

Kalabagh Dam: Look Before Your Leap

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The Kalabagh dam project has been lingering on for over two decades. In the last few months it has again gained momentum and many articles and statements have been published in the press both for and against the project. At this juncture it is very necessary to recapitulate its important aspects and study the latest position, so that the facts may be evaluated with cool mind before taking any decision. The purpose of this article is to attempt to review the various aspects of this project with reference to the studies made in the recent past and analyze the data and information available from WAPDA's records and publications, and other authentic sources, to bring out a clear picture to help the discerning reader to get a proper perspective of the project.

1 Water Availability

While considering the proposal for constructing a high storage dam like Kalabagh Dam, the first thing to do is to ascertain reliable availability of water for storage after accounting for all existing uses and commitments. In this context it is necessary to know the sources of water availability, the quantity of water available, the requirements of existing projects and the commitments already made. It is also important to have a clear picture about the reliability of the available surplus water.

1.1 Sources Of Surface Water Availability

Pakistan depends almost entirely on the flows of Indus System for surface water supplies for its requirements of irrigated agriculture. The Indus System consists of the main Indus and its eastern tributaries Jehlum, Chenab, Ravi, Beas and Sutlaj and north western tributaries, Kabul, Swat, Haro and Soan. Of these, the three eastern rivers, namely Ravi, Beas and Sutlaj have been exclusively assigned to India under the provisions of the Indus water Treaty, 1960. Also, under the Treaty, India has been allowed to develop 1,343,477 acres of irrigated cropped area on the western rivers, without any restriction on the quantum of water to be utilized.

1.2 Water Availability In Indus System

There is no way of knowing how much water will be available in the rivers in the future. All we can do is study the past trend of river flows from available records and assume that more or less similar

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pattern will manifest in the future. Fortunately we have historic records of river flows available since the year 1922-23. A study of these records shows that flow pattern of our rivers has been highly erratic. This is evident from the fact that the highest annual flow in the recorded history of 72 years (1922-1994) was 186.79 MAF in the year 1959-60 as against the minimum of 97.74 MAF in the year 1974-75, with an annual average of 138.69 MAF, of which 83.6% is in Kharif and 16.4% in Rabi. There has been a drought cycle of nine continuous years from 1924-25 to 1932-33, when the river flows were below the average. Under these circumstances it is very necessary to have a cautious approach in undertaking any scheme for construction of a high dam in consideration of the vagaries of the river water availability.

1.3 Development Of Water Uses

At the time of independence¹ about 64 MAF of water was being utilized annually in the irrigation canals in the country. With the construction of more barrages, link canals, and storage dams, water uses have increased to an average of 106 MAF. Under the Indus Water Accord, 117.35 MAF have been allocated to the provinces which will be utilized after some on-going schemes are completed, and the area in the command of recently completed schemes is fully developed. It must be noted that with the continuous increase in water use development, the reliability of balance water has been progressively on the decrease, and at present surplus water is available only in high flow years.

1.4 Net Water Availability Computations And Criteria

With the continuous increase in water use/ commitments since independence, particularly after signing of Indus Water Treaty, 1960, and construction of dams, barrages and link canals, one would have expected that the net water availability scenario would have been continuously assessed and updated. The criteria for water availability computation should also have been clearly spelled out right from the start. However, no such exercise was carried out till 1987, when for the first time, water availability computations were made by WAPDA² for the Committee on Water Resources and Management of the National Commission on Agriculture. This exercise depicted two scenarios, one based on average water availability for a period of 64 years (1922-1986) on pre Water Accord conditions and the other based on 4 out of 5 years flows i.e. 80% probability. The criteria of water availability indicated by WAPDA in their report for the Committee were as under:

“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 average 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 the flows but also to the creation of additional surface storages.”

The same criterion of 4 out of 5 years water availability was re-confirmed in the document “Integrated Valley Development Programme” prepared by President of Pakistan, Farooq Ahmed Khan Leghari, when he was Minister for Water and Power in the year 1990.

After signing of the Water Accord, WAPDA calculated post Water Accord availability in the year 1992. Subsequently, in December, 1994, WAPDA carried out another exercise for water availability

¹Pakistan got independence in 1947

²WAPDA is the Water and Power Development Authority of Pakistan

S. No.	Description	Pre Accord (1987)		Post Accord (1994)	
		Mean Year	4 Out of 5 years (80% Probability)	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

Table 1: WAPDA's Calculations Of Water Availability From Western Rivers On Pre-Accord And Post-Accord Conditions (figures in MAF)

on the post Accord conditions. However both these post Accord computations were made only for mean year basis and no exercise was made for 4 out of 5 year basis.

