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DEVELOPMENT OF STORAGES FOR ADDRESSING THE EMERGING WATER SCARCITY IN PAKISTAN BRIDGING THE CRISIS OF CONFLICTING INTERESTS

BY
Asrarul Haq
Abdul Sattar Shakir
Bagh Ali Shahid

DEVELOPMENT OF STORAGES FOR ADDRESSING THE EMERGING WATER SCARCITY IN PAKISTAN: BRIDGING THE CRISIS OF CONFLICTING INTERESTS

Asrar-ul-Haq[1], A.S. Shakir[2] and B.A. Shahid[3]

ABSTRACT

The Paper describes the role of storages in water resources development in the context of the emerging global water scarcity. It highlights the looming water crisis in Pakistan and brings out the urgent need to implement the water resources development projects in order to optimally harness the available water potential to bridge the widening gap between the requirements and production of food-grains. The Paper also reviews the constraints in the way of implementation of proposed Kalabagh dam project in Pakistan. Kalabagh is one of the many potential dam sites on river Indus and its tributaries. It is however the only project that is ready for take-off, with detailed designs and tender documents having been finalized in 1988. The implementation of this project has however been delayed due to objections raised by the upper and lower riparians.

The world is reaching its capability to feed its population as we enter the 21st Century. In some parts of the world, the food production situation is already precarious. By the year 2050, almost as much as two-thirds of the population of the globe could be plagued by scarcity of water. While water scarcity is becoming increasingly severe, yet in many water-short regions large quantities of water annually flow out to sea unutilized. Because of the sporadic spatial and temporal distribution of precipitation, the only way water supply can be enhanced to match the increasing demand is through the storages. It has been estimated that water conservation and the enhanced productivity of water can meet about half of the projected 50% increase in water demand by 2025. Most of the rest will have to come from the new storage projects.

The Constraints in the implementation of Kalabagh project in Pakistan can broadly be categorized as technical and socio-political. While the technical issues / concerns raised by the upper and lower riparians have either been clarified or addressed by making appropriate adjustments in the design, the stalemate continues due to over-exploitation of the socio-political factors, which have created an environment of polarization and distrust. A framework for addressing the stalemate and bridging the crisis of conflicting interests has been presented. The Paper concludes that for sustainability of irrigated agriculture, urgent construction of a series of storages is essential and that Kalabagh is the only storage project ready for implementation. It identifies the need for evolving a mechanism to resolve the conflicts by initiating mutual consultations amongst the federating units and by closely associating the upper and lower riparians in the decision-making process.

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1 Director Floods, Irrigation & Power Department, Lahore.

2 Prof. & Head, Hydraulics and Irrigation Engineering, University of Engineering & Technology, Lahore.

3 Superintending Engineer, Bahawalpur Canal Circle, Bahawalpur.

INTRODUCTION

Agriculture is the backbone of Pakistan's economy and it accounts for 25% of GDP. Agriculture sector employs more than 50% of the labour force and provides 70% of country's export earnings (World Bank, 1994). In the arid to semi-arid climate of the country, irrigation water is an essential input for sustenance of agriculture. Pakistan's irrigation system is based on the run of the river supplies with limited storage facilities. River flows are highly seasonal and about 85% of annual flows are received in summer monsoon season. No major water resources development project has been undertaken since construction of Tarbela Dam in 1976. As a consequence, the overall water availability has not only frozen but it is rather depleting due to progressive sedimentation of the existing reservoirs. With rapidly growing population, increasing at about 3% per annum, there is an urgent need to increase agricultural production. Recent studies project large deficits in food grain production by the end of this century (WSIPS, 1990). In order to meet escalating demands for irrigation water, the farmers are forced to over pump and use groundwater of marginal quality. Sustainability of agriculture may thus be jeopardized without immediate construction of new reservoirs. Besides water shortages, national demand for electricity has been and would keep on growing rapidly. The present gap between power demand and supply would therefore continue to widen. Thermal Power Projects in the private sector do help in bridging this gap, but power tariffs have increased to dangerous levels. To keep the power tariffs within affordability of the consumers, generation of cheap hydropower is the only solution.

