge volume of the last ten years (1994-2004) was approx. 6.8 MAF. In the extremely dry period 2000-2004 only approx. 2 MAF per year have been released downstream of Kotri Barrage."

"The water releases during Rabi season have declined very strongly after 1965. In 22 out of 39 years the discharge volume of the Rabi season was less than 1.0 MAF. In 7 years since 1965 almost no water was released during the Rabi season. Compared to the period pre-Kotri the average discharge volume of the Rabi season declined from 9.4 to 2.2 MAF. The discharge volume of the Kharif season have also declined very strongly from an average of 71.7 MAF in the pre-Kotri period to an average of 32.6 MAF in the post-Tarbela period."

"The distribution of flow volumes over the year has changed compared to pre-Kotri period. Presently about 83 per cent of the annual discharge volume occurs in the months of July, August and September. In the pre-Kotri only 66 per cent of the annual flows occurred in these three months." (GoP Study II, 2005:92)

At another place the same study (p.173) referring to comparison with still an earlier period says "Exploitation of water resources upstream and recent drought periods resulted in reduction of flow levels below Kotri Barrage from 170 MAF to 35 MAF per annum."

Committed nature of the flow. Even this average outflow is not entirely uncommitted. For the most part it is already committed. For example, it includes 10 MAF as the essential environmental outflow committed under the 1991 interprovincial accord. It also includes what is already signed off as belonging to India under the 1960 Indus Basin Treaty and India plans to consume in future.

Environmental outflow to sea committed in the Accord 1991	10.00 MAF
Eastern rivers share belonging to India.	4.50 MAF
Estimate of future Indian claim on western rivers for non-reservoir irrigation	4.70 MAF
Unutilized part of the increased canal withdrawal (106→114 MAF) committed allocation under the 1991 Accord	8.00 MAF
Expected increases in system losses upon the construction of KBD	4.00 MAF

This totals 31.20 MAF. If and when all this is used only 3.8 MAF will be left to flow down the Kotri Barrage over and above the 10 MAF, agreed in the Accord 1991 as the essential environmental flow, even in the average year of 35 MAF.

Is the outflow a wastage? It needs to be remembered that a certain amount of outflow to sea is absolutely essential for the health of the delta and other environmental considerations including protection against pollution, erosion, inundation of the delta and, encroachment of groundwater salinity, saving whatever mangroves remain and the sustenance of fisheries and other aquatic life. The International Union for the Conservation of Nature (IUCN) put the minimum required outflow figure at 27 MAF in one of its studies but in the Waters Accord 1991 a minimum outflow figure of 10 MAF was agreed, though Sindhis are not very happy about this figure and consider it too low. Having agreed to a 10 MAF environmental outflow in 1991 the federal government has now started to suggest that the average annual environmental outflow need be no more than 3.6 MAF (GoP 2005). Even the World Bank, the main protagonist of major dams has to say the following in its 2005 report:

"There is no feasible intervention which would enable Pakistan to mobilize appreciably more water than that it now uses. Arguably, overall use for irrigation needs to decline so that there are adequate flows into the degrading delta". The allocated figure of 10 MAF outflow should be looked at in this perspective.

Not only the outflow at Kotri has been reduced from 81.11 MAF in the pre-Kotri period to 62.52 in pre-Tarbela period (1955-56 to1975-76) to 34.75 MAF in the post Tarbela period (1976-77 to 2003-04) (See Appendix IV) but also the duration of the flow has been reduced to less than 3 months between the end of June to the beginning of September and that also in high flood years.

And even if we wanted to store only the super-floods, KBD could not do that. All dams in Pakistan including the proposed KBD store water only after meeting the current irrigation requirements at any moment of time and they are not empty when the flood comes. Thus the extra water during high floods is spilled over into the sea. A carry-over dam like the proposed Katzarah Dam near Skardu is different. It can

store excess floodwater in it for use in subsequent years. KBD is not being proposed as a carry-over dam.

Finally, even if 35 MAF or 10 MAF passes down the Kotri Barrage, is it wastage? The federal government says yes, and we should use it for badly needed irrigation. According to Sindh on the other hand, water passing down the Kotri Barrage is the lifeline of the Indus Delta, and even of the annual flood plain, Kachho, of River Indus in Sindh. This water sustains the riverine forest and Kachho cultivation, recharges and helps maintain the quality of the ground water, dilutes the pollution in the river and is necessary for the aquatic life and vegetation in the region.

Siltation: Loss of existing storage capacity

Loss of existing storage capacity has been used as one of the main justifications for KBD as a new storage to replace the lost storage capacity.

It has been pointed out that Mangla, Chashma and Tarbela are rapidly silting up and we are close to losing nearly 30 per cent of the total built storage capacity. Constructing KBD is not only a question of making a new dam but also of replacing the lost capacity. The World Bank Report (2005) says under the sub-title, Sobering Fact 12, "Pakistan has to invest and invest soon, in costly and contentious new large dams….And there is an urgent need for storage just to replace the capacity that has (as predicted) been lost to sedimentation. Given the high silt loads from the young Himalayas, Pakistan's two large reservoirs are (as predicted at design) silting relatively rapidly)." Abbasi and Kazi (2000) have analysed at length and consider the siltation claims as exaggerated. According to them:

"The life of Tarbela and Mangla reservoirs was envisaged to be 55 and 75 years in the original projects, which has been revised to 125 and 225 years respectively due to lower than estimated rates of siltation. The large-scale watershed management programmes undertaken should further reduce the rate of siltation."

The height of the Mangla Dam has been raised as per stipulated provision in design. That will add another 2.9 MAF of storage capacity. However, even without increase in its height Mangla could store an additional 2 to 3 MAF in its present shape. As for Tarbela its silt deposits can be flushed out though sluicing as recommended by the Chinese experts at one seventh the cost of KBD.

Again, WAPDA has exaggerated the extent of siltation. In 1988 it said the reservoirs indicated a siltation of 1.23 MAF and gave an annual rate of siltation of live storage at 0.081 MAF for all three reservoirs. That adds up to only 2.20 MAF by the year 2000 and not to the siltation figure of 2.91 MAF by 2000 as suggested by WAPDA in 1994 (Abbasi and Kazi 2000).

WAPDA tried to link the utilization of enhanced irrigation allocation (117.5 MAF) under Accord 1991 with the issue of siltation of present reservoir capacity in a

meeting of the Council of Common Interests held on September 16, 1991 but the same was not accepted. Consequently the enhanced irrigation allocation of 117.5 MAF (or 114.5 MAF without the civil canals' usage in NWFP) is not linked to the construction of KBD in the Accord 1991 documents.