The computations made by WAPDA for water availability in 1987 (Pre Accord) and in 1992 and 1994 (Post Accord) are reproduced in Table 1.

1.5 Inaccuracies, Inconsistencies And Shifting Positions In WAPDA's Computations

In the above computations WAPDA has not only made some incorrect assumptions, but also deviated from their own stance from time to time.

The inconsistencies and inaccuracies in WAPDA's computations are discussed below:

1. Criterion for Water Availability

The criterion of water availability (4 out of 5 years), clearly laid down by WAPDA themselves in 1987 and re-confirmed by President Farooq Ahmed Khan Leghari when he was Minister for Water and Power in 1990, has been arbitrarily ignored. The post Water Accord availability has been worked out by WAPDA only on mean year basis.

2. Western River Rim Station Inflows

As stated above, there is no way of knowing how much water will be available in the rivers in future except by studying the past trends from the available data. The basic record for the

river flows is available from the year 1922-23 to date. In their computations of 1987 and 1992, WAPDA used the figures for the period from 1922 onwards for their computation. However, in the computations of 1994, WAPDA has arbitrarily used the figures only for post Tarbella period (1977-1994) which pertains to comparatively wet cycle. Thus the figure of mean year availability has been increased from 138.7 MAF (1922-1994) to 143.1 MAF(1977-1994). This arbitrary shift in WAPDA's own method of computations is neither understandable nor justifiable, particularly because the flow pattern of the rivers is highly erratic. The established practice of using the available data for the entire period must therefore be adopted, so that the trend of the river flow including both wet and dry periods may be properly reflected and analyzed.

3. Eastern River Contributions

Under the Indus Water Treaty, 1960, the flows of three eastern rivers have been allocated to India for their exclusive use. In the computations of water availability of 1987, WAPDA recognized this position and conceded that after completion of the storage reservoir on Ravi (Thein) in 1989, there will be no significant flow from eastern rivers in Pakistan except for occasional flood flows towards the end of monsoon season. In spite of this clearly stated position, WAPDA adopted figures of 2 MAF and 1.5 MAF respectively as eastern river contributions for mean year and 4 out of 5 years in their computations of 1987.

In 1992 post Accord computation, WAPDA accepted the position that the eastern rivers having been allocated to India, no contributions from these rivers can be expected. However, for the first time they come up with a fantastic idea that some flow is generated from eastern rivers from the catchment above rim stations within Pakistan territory. It is not understandable how this discovery has been made by WAPDA thirty-two years after signing of the Indus Water Treaty, 1960. The figure incorporated in the 1992 computations on account of flow generated in Pakistan is 1.3 MAF, whereas in 1994, this figure has been increased to 4 MAF which is double of WAPDA's own figure of 1987, when they assumed (though wrongly) that some flow will be coming from India with no generation within Pakistan. In support of this contention, WAPDA has taken the figures of the flows reaching the upstream of the rim station barrages in Pakistan on Ravi and Sutlaj rivers (Baloki and Sulemanki), and the flows down stream of the last barrages on those rivers in India (Madho pur and Ferozpur), and assumed that the difference in the two figures represents the flow generated within Pakistan. This is absolutely incorrect, because there are a number of link canals which join Ravi and Sutlaj rivers upstream of rim station barrages and transfer water to these barrages from the western rivers. The additional flow reaching the rim stations of the eastern rivers is therefore not the flow generated in Pakistan, but the water transferred to eastern rivers from western rivers through link canals. It may also be stated that the rim stations of eastern rivers in Pakistan are located very close to the Indian border and the extent of catchment area within Pakistan above the rim stations is very small. As such, the generation of a huge flow of 4 MAF within Pakistan is out of question. WAPDA should have supported their contention by indicating the total catchment area of each of the eastern rivers above the rim stations and the flow generated therefrom, and compared it with the catchment area above the rim stations inside Pakistan and the flow generated according to WAPDA's computations, so that the two figures could be co-related for their authenticity.

Under the circumstances it is unrealistic to assume that there will be any flow generating in the eastern rivers within Pakistan. The eastern river contribution must therefore be taken to

be zero.

4. Uses Above Rim Stations

The figure of NWFP's uses above rim stations have been taken to be 5.5 MAF in the 1987 WAPDA computations, whereas in the 1992 and 1994 computations the figure has been taken to be 5.7 and 5.3 MAF respectively. It may be stated that in the Water Accord, 1991, a quantity of 3 MAF has been provided for un-gauged civil canals of NWFP above rim stations. This figure of Water Accord must be shown in the computations. It may be stated that whatever may be the quantity of water used by NWFP above rim station, it should not and cannot affect the figure of water availability at the rim stations. It is incorrect to add 5.5 MAF to the availability and then reduce it by only 3 MAF thus showing a surplus of 2.5 MAF as notional increase in the availability at rim stations, which is simply not there because what ever water is allocated and used by the NWFP above rim stations, it stands utilized and no portions of it will become available at the rim stations downstream.