Keeping in view the need for irrigation water and power, Government of Pakistan planned the development of a multi-purpose Project on river Indus at Kalabagh. The project has been investigated in great detail and the best international expertise has gone into its planning and design. Starting with pre-feasibility studies in 1953 and 1966; project feasibility, appraisal, detailed design, design refinements and tender documents were prepared during the period 1972 to 1988. The Government has already spent about US $ 70 Million on feasibility studies and detailed investigations. The project has been evaluated by international expert teams to be very promising both from technical as well as economic considerations. Otherwise ready for implementation, the project start has been delayed due to controversies and conflicts of interests of various pressure groups.

GLOBAL WATER SCENARIO

The only issue that the UN General Assembly was able to agree on, in 1998 at its Special Session, five years after Rio Earth Summit of 1992, was the looming water crisis. Closely linked to this crisis is the deepening concern over the global food supply. Each year, the world's population increases by 80-85 million persons. At the end of the twentieth century the world is reaching the limits of the capability to feed its population. In some parts of the world, the food supply situation is already precarious. By mid-1999, the FAO concluded that thirty-four countries in the developing world are plagued with serious food shortages. The ability to produce food is unmatched by the ability to get the food to those who are in need, especially the poor and vulnerable in developing countries. For

some countries the issue is no longer food self-sufficiency but rather food security. The ever-increasing population growth, coupled with an emerging water crisis in many parts of the world, require a new approach and mindset in managing our lands and water (Shady, 1999).

By the year 2050, almost as much as two thirds of the world's population could be plagued by scarcity of water. This could seriously reduce food production, thereby endangering food security at the highest scale. The other issue relates to management of water, which is fragmented among multitude of institutions at the international, national and regional levels. This has created conditions that perpetuate inefficiencies and aggravate access to resources, leading to competing priorities and contradictory policies, programs, and practices. Many of the inter-sector competition, regional and international disputes on shared water are causing major concerns, and threaten harmony, peace and security at the national and international levels. There is also a lack of awareness by the public and many decision-makers on many of these emerging issues and problems. Timely and appropriate decisions are often neglected or seriously delayed in favour of other competing interests.

Water has played a fundamental role in the development of many countries. At regional and national level, it has been the means to transform agricultural production for home consumption and export and transform agrarian conditions in the rural areas. Irrigation development has received special attention for its ability to intensify land use, increase yields as part of a package of new agricultural technologies, generate income and food for small-holders, and generate employment in agriculture and related industry. In retrospect, from the 1950s to early 70's, there was a global surge in irrigation development. In fact, irrigation was the lead factor in the Green Revolution, which put an end to the mass starvation in the world. Today, irrigation is practiced on more than 250 million ha worldwide. This represents about 17% of cultivated lands. These irrigated lands produce about 40% of the total agricultural output.

By 2025, there will be 3 billion people living in water-stressed countries; 6.5 times more than there are today. The commonly held presumption that international trade will fill the gaps in food deficit countries deserves more careful scrutiny. Empirical evidence suggests that limited water supply combined with population growth is eliminating the option of food self-sufficiency in more and more countries. Seckler et al (1998) have estimated that the growth in world requirements for the development of additional water supplies varies between 57% at the current level of productivity to 25% considering realistic improvement in water utilization.

ROLE OF STORAGES IN WATER RESOURCES DEVELOPMENT

Irrigated agriculture depends on the storage and regulation of water flows, and requires various hydraulic structures to perform this function. In past several years, controversy has been fanned from environmental interest group against large dam projects. The arguments on each side have merits. But looking down the road, more structures will be needed to upgrade and replace existing dams, along with the need for new dams to

provide for additional storage capacity in order to feed the growing population particularly in the third world countries.

While water scarcity is becoming increasingly severe, yet in many water-scarce regions large amounts of water annually flow out to the sea. True that some of this floodwater might be needed for preventing environmental hazards but in many instances, the flood water is simply wasted; and of course, the floods themselves do inflict huge damages to the life and property. This problem is epitomized in monsoon regions where precipitation is concentrated in the three summer months and further in only a few days of these months. Because of the sporadic spatial and temporal distribution of precipitation, the only way water supply can be controlled to match the increasing demand is through storages. In natural systems precipitation may be intercepted by vegetation and temporarily stored on plant surfaces and on the soil surface. When water infiltrates the ground it is stored in the soil and may percolate to deeper groundwater storage. On the land surface water is stored in watercourses, lakes, and other water bodies and in frozen form as snow and ice.