Accounting for rainfall and underground water

The River Indus is the only source of water either for drinking or for irrigation, available to the people of Sindh. Unlike Punjab, which gets considerable rain in the monsoons. Punjab gets most of the 40 MAF equivalent annual rain (20-40 inches) on the irrigated part of Indus Basin, while Sindh is parched land getting 4-12 inches (100-300 mm) of rain per year.

Further, while Punjab has a large reservoir of sweet water under its soil from which over 350,000 tube wells draw as much as 40 MAF of water every year, the subsoil water of most of Sindh is as saline as the sea (Gadi, 2003). Deep groundwater in Sindh is invariably brackish. Fresh groundwater is limited to areas where the river has flowed in recent centuries for a very long period. It floats upon brackish water down below, which has the same ratio of sodium chloride and potassium chloride as in seawater.

Intervening Natural Ecosystems

There is a need to look at the context of the debate. If we look at the water issues in a historical context we can see three trends: the need for water increasing, the total available water decreasing, and the downstream flows declining as more and more water is used upstream with new storages and canals.

The absolute quantity of water decreased with the signing of the Indus Water Treaty (IWT) in 1960, under the aegis of the World Bank (WB). The IWT was followed by construction of new reservoirs, and link-canals to transfer water from the western rivers. A World Bank study of 1960s had recommended shifting agriculture towards high input-high field crop systems—making system as much crop demand based as possible (Lieftinck et al. 1968). Thus in 1960s High Yielding Variety (HYV) of seeds were introduced which needed more intensive external inputs including chemical fertilizer and later pesticides to protect the new seed varieties which were more vulnerable to disease and pest attacks than the traditional varieties. The 'green revolution' seed varieties also needed much more abundant (up to 3 times as much water for the new wheat seeds, Gadi 2003) and timely supply of water and were, thus, linked to the construction of new dams and canals.

Lieftinck et al. (1968) World Bank study also recommended full storage and use of Kharif (monsoon) surplus water in Indus by the year 2000. However, the gradual intensification of irrigation has led to the dual menace of water logging and salinity, which had already became alarming in the sixtees. New loans were contracted from the World Bank to install heavy-duty tube-wells to tackle the new menace of water-

logging and salinity. The tube-wells lowered the water table in some area and washed down salts accumulated on surface. Soon, however, the tube-wells were adding more salts than they were washing down because the groundwater contains more salts than river water and the quality degrades further with intensive pumping. Although they helped in lowering the water table in some water logged area the big capacity Salinity Control and Reclamation Project (SCARP) tube wells carried 1500 ppm of total dissolved salts as against 150 to 250 ppm carried by canal water (Chaudhry et al. 2002).

With the failure of tube well solution the World Bank came up with still another mega engineering solution i.e., plans to build surface water drains to counter the rising water logging and salinity. The first phase built at huge expense, comprised the Left Bank Outfall Drain (LBOD) in Sindh. The consequences have to say the least, been disastrous, impeding natural drainage, increasing pollution, drying up water bodies, diminishing and killing fauna and causing social dislocation and misery. Even the World Bank has admitted it. The Right Bank Outfall Drain (RBOD) has yet to be completed.

Why does the irrigation system lead to water logging? Water logging is caused when more water is added to the soil than can be drained. Nearly sixty per cent of the water through the irrigation system is wasted on the way mainly through seepage and percolation through canals distributaries and water courses into the ground leading to water logging. Only 40 per cent reaches the fields but, in fact, only 30 per cent is actually needed by the crops. However, excess water is required because of the flood irrigation method used in uneven fields. The overall irrigation efficiency in irrigated areas is estimated to be hardly 30 per cent (GCISC 2005).

Uptil 1967, 150 years after its development, Indus and its large canal network operated without any reservoir and 70 per cent of cropped area, having scarcity by design (Habib, 2006). The first reservoir of the Basin, Mangla was built as a replacement works storing and transferring water from River Jhelum to Ravi and Sutlej. The second big reservoir, Tarbela, also contributed to the replacement works through two big link canals, transferring water to the eastern rivers given over to India.

There is a need to understand that damming the rivers and building irrigation systems is an intervention with nature. A dam generally has two main purposes, to store and divert water for irrigation and to generate hydropower. It should be understood that generation of power does not entail major intervention because such dams that only generate hydropower are run-of-the river type and need only a one time small storage without consuming any. This is not to say that all storing and diverting water to irrigation is bad. It is only to highlight that interventions in the ecosystem have consequences and that mega-engineering solutions are one-dimensional. It follows intervention should not be large, may be local rather than regional, and solutions to problems should be as natural as possible. The findings of the World Commission on Dams (WCD) were highly critical of these negative

dimensions of the mega-engineering solutions to agricultural problems. In the words of WCD (2000) report "These ecosystems yield products such as wildlife, fisheries and forest resources and are of aesthetic and cultural importance to many millions of people. Diverting water to dams alters the natural distribution and timing of stream flows. This in turn changes sediment and nutrient regimes… affects the natural productivity of floodplains and deltas". For a decade or so after the WCD report the World Bank lowered its profile but is back exhorting the governments to build without itself taking high profile public positions. We should, therefore, be cautious when discussing the positive outcomes of mega-engineering projects as solutions to our agricultural problems. Their negative outcomes may be equally serious but not highlighted and marketed in the media as their positive outcomes are.

A matter of trust

The federal government has repeatedly suggested that it is ready to incorporate Sindh's water concerns in the Constitution. Since the Sindhis have refused to buy that offer, clearly there is a breach of trust. But what has made the Sindhis lose their trust?

In Feb/March, 2006, the President appeared on the national television and announced that the government had decided to postpone the construction of Kalabagh Dam to 2016 and had decided to build the Diamer-Bhasha Dam instead first. Again Raja Pervaiz Ashraf, the Federal Minister for Water and Power addressing a crowded press conference in Lahore declared "the government has finally decided to shelve the controversial Kalabagh Dam Project forever owing to the tremendous objection of the different stake-holders". He said that controversy over KBD had reached an alarming stage that was threatening the unity of the Federation (The Nation May 27, 2006). Work on Bhasha Dam would now be taken up with immediate effect. In Sindh there was a sigh of relief and a feeling that a major thorn of discord in the body politics of Pakistan had finally been removed.