Under the circumstances, the figure of 3 MAF as per Water Accord must be taken into account in the computations, and no additional water can be available on this account at rim stations.

5. Losses And Gains Below Rim Stations

In 1987 computations, WAPDA has taken the figure of 10 MAF as system losses on the basis of an average figure for post Mangla period. However, this was not the correct approach, because the river regime conditions have further changed after construction of Tarbella Dam in 1977. It may be stated that construction of any high dam disturbs the regime, and historical pattern of losses in the down stream reaches undergoes radical changes resulting in losses much higher than pre-dam construction period. In similar circumstances in USA on the Colorado River below Hoover Dam, river losses increased beyond what they were prior to the construction of the dam. The experience in Pakistan is also similar because the average annual system losses in post Tarbella period (1976-94) increased to 14.7 MAF as against 6.2 MAF in the post Mangla pre Tarbella period (1967-76), showing an increase of 8.5 MAF.

It is highly appreciated that WAPDA, having realized this position, have taken the figure of Post-Tarbella losses in their computation of system losses in 1992 and 1994 (Post Accord) computations. However, having worked out the correct figure of losses as per actual record, they have again come up with a ridiculous idea that after construction of Kalabagh Dam, substantial quantity of system losses will be salvaged due to lower discharges flowing in to the river. The figures of salvage of system losses indicated in 1992 computations is 7.0 MAF, whereas in those of 1994 it is 4.2 MAF. It is mind boggling to assume that a storage of 6 MAF will result in salvage of system losses by 7 MAF, thus making 1 MAF additional water available in the system even after construction of Kalabagh Dam. If such a magic formula is really available with WAPDA, we can construct any number of dams without caring for water availability.

The experience in USA as well as Pakistan clearly reveals that with the construction of a high dam, system losses will increase. In case of Kalabagh Dam, the additional losses should be assumed to be at least 4MAF instead of visualizing any salvage of losses.

6. Out Flow to Sea

In the pre Water Accord computations (1987), WAPDA has indicated a figure of 5 MAF for mean year and 3 MAF for 4 out of 5 years towards out flow to sea. Under the provisions of Water Accord, 1991, a quantity of 10 MAF has been provisionally earmarked for out flow to sea. WAPDA has rightly indicated this figure of 10MAF, in 1992 computations. However, in the 1994 computations, WAPDA has arbitrarily reduced this figure to 5.8 MAF. This aspect will be discussed more comprehensively in the succeeding paragraphs, but for the purpose of computations, the Water Accord figure of 10MAF as already indicated in 1992 exercise by WAPDA must be adhered to.

7. Canal Withdrawals and Accord Allocations

In the pre Accord (1987) computations WAPDA has shown a figure of 106.79 MAF in mean year and 103.44 MAF in 4 out of 5 years. In the post Accord computations of 1992 and 1994, WAPDA has correctly taken the figure of 117.4 MAF as per Water Accord. This figure includes 3 MAF for NWFP's civil canals above rim stations. However, if this figure of 117.4 MAF is to be retained then the figure of uses above rim stations should be corrected to 3 MAF as per Water Accord provisions instead of 5.3 MAF as indicated by WAPDA, because whatever water is used by NWFP above rim station (whether it is 3.0MAF or 5.3 MAF), it will not add to the availability at the rim stations. Alternatively the figure of uses above rim stations may be deleted from the table, and the figure 114.4 MAF being the Water Accord allocations below rim stations should be adopted.

8. Authorized Uses By India Out of Western Rivers

The figure of 2 MAF for authorized uses by India on western rivers has been taken by WAPDA in all three computations of 1987, 1992 and 1997. In this connection it may be stated that according to the provisions of Indus Water Treaty, 1960, India is entitled to develop a total of 1,343,477 acres of cropped area on the western rivers. There is no restriction whatsoever on the quantity of water which they can utilize or the time period in which the area is to be developed. Out of the above area India has already developed 785,799 acres and utilized 6.75 MAF. Thus for the development of remaining area of 557,678 acres, India will require 4.79 MAF more on pro-rata basis, though they can use more water if they like as there is no such restriction on them under the Treaty. WAPDA's figure of 2 MAF is based on the cropping pattern and water allowance of Chashma Right Bank Canal, with only 60% Kharif Cropping intensity. We can not impose the conditions of Chashma Right Bank Canal on India, and it is not possible to deviate from express conditions of International Agreement. As such the figure of 4.79 MAF, for development of remaining area based on existing pattern of water use by India must be adopted.