As water becomes increasingly scarce in many regions of the world, a higher proportion of the normal flow of water will be consumed, and the incidence of shortages in periods of low flow will increase. For this reason, the need for additional storage as a proportion of the total water consumed will increase in the future. This is particularly true for the semi-closed basins. In these basins, there is no excess flow during the low-flow season, but there is excess flow during the high-flow season. Thus by storing water and reallocating it between seasons potentially large increases in the value of water can be achieved.

By 1997 there were an estimated 800,000 dams in the world, 45,000 of which qualify as large dams. More than half of the large dams have been constructed in the past 35 years. In 1997 an estimated additional 1,700 large dams were under construction (WCD, 1998). It is interesting to note that of all of the registered large dams in the world only 5% are in Africa where most of the severe economic water scarce countries are located. Fifty-five percent of the large dams are in North America and Europe, where we don't anticipate severe shortages (LeCornu, 1998).

Large surface water reservoirs have the advantage of greater storage efficiency than small reservoirs. This is because of a lower evaporation loss fraction in large reservoirs and their capacity to capture more uncommitted flows than small reservoirs. Because of their capacity many large reservoirs can store water for multi years to mitigate impacts of droughts. In monsoon climates, large reservoirs store excess flows in the wet season for use in the dry season. Other advantages of large surface storage facilities include their relatively low cost and multi-purpose qualities – e.g., hydropower and irrigation. An emerging new use of large reservoirs in the USA is to mitigate environmental impacts associated with water development. By releasing artificial flood flows from large storage dams, the hydraulics of the natural river system can be imitated and the dynamic conditions of an environmentally healthy system recreated with less water than under virgin conditions.

Keller et al (1999) concluded that under all but the most optimistic scenarios. Increasing storage through a combination of groundwater and large and small surface water facilities is critical to meeting the water demands of the 21st Century. The productivity of water as presently used must be assessed to determine the extent to which increased demands for irrigated agricultural production can be met by increasing the productivity of water currently used, and the extent to which increased demands will require increased consumption of water. It has been estimated that water savings and the productivity of water will have to increase at a global level by about 50% over 1990 levels to meet the projected demands in 2025. About one half of this can come from improved irrigation practices. Most of the rest will likely have to come from new storage projects. Since about 1% of storage is estimated to be lost per year to sedimentation, an additional 25% more storage would be needed in 2025 just to offset sedimentation losses between now and then. This implies that the storage capacity of the reservoirs will need to be increased by over 50% during the period 1990-2025.

Besides sedimentation and safety, the major and general issues stalling the construction of large dams are their social and environmental impacts. The intense social and environmental debate over large dams led to establishment of the World Commission on Dams, which started its work in May 98. The Commission's report is due by June 2000, (WCD, 1998).

EMERGING WATER CRISIS IN PAKISTAN

Pakistan as a whole is faced with serious water scarcity, which is going to aggravate with the passage of time. Recent studies have concluded that for most of the country, irrigated agriculture will continue to be constrained by the overall water availability, system capacity and supply side considerations. Seckler et al. (1998) have analyzed the water availability situation and concluded that Pakistan is confronted with serious water scarcity that will be a major constraint on food production, human health, and environmental quality. The growing population has reduced the per capita water availability over time: from 2500 m^3 in 1951 to around 1000 m^3 by the year 2000; a level commonly taken to indicate a severe level of water scarcity. Reviewing the situation, Global Water Partnership (1999) have observed that projections of food production indicate that Pakistan will be facing shortfall in the production of all major food grains and crops. Projections of grain production show a shortfall of 11 million tons by 2010 and 16 million tons by 2020. The Government would be forced to import edible oils, large quantities of wheat as well as all major crops. With growing external debt, poor foreign and internal financial resources and an inadequate industrial base it would be very difficult if not impossible for the government to finance the rising import bill. Food scarcity could create famine-line conditions in the country. It has been brought out that there is not much of a vision of a sustainable scenario; rather, ringing of the alarm bells to see the challenges and devise ways of coping with them in good time.