In December 2006, KBD started to be mentioned in the official plans again. The Central Development Working Party (CDWP) took up the issue with President Pervaiz Musharraf in the chair. The spokesperson at the end of the meeting declared that the project had been dropped due to lack of consensus. This was duly reported in the newspapers. The day-after newspapers, however, carried a different story. The KBD was after all going to be built along with four other dams and would be completed before 2016 and that committees had been constituted to immediately start mobilizing funds from the private sector through the creation of a Special Purpose Vehicle (SPV). When the reporters asked how could such a decision have been taken without approval of the inter-provincial technical and political committees the spokesperson replied the cabinet were all powerful and their decision would be binding for all committees and bodies (Dawn Dec 1, 2006). What trust is then left under these circumstances?

Dams are not the only thing, canals like the Greater Thal Canal (GTC), which are even more important, have been constructed without the consent of the lower riparian. Then there are canals which when built were promised to be seasonal but have now been operating on perennial basis. The federal government says some canals will draw water only during flood season. The same was said about the Chashma Right Bank Canal, when it was planned to be constructed. Now it is being fed on perennial basis.

When the opponents of the dam agitated against the danger of flooding to Nowshera city in NWFP WAPDA claimed the height of the reservoir had been reduced by 10ft to 915 feet. It has, however, been pointed out (Khan 2006) that actually the height of the reservoir has not been reduced, what WAPDA meant was that it would not be filled beyond 915 ft.

Referring to the KBD Project Report of June 1988, it has also been pointed out by a former chairman of the IRSA (Indus River Systems Authority) that because of the mid-level sluicing design of the dam even the claimed hydro power generation capacity is highly exaggerated (Khan 2004).

A major argument for KBD rests on its ability to provide cheap electricity. At the public meeting in Swabi President Musharraf said the electricity produced through water was Rs one per unit while the electricity with thermal power was produced from Rs 5 to 7 a unit (the Nation January 15, 2006). This highly attractive rate should be contrasted with proposals to offer 11.5 cents per unit to private hydropower plants.

The federal government says its words and intentions must be trusted while it accuses the smaller provinces of malicious intention. The Sindhi claim that even the earlier 1991 Indus water-sharing Accord, which is a document guaranteed by the constitutional body, the Council of Common Interests, has been violated (Wikipedia 2008), and water distribution is not taking place as had been agreed. How can there be trust if the debate is stifled, figures are manipulated and opposition's viewpoint is considered traitorous? The federal government promises the displaced population of the dam and reservoir area will be adequately compensated and resettled. Who can trust that when many of the Tarbela displaced have neither yet been settled nor adequately compensated. The federal government does not care for the decisions of the Council for Common Interests and for the repeatedly passed unanimous resolutions of the provincial assemblies of Sindh, NWFP and Balochistan (Sindh:14 June, 1994, 28 Feb 2003, 19 June 2003; NWFP: 20 Dec 1988, 30 May 1991, 18 Nov 1993; Balochistan: 6 Oct 1996). How can there be trust? If there is malice let facts decide where it lies.

Conclusion

One, KBD is a political issue. The issue of KBD is not an issue of technical feasibility. All major technical issues of national or international level are political

issues and should be decided first and foremost on the basis of political feasibility. If and when there is a conflict between technical and political considerations, political considerations must prevail.

The water conflict between upper riparian, lower riparian is nothing special to Pakistan. It is common between provinces and between states. The resolution lies not in authoritative imposition but in consensus. Authoritative imposition by a majority province, a state, or an interest group can lead to long-term consequences and a crisis of legitimacy. No single province, not to speak of a single individual, has the right to determine the national interest. The adverse political fallout of such a policy will outweigh any presumed real or imagined technical or economic advantage. Time and again, we have been faced with conflicting perceptions on issues concerning smaller provinces, e.g., on the Urdu versus Bengali language issue in 1948, or the 1971 election related insurgency in East Pakistan as well as on the autonomy demands of smaller provinces in West Pakistan and now on the construction of Kalabagh Dam resolutely opposed by all three smaller provinces. The consequences have been erosion of trust at the minimum and dismemberment of the country at the worst.

Two, the shortage of water and shortage of power, too, in a sense are universal problems in all countries and, in another sense, have been exaggerated to build a case for the KBD and other storages. Acquiring unity through the creation of fear and panic is a standard technique in politics. It is now established that in United States and Britain, public backing for the invasion of Iraq was acquired by creating a totally false and fabricated fear and panic of the weapons of mass destruction and the threat of imminent attack from Iraq. In Pakistan, for example, fear of impending war or invasion have been commonly used to acquire national backing. In 1971 the secessionist image of Awami League was effectively used to subvert the transfer of power to a democratically elected majority party and thereby, actual dismemberment was promoted and ensured. Load shedding has likewise been used to acquire public backing for entering unequal treaties with Independent Power Producers (IPPs). Realistic decisions are not possible in a state of panic where people are given to believe famine and darkness are looming across the door. That is what Punjab has been given to believe on the issue of KBD.

Three, alternative options are available. These include conservation measures like the lining of canal and water courses, better irrigation practices, and better farming practices including a reversion to our age old tradition of organic farming based on indigenous by developed seeds requiring much less water. Through these means and others we can save far more water than can be stored in the Kalabagh Dam. However, building the dam or emphasizing conservation and ecology are two different paradigms. One is techno-centric, the other is socio-centric. Techno-centric solutions are promoted by lending agencies like the World Bank while socio-centric solutions require social capital, social mobilization, education and above all a policy of self-reliance. The benefits of socio-centric policies are widespread with extensive spillover externalities.

Four, a careful look at the water budget shows the water for KBD can be spared only by ignoring the ecology of the Sindh province. It is scientifically wrong to consider the water going down from Kotri into sea as wastage. It has an important role in sustenance of aquatic life, maintaining the essential equilibrium in the delta region governing mangrove forests, safeguarding the coast from cyclonic winds and erosion, diluting pollution, maintaining the quality of underground water, replenishing soils, watering riverine forests and agriculture, and sustaining people's livelihoods and habitat.

The reality and significance of the ecological and environmental argument should not be downplayed. Twenty eight per cent of arable land in Pakistan has already fallen prey to a variable degree of water logging and salinity, which is a direct result of canal irrigation. Effects of dams and canal irrigation are much more serious in Sindh where 50 per cent of land is affected by water logging and salinity, the underground water has degraded, the saline water front from the sea is encroaching and the fifth largest delta in the world is suffering from major desertification including vanishing mangrove forests and aquatic life and consequent loss of livelihoods and dislocation of human settlements. Add to this the apprehensions of NWFP again about water logging and salinity of choice lands in Mardan, Charsadda and Nowshera. The federal government says NWFP's fears have been addressed in the revised design but there is a deficit of trust because of the many about-turns, betrayals and misinformation.