From the above discussion, it is abundantly clear that WAPDA has attempted to inflate the figures of water availability and reduce the figures of system losses, outflow to sea and India's authorized uses on western rivers, with the purpose to some how arrive at a high figure of net water availability. This is inconsistent with established engineering practice where safe, realistic and conservative figures are to be adopted in the computations for design of such major projects. Moreover, WAPDA has also changed their own criteria and the method of computations, each time just to project a rosy picture of water availability. The inconsistencies are apparent when we take a look at WAPDA's own figures for mean net water availability, which has been shown in the first post Accord computations of 1992 as 5.56 MAF, and later inflated to 17.2 MAF in the 1994 computations by further manipulations.

S. No.	Description	WAPDA's Computations	Realistic Projections from WAPDA's Published Data		Mean Year Difference
		Mean Year	Mean Year	4 out of 5 (80% Prob.)	
1	Western Rivers rim Station in flows.	143.1 (1976-94)	138.7 (1922-94)	125.3 (1922-94)	4.4
2	Eastern River Contribution	4.0	Nil	Nil	4.0
3	Uses above rim station	5.3	3.0	3.0	2.3
4	Loss and Gains inclusive of in flows below rim station (Post Tarbella 1977-1994)	10.0	14.7	11.8	4.7
5	Out flow to sea	5.8	10.0	10.0	4.2
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	2.8
Net Availability		+17.2	-5.2	-15.3	22.4

Table 2: Comparison Of Actual Post Water Accord Availability With WAPDA's Computations of 1994 (Figures in MAF)

Table 2 compares the water availability worked out by WAPDA in 1994 (latest) with the realistic figures computed from WAPDA's own basic data from published records.

The figures in this table show that according to realistic computations, the net water availability on mean year basis is minus 5.2 MAF, as against 17.2 MAF computed by WAPDA by manipulation of the figures by a huge 22.4 MAF. The net deficit on 4 out of 5 years computations, which is WAPDA's own prescribed criterion laid down in 1987, duly endorsed by the President Farooq Ahmed Khan Leghari in his capacity as Minister for Water and Power in 1990, comes to minus 15.3 MAF. Thus there is a substantial short fall in water availability even for present commitments, leave aside the construction of Kalabagh Dam.

1.5.1 Implications Of The Assumption: Mean Year Vs. 4 Out Of 5 Years

With the shifting positions of WAPDA in respect of criterion for water availability from 4 out of 5 years (80% probability) to average year (50% probability), it is necessary to understand precisely the concept and the implication of these criteria. It may be stated that the storage dams already

constructed in Pakistan and the proposed Kalabagh Dam are designed to store water from the flow available during a particular year after meeting the current requirements and the balance water of high floods is spilled over in to the sea. This water which escapes to sea is not available for use in subsequent years, in the absence of a carry over dam which can store the surplus flow of high flood years for subsequent use. Under the circumstances it must be clearly understood that if the criterion of mean year availability is adopted, water available will be less than this figure for 50% of the time. Is it practicable to conceive a huge project of storage dam with over Rs. 250 billion³ investment, knowing that water may not be available for storage for 50% of the time? How can such a project be feasible and economically viable?

1.6 Other Important Aspects Of Water Availability

It is felt that the computations of water availability on mean year and 4 out of 5 year basis are not sufficient to give a clear picture for proper assessment of the situation. It is therefore necessary to examine and analyze other important aspects of water availability.

1. Water Availability On Year to Year Basis

Since the flow of the rivers in Pakistan is highly erratic, it is also necessary to examine the water availability position on an year to year basis, to see for how many years water is available to meet the existing requirements/ commitments.

The existing requirements/ commitments as as under:

	MAF
a. Water Accord Allocation (excluding civil canals of NWFP) (Below Rim Stations)	114.4
b. System Losses (annual)(Post Tarbella WAPDA figures 1977- 1994)	14.7
c. India's authorized uses on western rivers	4.8
d. Out flow to sea (Water Accord figure)	10.0
Total	143.9

The above quantity has been available for 25 out of 72 years during the recorded history from 1922-1994. The availability percentage is 35.