The fact cannot be ignored that foreign banks, especially World Bank and the ADB, are interested in extending loans for the construction of KBD. The World Bank has a poor track record. It was under its auspices that we signed away three rivers to India in 1960, entered into a debt trap, lost sovereignty and spread poverty in the name of poverty alleviation. The World Bank's business is lending money for mega-projects. It is not neutral, it has a stake in the construction of the KBD. It is in this context that many of the WB and ADB funded seminars have to be looked at as "Marketing activities" leading to tens of billions of USD loans.

More important, World Bank has another programme on the anvil, it is water privatization. Numerous global water organizations like Global Water Partnership (GWP), Pakistan Water Partnership (PWP), IIMI, International Waterlogging and Salinity Research Institute (IWARSI), etc. have not only taken over water resource planning from WAPDA but are instrumental in restructuring WAPDA itself and planning the privatizing of its assets and organizational structures in bits and pieces. Irrigation water will be privatized in the form of reservoirs. KBD will also carry one such reservoir. Telemetry is being installed and trial privatisation runs have been attempted on smaller scale. Nearly all new hydropower stations like the Neelum-Jhelum Project are already being built on BOT basis by investors. Kalabagh Dam Project is not likely to be different. At the provincial level the NWFP's MMA government offered many attractive sites and incentives for investment in hydropower stations to international bidders at the guaranteed purchase price of 4.7 cents per unit. This was nearly the same price at which the thermal power stations were contracted in

mid-ninetees by the Benazir Bhutto government. That price offer, however, was contemptuously turned down by the intending private parties. Why shouldn't they when the federal government is now offering 11.5 cents per unit to the private parties at the proposed new hydel sites. Water as well as hydropower are in for privatization. This is something to consider when explanations are sought why KBD is being pushed so hard. The lenders have come a long way from the days of Mangla and Tarbela. Now they seek ownership profits not simple interest.

The historical and global perspective of major water related issues cannot be ignored today. Indus Basin is one of the major granaries of the world and its grain and raw material potential was realized by the British long time ago when in 1880 they started building weirs across the Indus River System and diverting water into canals simultaneously being built. The second assault on the Indus Basin took the form of Indus Basin Water Treaty (1960). The canal building and tube-well installation project was accompanied by the introduction of imported seeds which needed much greater input of water, artificial fertilizer and pesticides (Gadi 2003). These requirements were a major step towards integration of its production with the global markets and technologies. The third assault is in its initial stage and involves the construction of infeasible new reservoirs, the use of genetically modified (GM) seed, privatization of the water resource and corporatization of agriculture.

While doing social policy analysis it is important to remember there are two sides to every issue. Pointing the malaise, the wastage, the growing shortage and the inequitable distribution of water is the first part in selling a policy, and this people recognize as their own experience. The second part, the prescription, paints rosy promises of conservation, plenty and equitable distribution of water. It is the second part or the prescribed policy of mega-projects and privatization, which is more or less, sold blind because people cannot relate this future scenario to their past experience. It is this prescription that contains the bomb, but that will be discovered only after when the policy has been implemented and it is already too late. Neither the fallout from, nor the alternatives to the prescribed policy are properly discussed or debated beforehand. As individuals people have neither the resource nor the time to discuss their own or other countries historical experience and link it to what is being marketed, in the name of 'development', or 'supreme national interest'.

References

Abbasi, A.N.G. and Kazi, A.M. 2000. 'Kalabagh Dam: Look Before You Leap'. http://www.angelfire.com/az/Sindh/indus4.html February 23. Also http://www.sanalist.org/kalabagh/main.htm

Bengali, K., *editor*. 2003. 'Water Reforms: The World Bank's View' in *Politics of Managing Water*. Pakistan: SDPI-Oxford University Press.

Chaudhry, M.R., M.N. Bhutta, M. Iqbal and K.M. Subhani 2002. Proceedings of the Second South Asia Water Forum: 67-81. Islamabad.

Gadi, M. 2003. 'Re-colonizing the Indus Basin Irrigation System' in *Politics of Managing Water*. Kaiser Bengali (ed), Karachi: SDPI-Oxford University Press.

GCISC 2005. *Water and new technologies*. Global Change Impact Study Centre. Islamabad. Reported Dawn August 29, 05.

GoP 2004. Government of Pakistan. Private Power and Infrastructure Board (PPIB). Advertisement. Herald, Karachi. August.

GoP 2005. *Kotri Barrage Study-II Consultant Group. Federal Flood Commission, Final Main Report*. Ministry of Water and Power. Lahore: Study by Lahmeyer International Gmbh Germany and Indus Associated Consultants.

GoP 2005a. Report of Technical Committee on Water Resources. Government of Pakistan, August 2005.

Habib, Zaigham 2006. Water Management and Reservoirs in Pakistan. *South Asian Journal* 11. Lahore: Free Media Foundation.

IWT 1960. *The Indus Water Treaty between the Government of India and the Government of Pakistan*. World Bank.

Kazi, A. 2003. 'Kalabagh Dam: Varying Points of View' in *The Politics of Managing Water*. Kaiser Bengali (ed), Karachi: Oxford University Press.

Khan, Asfandyar Wali. 2006. 'The Pakhtunkhwa's case against the proposed KBD project' *The Nation*. January 10, 2006. Lahore.

Khan, Fateh Ullah 2004. 'Infeasibility of the Kalabagh Dam'. *Dawn Economic and Business Review* November 01-7:pIV

Lieftinck, P. 1968. *Water and power resources of West Pakistan; A study in sector planning I, II, III*. World Bank. Baltimore: Johns Hopkins.

Shiva, Vandana. 2002. *Water Wars*. Cambridge MA:South End Press.

WAPDA 1994. *Indus River and Canal System Water Related Data*. Accord Documents and Studies. Lahore: Technical Committee on Integrated Water Resources Development Programme.

WAPDA 2006. 'Important points from President General Pervaiz Musharraf's address on the foundation stone laying ceremony of Diamar – Bhasham Dam'. *Wapda Khabarnama* (Urdu). Vol. 30, Nos. 17-18, May 1 to 15, 2006.

Waters Accord 1991. *Government of Pakistan Indus Waters Accord*.

WB 1995. *Private Sector Participation and Infrastructure Development in Pakistan*. Background paper for Pakistan 2010 Report, July 1995 (unpublished). World Bank.

WB 2005. *Pakistan – country water resources assistance strategy: Water economy running dry*. Washington: The World Bank.

WCD 2000. Dams and Development: A new Framework for Decision-Making. The report of the World Commission on Dams. http://www.dams.org/report/wed_overview.htm

Wikipedia 2008. http://en.wikipedia.org/wiki/kalabagh_dam

Zaidi, S.A. 2004. 'Social Science Research in Pakistan.' Daily *Dawn*, August, 22, 2004.

WESTERN RIVERS RIM-STATION INFLOWS

Years	RIM-STATION INFLOWS																							
	INDUS AT KALAGAGH						JHELUM AT MANGLA						CHENAB AT MARALA						TOTAL					
	KHARIF		RABI		ANNUAL		KHARIF		RABI		ANNUAL		KHARIF		RABI		ANNUAL		KHARIF		RABI		ANNUAL	
	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1922-23	81.65	107.0	16.04	117.6	97.69	108.7	20.39	111.9	5.37	110.8	25.76	111.6	19.44	90.9	4.55	104.9	23.99	93.3	121.48	104.8	25.96	113.9	147.44	106.3
1923-24	95.09	124.6	14.95	109.8	110.04	122.4	18.14	99.5	4.79	98.9	22.93	99.4	17.23	80.6	3.81	87.8	21.04	81.8	130.45	112.6	23.55	103.3	154.01	111.0
1924-25	69.62	91.3	13.08	96.1	82.70	92.0	22.71	124.6	3.75	77.4	26.46	114.7	17.23	80.6	3.30	76.1	20.53	79.8	109.56	94.5	20.13	88.3	129.69	93.5
1925-26	66.36	87.0	11.40	83.7	77.76	86.5	17.03	93.4	3.71	76.6	20.74	89.9	17.12?	80.1	3.11	71.7	20.23	76.7	100.51	86.7	18.22	79.9	118.73	85.6
1926-27	61.15	80.2	11.71	86.0	72.86	81.0	19.03	104.4	3.36	69.3	22.39	97.0	18.98	88.8	3.06	71.0	22.06	85.8	99.16	85.6	18.15	79.6	117.31	84.6
1927-28	57.07	74.8	12.66	93.0	69.73	77.6	16.18	88.8	4.51	93.1	20.69	89.7	17.17	80.3	3.24	74.7	20.41	79.4	90.42	78.0	20.41	89.5	110.83	79.9
1926-29	68.37	89.6	12.75	93.7	81.12	90.2	21.80	119.6	5.42	111.9	27.22	118.0	18.05	84.4	3.92	90.4	21.97	85.4	108.22	93.4	22.09	96.9	130.31	94.0
1929-30	62.45	81.9	14.22	104.4	76.67	85.3	15.83	86.8	7.74	159.7	23.57	102.2	18.92	88.5	4.98	114.8	23.90	92.9	97.20	83.9	26.94	118.2	124.14	89.5
1930-31	74.09	97.1	12.32	90.5	85.41	96.1	21.16	116.1	4.42	91.2	25.58	110.9	21.88	102.4	2.99	68.9	24.87	96.7	117.13	101.1	19.73	86.5	135.85	98.7
1931-32	63.27	62.9	14.79	108.6	78.05	86.8	20.83	114.3	4.47	92.3	25.30	109.7	17.00	79.5	3.04	70.1	20.04	77.9	101.10	87.2	22.30	97.8	123.40	89.0
1932-33	71.08	93.2	10.97	80.6	82.05	91.3	17.83	97.8	3.51	72.4	21.34	92.5	18.71	87.5	3.16	72.9	21.67	85.0	107.62	92.9	17.64	77.4	125.25	90.3
1933-34	80.25	105.2	11.60	85.2	91.85	102.2	22.52	123.6	3.66	75.5	26.16	113.5	22.91	107.2	3.51	80.9	26.42	102.7	125.68	108.4	18.77	82.3	144.45	104.2
1934-35	74.45	97.6	11.61	85.3	86.07	95.7	14.36	78.8	3.65	75.5	18.02	78.1?	19.37	90.6	3.40	78.4	22.77	88.5	108.19	93.4	18.67	81.9	126.85	91.5
1935-36	74.61	97.8	12.82	94.2	87.43	97.3	20.23	111.0	5.57	115.0	25.80	111.8	21.97	102.8	3.89	89.7	25.86	100.6	116.81	100.8	22.28	97.7	139.09	100.3
1936-37	82.49	108.1	13.20	97.0	95.69	106.4	19.90	109.2	4.41	91.0	24.31	105.4	22.52	105.3	3.30	76.1	25.82	100.4	124.91	107.8	20.91	91.7	145.82	105.1
1937-38	75.54	99.0	11.99	88.1	57.53	97.4	16.25	89.2	4.76	98.6	21.03	91.1?	18.31?	85.7	4.57	105.4	22.88	89.0	110.10	95.0	21.34	93.6	131.44	94.8
1938-39	81.81	107.2	13.85	101.7	95.66	106.4	18.65	102.3	4.95	102.2	23.60	102.3	24.90	116.5	3.79	87.4	28.69	111.6	125.36	108.2	22.59	99.1	147.95	106.7?
1939-40	88.28	115.7	11.77	85.5	100.05	111.3	18.95	104.0	3.14	64.8	22.09	95.7	20.01	93.6	2.63	60.6	22.64	88.0	127.24	109.8	17.54	76.9	144.78	104.4
1940-41	74.66	97.9	10.25	75.3	84.91	94.4	13.50	74.1	3.04	62.7	15.54	71.7	16.36	76.5	2.29	52.8	18.65	72.5	104.52	90.2	15.58	68.3?	120.10	86.6
1941-42	75.97	99.6	15.32	112.5	91.29	101.5	13.94	76.5	5.83	120.3?	19.77	85.7	17.84	83.5	4.77?	110.0	22.61	67.9	107.75	93.0	25.93?	113.7?	133.67	95.4?
1942-43	99.78	130.8	12.84	94.3	112.62	125.3?	19.98	109.6	3.65	116.6	25.63	111.1	23.81	111.4	5.02	115.7	22.83	112.1	143.57	123.9	23.51?	103.1?	167.05?	120.5
1943-44	83.62	109.6	11.74	86.2	95.36	106.1	19.62	107.6	3.64	75.1?	23.26?	100.8	24.15	113.0	4.23	97.5	28.35	110.4	127.39	109.9	19.61?	85.0	147.00	105.0?
1944-45	80.01	104.9	12.32	90.5	92.33	102.7	15.42	84.6	4.01	82.8	19.43	84.2	20.63	96.5	3.77	85.9	24.40	94.9	116.06	100.1?	20.10	85.2?	135.16?	98.2?
1945-46	92.34	121.0	12.77	93.8	105.11	116.9	17.52	96.1	3.15	65.0	20.67	89.6	21.76?	101.9	2.94	67.8	24.72	96.1	131.64	113.6?	18.85?	82.7?	150.50	108.5
1946-47	78.92	103.5	11.34	83.3	90.26	100.4	11.81	64.8?	3.54	73.1?	15.35	65.5	19.71	92.2	3.54	81.6?	23.25	90.4	110.44	95.3	18.42?	80.5?	128.85	92.9
1947-48	67.20	88.1	11.12	81.7?	78.32	87.1	12.33?	67.6?	5.49	113.3	17.82	77.2?	21.83	102.1	6.70	154.5	28.53	110.9	101.35	87.5	23.3?	103.2	124.67	89.9
1948-49	82.07	107.6	13.03	95.7	95.10	105.8?	22.58	123.9	5.22	107.7	27.80	120.5	27.50	128.6?	5.32	122.7	32.82	127.5?	132.15	114.0	23.57?	103.4	155.72	112.3.
1949-50	90.73	118.9	13.37	98.2	104.10	115.8	19.70	108.1	5.04	104.0	24.74	107.2	21.85	102.3	5.30	122.2	27.16	105.6	132.29	114.2	23.7?	104.0	156.00	112.5
1950-51	95.31	124.9	11.03	81.0	106.34	118.3	25.27	138.6	4.92	101.5	30.19	130.5	39.70?	143.6	4.43	102.1	35.13	136.5?	151.28	130.5	20.38?	89.4?	171.65?	1235.5