2. Kharif Water Availability

It is also important to analyze the availability of water during Kharif season, because floods occur in this season and surplus water can become available for storage. The Kharif commitments (Post Water Accord) are as under:

³equal to \$ 6.25 billion at Rs. 40 per dollar

	MAF
a. Water Accord Kharif Allocations	77.3
b. Outflow to Sea	10.0
c. System Loses (WAPDA figures)	15.5
d. Authorized uses of India on western rivers (75% of annual 4.8 MAF)	3.6
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Total without storages	106.4
e. Requirement of existing storages	15.0
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Total with existing storages	121.4
f. Requirement of Kalabagh Dam(6.1 storage + 4.0 additional losses)	10.1
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Total Requirement including Kalabagh Dam	131.5

The quantity of 106.4 MAF without storages is available for 53 out of 73 years i.e. 74% of the time. The quantity of 121.4 MAF (Kharif requirements with present storages) is available for 24 out of 72 years (1922-94) i.e. only 33% of the time. Thus enough water is not available for even filling the existing dams. If the requirements of Kalabagh Dam are also included, the required quantity of 131.5 MAF is available for just 12 years out of 72 years i.e. only 16% of the time. This position clearly indicates that any future storage can be possible only in the shape of a carry over dam, when the surplus flows of very high flood years can be stored for use in subsequent years. It may also be stated that the water can be stored only when it is available in excess of Kharif demand, because the purpose of the storage is to impound surplus water without affecting the requirement of Kharif crop.

3. Kharif Availability on Mean and 4 Out of 5 Years Basis (80% Probability)

According to WAPDA's published figures, Kharif availability on mean year basis during the 72 years period (1922-94) was 115.9 MAF, and on 4 out of 5 year basis it was 101.8 MAF. This shows that on average year basis, there is enough water for meeting existing demand/commitments of 106.4 MAF without storages. However, there is a shortfall of 5.5 MAF in the requirement of 121.4 MAF for filling existing storages. This deficit goes up to 15.6 MAF if requirements of Kalabagh Dam are included. On 4 out of 5 year basis, the water is not sufficient even for existing commitments excluding dams and there is no water whatsoever available even for filling the existing dams.

2 Out Flow To Sea: Environmental Effects

A lot of publicity is being made that a huge quantity of about 36MAF is flowing to the sea on the average which should be utilized by building new storages like Kalabagh Dam. In this context it may be stated that the water presently going in to the sea also includes, un-utilized part of existing allocations/ commitments under the Water Accord (12 MAF), flow from eastern rivers allocated to India for its exclusive use (8.7 MAF) and un-utilized portion of India's entitlement on western river (4.8 MAF). Besides 10 MAF have been provisionally earmarked in the Water Accord, 1991, for out flow to sea. After accounting for these commitments, there is no surplus water for construction of Kalabagh Dam.

The quantity of out flow to sea has been progressively reducing, particularly after the construction of more barrages, dams and link canals after the signing of Indus Water Treaty, 1960. The actual out flow to sea at the time of independence was about 80 MAF, which has now reduced to 36 MAF. The duration of the flow has also reduced to less than 2 months and that also only in

high flood years. Even this quantity is dwindling further as the un-utilized allocations of water are being harnessed.

Under the provisions of the Water Accord, 1991 a quantity of 10MAF has been provisionally earmarked for outflow to sea pending further studies to be undertaken to establish the needs of minimum escapages down stream Kotri. Unfortunately the study has not been initiated even after 7 years of signing the Water Accord due to frivolous objections raised on the terms of study. However, the IUCN, an international organization based in Pakistan has worked out the annual requirements for out flow to sea for environmental sustenance to be 27 MAF. This corresponds to 0.3 million cusecs discharge flowing for a period of 45 days. Let aside the requirement of 27 MAF indicated by IUCN, the quantity of even 10MAF provisionally allocated under the Water Accord is available only for 24 out of 72 years as calculated under the title 'Kharif availability'. It is therefore abundantly clear that the required quantity of water for the sustenance of the environment cannot become available under the present circumstances when water is already committed for existing uses and storages. It is not possible that this position can be improved by denying the allocations/ commitments of present operational projects or by leaving the existing storages unfilled. However, it is important that at least further deterioration in the ecological conditions must be prevented. The best that can be done to save the environment from complete devastation is to plan future projects so that the minimum required discharge of 300,000 cusecs is available for outflow to sea at least for as much time as it is available, after meeting the current Kharif demand. This figure of 0.3 million cusecs is also supported in the WAPDA's exercise of 1992. The balance flood water over and above this requirement could be impounded in future storages, which can only be possible in the form of carry over dams.