Appendix – I Continued

WESTERN RIVERS RIM-STATION INFLOWS

Years	RIM-STATION INFLOWS																							
	INDUS AT KALAGAGH						JHELUM AT MANGLA						CHENAB AT MARALA						TOTAL					
	KHARIF		RABI		ANNUAL		KHARIF		RABI		ANNUAL		KHARIF		RABI		ANNUAL		KHARIF		RABI		ANNUAL	
	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1951-52	59.57	78.5	12.06?	88.6	71.93	80.0	16.37	89.8?	4.20	86.7	20.57	89.2	17.36	81.3?	3.95	91.4?	21.31	82.9	93.65	80.8?	20.21?	86.7?	113.81?	82.1?
1952-53	74.86	98.1	11.59	85.1	86.45	96.2	16.31	89.5	3.25	67.3	19.57	84.8	21.16	99.0	3.12	71.9	24.28	94.4?	112.33	96.9	17.97?	76.8?	130.30?	94.0?
1953-54	79.51?	104.4	13.95	102.5	93.57	104.1?	15.29	83.9	7.39	152.5	22.68	98.3?	21.41?	100.2	5.42	125.0	26.83	104.3?	116.31	100.4?	26.77?	117.4	143.08?	103.2?
1954-55	78.79	103.3	12.02	88.3	90.81	101.0	19.28?	105.8	4.42	91.2	23.70	102.7?	21.91	102.5	3.83	85.3	25.74	100.4?	119.98?	103.5	26.27?	88.9?	140.25?	101.1?
1955-56	70.69	92.7	13.58	99.7	84.27	93.7	14.92	81.9	4.40	90.8	19.32	83.7	21.90	102.4?	7.04	162.3	28.94	112.5	107.51	92.8?	25.02?	109.5	132.53	95.6
1956-57	85.10	111.6	13.69	100.6	98.79	109.9	19.26	105.8	5.74	118.5	25.02	108.4?	27.54	128.8	6.03	139.0	33.57	130.5	131.92	113.8	25.45?	117.7	157.36?	113.5
1957-58	71.04	93.1	16.83?	108.9	85.87	95.5	25.07	137.5	7.67	158.3	32.74	141.9	26.89	125.8?	5.60	129.4?	32.49	125.5	123.00	106.4?	28.10?	123.3	151.10	108.9
1958-59	81.92	107.4	17.55	128.9	99.47	110.6	19.25	105.6	6.15	168.2	27.40?	118.5	23.30	109.0	8.39	193.4	31.69?	123.2	124.47?	107.4?	34.09?	149.5	155.65?	114.3
1959-60	99.84	130.9	20.25	148.7	120.09	133.6	25.60	140.4	6.05	124.9	31.65	137.2	29.30	137.4?	5.75	132.6	35.05	136.3	154.74	133.5	32.07?	140.6	186.79?	134.7
1960-61	90.99	119.3	13.52	99.3	104.51	116.2	13.00	71.3	3.26	67.3	15.26?	70.5	20.95	98.4?	3.95	91.3	24.94	97.0?	124.97	107.5	20.?	91.0	145.7?	105.4?
1961-62	80.79	105.9	13.08?	95.9	93.85	104.4?	14.24	78.1	3.55	73.3	17.79	77.4?	24.55	114.5?	4.32	99.5?	28.87	112.3	119.58?	103.2?	20.?	91.5	140.51?	101.3?
1962-63	60.23	79.0	11.10	81.5	71.33	79.3	11.91	65.3	4.26	87.9	16.17	70.4?	17.82	83.4	4.49	103.5	22.31	85.5?	89.96	77.6?	19.85?	87.1	109.81?	79.3?
1963-64	76.41	100.2	12.95	95.1	89.36	99.4	17.63	96.7	4.38	90.4	22.01	95.4?	19.35	90.6?	4.33	99.8	23.69	92.1	113.40	97.9	21.65	95.0	135.05	97.4?
1964-65	75.15	98.5	13.58	99.7	88.73	98.7	19.30	105.9	4.30	88.7	23.60	102.3	21.65?	101.3	4.44	102.4	26.10	101.5	116.11?	100.2	22.32	97.9	135.43	99.8?
1965-66	76.83	100.7	12.91	94.8	89.74	99.8?	22.37	122.7	4.23	67.3	26.60	115.3	15.69	87.4	3.95	91.4?	22.64	88.0	117.83	101.7	21.07?	92.5	135.95	100.2
1966-67	77.54	101.6	13.93	102.3	91.47	101.7	17.58	96.4	5.52	113.9	23.10	100.4?	21.52	100.7	4.38	101.0	25.90	100.7	116.64	100.6	23.83	104.5	140.47	101.3
1967-68	81.92	107.4	15.05?	110.6	95.95?	107.9	16.41	101.0	5.49	113.3	23.90	103.5?	20.10	94.0	5.21	120.4?	25.31	98.4?	120.43	103.9	25.76?	113.0	146.19	105.4?
1968-69	78.83	103.3	14.40	106.2	93.29	103.8	16.40	90.0	5.24	108.1?	21.64	93.8?	20.40	95.4?	3.51	80.9	23.91	93.0	115.63	99.8?	23.21	101.5	138.82?	100.1?
1969-70	74.47	97.6	13.03	95.7	87.50	97.3	20.11	110.3	4.10	84.6	24.21	104.9?	12.91?	93.1	2.64	60.9	22.55	67.7	114.49	98.8?	19.77?	56.7?	134.25?	95.8
1970-71	61.35	80.4	10.15	74.6	71.52	79.6	12.33	67.6?	3.02	62.3	15.35	65.5	18.56?	77.6?	2.72	62.7	19.30	75.1?	90.27	77.9	15.93?	69.7?	105.17?	76.?
1971-72	62.38?	91.5?	9.36?	68.8	71.74	79.8	10.19	55.9	3.36	69.3	13.55?	59.7?	15.83?	74.1?	3.02	69.6?	18.85	78.3?	85.40	70.?	15.?	69.0?	104.14?	75.?