Colossal damage has already been caused to the environment in lower regions, as under:-

1. Progressive reduction in the volume of silt from 200 million tons/ year in 1947 to 36 million tons per year in 1991. This has resulted in the erosion and degradation of the Delta and consequent sea water intrusion besides the harmful effects on fisheries, specially shrimp and mangrove forests due to loss of nutrients.
2. The mangrove forest area has reduced from 263,000 hectares in 1977 to 158,500 hectares in 1990 showing reduction of 38%. Even this remaining area is being progressively degraded.
3. The famous Palla fish has become nearly extinct. The annual production has reduced from 5000 tons in 1951 to just 500 tons, besides marked reduction in its size. The rare species of fresh water Dolphin are also facing similar threat.
4. 600,000 acres of riverian forests and 550,000 acres of sailaba areas of Sindh have been very seriously affected and they are in the danger of complete elimination.

Pakistan is signatory of Rio Declaration signed by the Prime Minister Mian Muhammad Nawaz Sharif. The Principle No. 4 of this declaration proclaims that "In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it." We should therefore, do all that is possible to abide by this commitment in letter and spirit.

3 Justification For Kalabagh Dam To Overcome Effect Of Silting Of Existing Reservoirs And To Utilize Water Accord Allocations

In their latest exercise of 1994, WAPDA has tried to justify the construction of Kalabagh Dam by projecting that there will be loss of capacity in existing reservoirs by 2.91 MAF upto the year 2000, and that 3.6 MAF storage is required for assuring the water availability to provinces under the Water Accord, 1991. In other words, Kalabagh Dam will be a replacement dam requiring no additional water. In this context it may be pointed out that the Kalabagh dam project was conceived in the year 1975 and the revised documents was prepared in the year 1984, much before the Water Accord was signed in the year 1991. The design of Kalabagh Dam is therefore not based on the concept of the dam being a replacement dam. Surely the reservoir operation criteria and the economics of the dam will change drastically if it is to be considered entirely as a replacement dam.

As regards the contention of WAPDA that 3.6 MAF of water of Kalabagh Dam would be utilized for ensuring water availability to the provinces under the Water Accord, it may be stated that specific allocations have already been made to provinces under para 2 of the Accord. It is inconceivable that the Accord allocations for present projects can be made dependent on a controversial Kalabagh Dam expected to be constructed in future. It may also be pertinent to point out that this point to link the Water Accord allocations with future storages was raised by a province in the meeting of Council of Common Interests held on 16th September, 1991, but it was not accepted. It may further be stated that Water Accord allocations have been made knowing fully well that the allocated water would not be available all the time and this position has been taken care of in para 14(b) of Water Accord, which specially deals with the shortages and surpluses of water availability and it lays down that these are to be shared by the provinces on an all- Pakistan basis.

The linking of water allocations with future storage will create more complications. Under para 4 of Water Accord the surplus water from the future storages has to be shared in the ratio 37:37:12:14 for Punjab, Sindh, Balochistan and NWFP respectively, whereas if Kalabagh Dam is treated entirely as a replacement dam, as now suggested by WAPDA, the distribution of stored water would probably be in the same ratio as per allocations of existing projects under para 2 of the Accord. This will be a great loss to the smaller provinces, as the water allocations under para 2 of the Water Accord for the existing projects are in the ratio of 48.9:42.6:3.3:5.2 for Punjab, Sindh, Balochistan, and NWFP respectively. This will be a clear violation of specific provisions of the Water Accord.

Now let us examine the aspect of silting of reservoirs brought up by WAPDA as a justification for Kalabagh Dam. In this context, instead of raising this issue simply to justify Kalabagh Dam, WAPDA should have projected the complete picture as to what was the expected rate of siltation of each reservoir according to the original project feasibility report and what was the estimated life of each reservoir. Also what were the measures envisaged and being taken to reduce the incidence of siltation and their efficacy. Further it should also have been mentioned what remedial measures were envisaged for offsetting the effect of siltation and with what results.

As far as the life of the reservoirs is concerned, it was envisaged to be 55 and 75 years for Tarbella and Mangla respectively in the original projects, which has been revised to 125 and 225

years respectively due to lower rate of siltation than estimated. The rate of siltation will be further reduced as WAPDA has already initiated a large scale water shed management programme in the catchment areas of the reservoirs, though they have not published the results achieved. Moreover, by proper sluicing operations, the silt deposits of Tarbella dam can be flushed out as recommended by Chinese experts. WAPDA had made a study of siltation of reservoirs in 1988, in which, extent of siltation of the reservoirs was indicated to be 1.23 MAF and the annual rate of siltation of live storage was indicated to be 0.081 MAF for all three reservoirs. WAPDA has updated these studies in 1992-93 and some how or other tried to show higher rate of siltation, though it should have reduced consequent upon water shed management and silt exclusion operations. Adopting WAPDA's figure of 0.081 MAF of siltation per year, further loss of capacity will be only about 1 MAF more in the next 12-13 years from 1988 upto the year 2000.