WESTERN RIVERS RIM-STATION INFLOWS

Years	RIM-STATION INFLOWS																							
	INDUS AT KALAGAGH						JHELUM AT MANGLA						CHENAB AT MARALA						TOTAL					
	KHARIF		RABI		ANNUAL		KHARIF		RABI		ANNUAL		KHARIF		RABI		ANNUAL		KHARIF		RABI		ANNUAL	
	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG	MAF	% of AVG
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1972-73	67.00	67.6	12.58	92.4	79.58	88.5	17.81	97.7	7.15	147.6	24.96	108.2	16.81	78.6	4.72	108.8	21.53	83.7	101.62	87.7	24.45	107.3	126.07	90.9
1973-74	95.27	124.9	11.42	83.9	105.69	118.7	22.13	121.4	4.31	89.0	26.44	114.6	27.57	129.0	3.39	78.2	30.96	120.4	144.97	125.1	19.12	83.9	164.09	118.3
1974-75	52.32	68.6	10.87	79.8	63.19	70.3	12.75	70.0	3.57	73.7	16.32	70.7	14.40	67.4	3.83	88.3	18.23	70.9	79.47	68.6	18.27	80.1	97.74	70.5
1975-76	68.24	89.5	13.05	95.9	81.29	90.4	20.30	114.4	5.09	105.0	25.39	110.0	22.76	129.9	5.08	117.1	32.84	127.7	116.30	100.4	23.22	101.9	139.52	100.6
1976-77	70.79	92.8	10.66	78.3	81.45	90.6	20.62	113.1	4.03	83.2	24.65	105.8	25.44	119.0	3.74	86.2	29.18	113.5	116.85	100.8	18.43	80.8	135.28	97.5
1977-78	68.20	89.4	13.03	95.7	81.23	90.4	14.54	79.8	5.09	105.0	19.63	85.1	21.62	101.1	4.98	114.8	26.60	103.4	104.36	90.0	23.10	101.3	127.46	91.9
1978-79	90.81	119.0	15.77	115.8	106.58	118.6	19.73	108.2	4.89	100.9	24.62	106.7	26.91	125.9	5.37	123.8	32.26	125.5	137.45	118.6	26.03	114.2	163.48	117.9
1979-80	73.01	95.7	13.98	102.7	86.99	96.8	15.51	85.1	5.20	107.3	20.71	89.8	20.32	95.1	3.96	91.3	24.28	94.4	108.84	93.9	23.14	101.5	131.98	95.2
1980-81	71.60	93.9	15.16	111.4	86.76	96.5	17.73	97.3	5.71	117.8	23.44	101.6	20.48	95.8	5.71	131.7	26.19	101.8	109.81	94.8	26.58	116.6	136.39	98.3
1981-82	75.87	99.5	14.07	103.3	89.94	100.0	18.37	100.8	4.22	87.1	22.59	97.9	23.45	109.7	4.64	107.0	28.09	109.2	117.69	101.6	22.93	100.6	140.62	101.4
1982-83	58.57	76.8	14.67	107.6	73.24	81.5	15.65	85.9	5.68	117.2	21.33	92.4	22.88	107.0	4.92	113.4	27.80	108.1	97.10	83.8	25.27	110.8	122.37	88.2
1983-84	79.36	104.0	14.55	106.9	93.91	104.5	22.72	124.6	3.50	72.2	26.22	113.6	26.20	122.6	3.62	83.5	29.82	116.0	128.28	110.7	21.67	95.1	149.95	108.1
1984-85	79.05	103.6	13.12	96.4	92.17	102.5	15.66	85.9	3.01	62.1	18.67	80.9	21.28	99.5	2.80	64.6	24.08	93.6	115.99	100.1	18.93	83.0	134.92	97.3
1985-86	60.22	78.9	15.61	114.7	75.83	84.3	12.07	66.2	5.57	115.0	17.64	76.5	19.37	90.6	4.86	112.1	24.23	94.2	91.66	79.1	26.04	114.2	117.70	84.9
1986-87	73.57	96.4	17.54	128.8	91.11	101.3	20.62	113.1	7.22	149.0	27.84	120.7	22.19	103.8	5.51	127.0	27.70	107.7	116.36	100.4	30.27	132.8	146.65	105.7
1987-88	70.00	91.8	18.03	132.4	88.03	97.9	21.38	117.3	6.45	133.1	27.83	120.6	20.41	95.5	4.80	110.7	25.21	98.0	111.79	96.5	29.28	128.4	141.07	101.7
1988-89	89.36	117.1	15.37	112.9	104.73	116.5	19.74	108.3	4.24	87.5	23.98	103.9	27.46	128.5	5.23	120.6	32.69	127.1	136.56	117.8	24.84	109.0	161.40	116.4
1989-90	64.26	84.2	16.94	124.4	81.20	90.3	18.01	98.8	6.70	138.3	24.71	107.1	19.74	92.3	5.67	130.7	25.41	98.6	102.01	88.0	29.31	128.6	131.32	94.7
1990-91	87.85	115.2	20.89	153.4	108.74	121.0	19.71	108.1	7.69	158.7	27.40	118.8	23.42	109.6	6.56	151.3	29.98	116.6	130.98	113.0	35.14?	154.1	166.12	119.8
1991-92	93.14	122.1	19.04	139.9	112.18	124.8	25.13	137.9	5.98	123.4	31.11	134.8	23.26	108.8	5.55	128.0	28.81	112.0	141.53	122.1	30.57	134.1	172.10	124.1
1992-93	90.84	119.1	19.06	140.0	109.90	122.2	25.18	138.1	6.82	140.8	32.00	138.7	22.60	105.7	5.18	119.4	27.78	108.0	138.62	119.6	31.06	136.2	169.68	122.3
1993-94	66.45	87.1	15.32	112.5	81.77	91.0	18.70	102.6	4.01	82.8	22.71	98.4	19.53	91.4	3.47	80.0	23.00	89.4	104.68	90.3	22.80?	100.0	127.48	91.9