There is an inbuilt provision in the design of Mangla dam for raising its height to increase its capacity to offset the effect of silting. In fact even in its present shape Mangla can store an additional 2 to 3 MAF of water, without any additional capital investment. The reasons put forward by WAPDA for not raising Mangla are that there is no enough water in Jehlum river and that the raising will be economical only after Mangla dam has silted by 50%. These reasons of WAPDA are flabbergasting. The water level in Mangla is being proposed to be raised to counter the effect of silting and not for storing additional water, so where is the question of availability of more water in Jehlum river for this purpose? WAPDA are proposing a costly Rs. 250 billion Kalabagh Dam to counter the effect of silting of Mangla reservoir, but refuse to raise the water level in existing Mangla dam till it has silted by 50%!

The above analysis shows that WAPDA has unnecessarily tried to link the issues of utilization of Water Accord allocation and silting of reservoirs with Kalabagh Dam.

4 Hydrel Power Generation

One of the justifications for the Kalabagh Dam project is its potential to produce 2400 MW of electric power. In this respect it is pertinent to note that almost all the hydel projects so far implemented, with total capacity of about 5000 MW, are high storage dams. In addition to these projects, 25 more hydel projects have been identified by WAPDA for future implementation, with a total potential of 23,500 MW. Out of these 22 projects with potential of about 15,000 MW are of run of the river type, requiring little or no storage. Recently one of these projects (Ghazi Barotha) has already been launched with the capacity of 1425 MW. It is therefore, necessary to implement similar promising run of the river non- controversial projects like Dasu, Bunji, Thakot etc. which have already been identified after feasibility studies carried out in early 80's through Montreal Engineering Company (MECO) under the sponsorship of Canadian International Development Agency (CIDA). Infact WAPDA had already prepared a PC-II proforma for updating the feasibility of these projects in 1991, which should have been approved and the studies completed by now. It may be stated that one of these run of river projects (Dasu) has power potential and hydrology quite comparable with Kalabagh Dam. It will also increase the life of Tarbella for another 20 years. Moreover, it has practically uniform flow during winter and interestingly it starts rising from February onwards. Projects like this should have been initiated long back instead of keeping them dormant for so many years just to give an impression that Kalabagh Dam is the only project ready for implementation.

One of the reasons being advanced by WAPDA for delaying the implementation of these run of the river projects is that they are costlier than the multipurpose projects of high storage dams. This excuse is hardly tenable because if a storage dam project is not feasible, you can not withhold all other hydel projects. Moreover these run of the river projects in any case are cheaper than thermal generation, and out of the identified hydel projects, the majority is that of non controversial run of the river projects. Also the run of the river projects have a distinct advantage over storage dams, because there is no restriction on the utilization of available water in these projects, whereas in the case of storage dams, the releases are dictated by demands of irrigation down stream.

Another reason for delaying the implementation of run of the river projects is that WAPDA has un-necessarily linked these projects with construction of future high dams so that the advantage of controlled regulation can be available. However, such an advantage can only be very marginal, and should not be made a reason for pushing back the promising run of the river hydel projects. To quote an example, it is claimed that after construction of Kalabagh Dam the generating capability of Tarbella will also improve by regulatory effect. However, in quantitative terms, the increase in generating capacity of Tarbella after Kalabagh Dam as worked out by WAPDA consultants is 336 GWH, as against its basic generation capacity of 1579 GWH, showing an increase of just 2.15%. Thus linkage of run of the river projects with future storage dams on this account is not at all justified. Under the circumstances, the work on two more run of the river projects, Dasu and Bunji must be started in the 9th five year plan period.

4.1 Other Alternatives To Hydel Power Generation

According to Geological Survey of Pakistan, huge reserves of about 22 billion tons of superior quality coal have been discovered in Desert of Tharparkar in Sindh, which can be harnessed for power generation. The gas exploration programme has also been intensified and there is considerable scope for use of natural gas for additional thermal generation.

5 Threat To Nowshera Town, Peshawar Valley And Geological Aspects

A lot of concern has been expressed about the harmful effect of Kalabagh Dam due to flooding of Nowshera town and rise of water table in Peshawar valley. It is feared that as a result of rise of water level due to ponding up at Kalabagh, the water level in Kabul river will rise due to back water effect, thus posing serious threat to the town of Nowshera and Peshawar valley. In this context it is pertinent to mention the Chinese experience of Sanmenxia reservoir constructed on the Yellow river in the year 1960. Due to acute sedimentation problem, this dam had to be redesigned and reconstructed within a short period of four years, because back water deposit extended up stream with remarkable rapidity endangering industrial and agriculture activities in the vicinity of the reservoir. The effect of sediment has extended for considerable distance upstream of the reservoir. The configuration of Kalabagh Dam is more or less similar to Sanmenxia dam and therefore we must take a lesson from the Chinese experience. Though it is not possible to forecast accurately the trend of siltation after construction of Kalabagh Dam, it is certain that a very high risk is involved which needs to be avoided. Moreover, geological experts have many reservations about the Kalabagh Dam site as it is located in an area with many geological faults, which may endanger

the safety of the dam. Besides, the reservoir area is in close proximity of Khewra and Kohat salt ranges which will pollute the water causing high salinity, thereby affecting its suitability for irrigation.

6 Conclusions

1. WAPDA has made desperate but vain attempts to prop up the falling edifice of Kalabagh. To this end, they have:-

- exaggerated the mean year water availability by a huge 22.4 MAF by making fantastic assumptions that:
 - (a) Storage of 6.1 MAF in Kalabagh Dam will salvage system losses by 7 MAF!
 - (b) 4 MAF of water will be generated in the catchment of eastern rivers in Pakistan above rim stations.
- Deviated from their own method of computations just to somehow increase the figure of water availability, knowing fully well that for design of large projects, it is always better to err on the safe side, and apply some factor of safety.
- Arbitrarily changed their own 1987 criterion of water availability of 4 out of 5 years to mean/average year, though the 1987 criterion was also endorsed by President Farooq Ahmed Khan Leghari when he was Minister for Water and Power in 1990.
- Tried to link the Kalabagh Dam with silting of present reservoirs. WAPDA do not want to increase the water level in Mangla dam, which can be done without any capital investment, but instead they want to construct Kalabagh Dam at the cost of Rs. 250 billion!
- Attempted to convey the impression that Kalabagh Dam is the only feasible project for storage and hydel power generation, and that it is ready for implementation. To make Kalabagh look indispensable, WAPDA has put the promising run of the river projects in cold storage and taken no serious steps to utilize huge coal reserves of Thar for power generation.

2. Water for storage is available only in very high flood years when it is in excess of Kharif needs and requirements of present storages. The WAPDA data shows that such high floods have occurred only in 12 out of 72 years. It is possible to store this water only by construction of carry over dam. Highest Kharif flows have occurred in 1959-60 (154.74 MAF) and in 1950-51 (151.28 MAF). In such years as much as 25 to 30 MAF is available which can not be stored in a dam like Kalabagh. Some preliminary investigations carried out earlier indicate the availability of a site for carry over dam at Skardu. Possibly Bhasha can also be re-designed as a carry over dam, though its capacity may not be as much as Skardu. The advantages of a carry over dam are:-

- (a) It will store every drop of surplus water available during very high flood years for use in subsequent years.
- (b) The water stored in a carry over dam can be released to supplement the requirements of the existing storages in the years of low flows.

- (c) It can counter the effect of silting of existing down stream storage and also check further silting of the reservoir thus increasing its life.
 - (d) It can be very effective for flood control, because it can impound all excess flood waters, whereas existing storages are not so effective for flood control because of their limited capacity and they are almost full when flood water comes.
3. There is serious deterioration in the ecological conditions in the deltaic region, due to a continuous increase in water use/ commitments. Statistics show that even the quantity of 10 MAF provisionally earmarked in the Water Accord of 1991 is not available for 48 out of 72 years. It is not possible to improve this situation by reducing the water allocations of existing projects or by leaving existing reservoirs unfilled. However, to prevent complete devastation, future carry over storages should be planned so that only the river flows in excess of present needs for existing projects and storages, and allowing 300,000 cusecs for out flow to sea whenever available, will be impounded.
 4. The proposed Kalabagh Dam poses great risk to the fertile Peshawar valley and Nowshera town. The quality of impounded water will also be polluted by salinity due to proximity of Khewra and Kohat salt formations.
 5. The alternatives to Kalabagh Dam are:
 - (a) a carry over dam for storage of every drop of surplus water in high flood years.
 - (b) raising water level in Mangla Dam to offset the effect of silting.
 - (c) launching of run of the river hydel projects like Dasu and Bunji etc.
 - (d) use of Thar coal for generation. The Minister of Water and Power has said that he will announce Power Policy in the month of July, 1997. It is suggested that run of the river hydel projects and coal based power generation should be hall marks of this policy.
 6. It is clearly established that the Kalabagh Dam project does not satisfy even the basic conditions of viability. If the dam is constructed inspite of this position, it will stand high and dry for most of the years as a monument of defective planning and wasteful expenditure. Under these circumstances, we urge upon the decision makers: "Look Before You Leap".