Appendix – I Continued

	At Kalabagh MAF			At Mangla			At Marala			Total		
	Kharif	Rabi	Annual	Kharif	Rabi	Annual	Kharif	Rabi	Annual	Kharif	Rabi	Annual
	Period 72 years (1922-23 TO 1993-94)											
Average	76.29	13.61	89.90	18.23	4.85	23.07	21.38	4.34	25.71	115.83	22.80	138.69
Maximum	99.84	20.89	120.09	25.60	8.15	32.74	30.70	8.39	35.13	154.74	35.14	186.79
Minimum	52.84	9.36	63.19	10.19	3.01	13.55	14.40	2.29	18.23	79.47	15.58	97.74
	PRE MANGLA 45 YEARS (1922-23 TO 1966-67)											
Average	77.51	13.05	90.56	18.24	4.70	22.94	21.18	4.26	25.44?	116.93	22.01	138.95
Maximum	99.84	20.25	120.09	25.60	8.15	32.74	30.70	8.39	35.13	154.74	3.09?	186.79
Minimum	57.07	10.25	69.73	11.81	3.04	15.35	16.36	2.29	18.65	89.95	15.55	109.8?
	PRE TARBELA 54 YEARS (1922-23 TO 1975-76)											
Average	76.48	12.92	89.39	17.99	4.68	22.67	20.97	4.18	25.15	115.44	2.76?	137.21?
Maximum	99.84	20.25	120.09	25.60	8.15	32.74	30.70	8.39	35.13	154.74	34.09?	186.79
Minimum	52.32	9.36	63.19	10.19	3.02	13.55	14.40	2.29	18.23	79.47	15.55	97.74
	POST TARBELA 18 YEARS (1976-77 TO 1993-94)											
Average	75.72	15.71 (90-91)	91.43	18.95	5.33	24.26	22.59	4.81	27.40	117.25	26.85?	143.1?
Maximum	93.14 (1991)	20.89 (76-77)	112.18 (91-92)	25.18 (1992)	7.69 (90-91)	32.00 (92-93)	27.46 (1988)	6.56 (90-91)	32.69 (88-89)	141.53 (1991)	35.14? (90-91)	172.10 (91-92)
Minimum	58.57 (1982)	10.66	73.24 (82-83)	12.07 (1985)	3.01 (84-85)	17.64 (85-86)	19.37 (1985)	2.80 (84-85)	23.00 (93-94)	91.65 (1985)	18.43 (84-85)	117.70 (85-86)
	POST TARBELA NO OF DRY YEARS											
	11	3	9	7	6	7	7	5	6	5	3	9
	POST TARBELA NO OF WET YEARS											
	7	15	9	11	12	11	11	13	12	10	15	9

Additional Western River Inflow Data for the Years 1994-2003

Year	Indus at Kalabagh	Jhelum at Mangla	Chenab at Marala	Western River Flowing Total (MAF)
94-95	109.120	26.491	30.200	165.811
95-96	98.819	28.074	31.875	158.768
96-97	100.316	29.043	31.888	161.247
97-98	89.932	24.024	28.294	142.249
98-99	99.890	21.722	27.942	149.553
99-2000	92.089	14.430	23.052	129.571
2000-01	70.408	12.550	19.930	102.887
2001-02	66.378	11.889	18.895	97.163
2002-03	77.129	17.403	23.491	118.022

Appendix – II

INDUS RIVER SYSTEM
Losses (-) and gains (+)

Year	TOTAL SYSTEM (MAF)			SUKKUR KOTRI REACH			
	Kharif	Rabi	Annual	Kharif	Rabi	Annual	
1985-86	-14.83	-1.66	-16.49	-8.66	-0.74	-9.40	
1986-87	-19.69	-2.66	-22.35	-29.38	-1.34	-30.72	
1987-88	-17.42	-3.15	-20.57	-8.18	-1.62	-9.80	
1988-89	-26.51	3.30	-23.21	-26.86	-2.18	-29.05	
1989-90	-13.83	-2.31	-16.41	-12.87	+0.56	-12.31	
1990-91	-23.27	-1.24	-24.51	-14.12	-11.73	-12.39	
1991-92	-17.39	-0.81	18.20	-17.04	+3.21	-13.63	
1992-93	-8.82	9.75	0.93	-18.59	+10.32	-8.27	
Pre-Mangla Average (1940-41 to 1996-67)	-20.23	5.71	-14.52	-5.44	0.62	-4.82	(33%)
Post-Mangla & Pre-Tarbela Average (1967-68 to 1976-77)	-16.04	0.79	-15.25	-14.35	0.44	-13.91	(91%)
Post-Mangla & Post-Tarbela Average (1967-68 to 1992-93)	-13.85	2.08	-11.77	-12.73	0.62	-12.11	(103%)
Long Term Average (1940 to 1992-93)	-16.98	3.93	-13.05	-9.01	0.62	-8.39	(64%)

Figures in brackets indicate annual Sukkur-Kotri reach loss as percentage of the total system

Reference: WAPDA 1994. Indus River and Canal System Water Related Data. Accord Documents and Studies. Technical Committee on Integrated Water Resources Development Programme 1(3)a sheet 2 of 2

Appendix – III

BALANCE RIVER SUPPLIES FOR FURTHER DEVELOPMENTS BASED ON POST-TARBELA (1977-94) ANNUAL ESCAPAGES BELOW KOTRI

BALANCE RIVER SUPPLIES (MAF)	AVAILABILITY	
	Years	Percent
0	2/18	11
6	13/18	72
8	12/18	67
11	9/18	50
14 And Above	7/18	39

Reference: WAPDA 1994. Indus River and Canal System Water Related Data. Accord Documents and Studies. Technical Committee on Integrated Water Resources Development Programme. Table III(5)-a

Appendix – IV

Long-Term Average Flows Downstream Kotri Barrage (MAF)

Period	Pre-Kotri 1937 to 1954	Post-Kotri 1955 to 1975	Post-Tarbela 1976 to 2004
April	2.594	1.397	0.805
May	6.010	2.680	1.328
June	9.719	5.281	1.639
July	16.430	13.181	6.222
August	24.131	21.326	14.345
September	12.773	12.589	7.044
October	3.749	3.139	0.996
November	1.306	0.721	0.194
December	0.938	0.529	0.137
January	1.243	0.867	0.316
February	0.521	0.330	0.169
March	1.105	0.277	0.247
Kharif	71.656	56.455	31.383
Rabi	8.862	5.862	2.058
Annual	80.52	62.32	33.44

Reference: Water escapages below Kotri Study I, Col. I Main Report Government of Pakistan October 2005, Ministry of Water and Power and Federal Flood Commission.