Water resources development and management has therefore acquired new dimensions in Pakistan because of a number of factors, which are reflecting adversely on the irrigated

agriculture. In the past, it was possible to keep the agricultural production in pace with population growth, by progressively increasing the irrigation water availability. The future prospects are however much gloomier and the very sustainability of irrigated agriculture appears to be jeopardized due to rapidly escalating water demands limited water resources and environmental concerns.

Water availability for the future has been estimated in the 9th Five Year Plan at about 108.7 and 108 MAF in year 2000 and 2010 respectively. Without requisite water supply, food and fibre deficits would be irrecoverable. The water availability would fall short of requirements by 40.3 and 92 MAF in years 2000 and 2010 respectively, which reveals a very disastrous scenario indeed. No substantial increase in the water supply is possible at the moment because implementation of new storage projects is going to take time even if there are no political or other bottlenecks. This brings to sharp focus the urgent need to resolve the stalemate on new storage projects in order to avert the catastrophic impacts of the increasing water scarcity.

Table 4.1: Water Requirements and Availability

	Year 2000	Year 2010
Water Requirement		
Irrigation	143.1 MAF	192.0 MAF
Non-Irrigation	5.9 MAF	8.0 MAF
Total Requirements	149.0 MAF	200.0 MAF
Water Availability		
Total Surface and Groundwater	108.7 MAF	108.0 MAF
Shortfall	40.3 MAF	92.0 MAF

There is an undeniable link between water availability and agricultural productivity. On the other hand there is the dire need of Pakistan to enter the 21st Century with a determination to ensure its food security. The obvious question therefore arises as to from where would come this additional water needed for sustained increase in agricultural production?

Keeping in view the land and water requirements to feed the growing population over the perspective plan period, the existing resources and future potential, even if fully exploited, do not cater the needs. The only solution seems to be to cut down our water demands / requirements to match the availability / supplies. To achieve this objective, options can be to modernize our irrigation system through introduction of sprinkler, drip irrigation system conservation measures, evolution of low delta crop varieties, water saving practices etc. It needs some comprehensive approach based on sound studies.

Chandio et al. (1997) have estimated land and water requirements up to the year 2000 for a population of 148 million. Based on this study, water requirements up to the year 2010 for a population of about 202 million are given in Table 4.2 below:

Table 4.2: Future Land and Water Requirements in Agriculture Sector

Item	With Present Yield		With 50% Increase in Present Yield	
	Year 2000*	Year 2010**	Year 2000*	Year 2010**
Area Required Mha	49.0	66.0	28.5	39.0
Water Requirement BCM (MAF)	242.4 (195)	330.0 (265)	127.7 (103)	174.0 (140)

KALABAGH DAM PROJECT

PROJECT DESCRIPTION

Kalabagh Dam Project is proposed on river Indus 160 km southwest of Pakistan's capital Islamabad. This multi-purpose project would have live storage capacity of 6.1 MAF. Besides making up for the capacity loss in existing reservoirs, it would make substantial contribution of firming up the irrigation supplies not only for new projects but also help in making available additional allocations agreed by the provinces under Water Apportionment Accord (WAA) of 1991. Further, it would add a large amount of cheap hydropower to the national grid through its 2400 MW (ultimate 3600 MW) installed capacity. The salient project features are presented in Box 5.1 (WAPDA, 1998).

Box 5.1
Salient Features of Kalabagh Dam Project

Reservoir Data	
Total Storage	7.9 MAF
Useable Storage	6.1 MAF
Dead Storage	1.8 MAF
Retention Level	915 FT SPD
Minimum Reservoir Level	825 FT SPD
Area at Retention Level	164 square miles
Installed Capacity	
Initial	2400 MW
Ultimate	3600 MW
Energy Generation per annum	11413 Gwh
Unit Cost of Generation (1997)	Rs 0.63
Main Dam	
Crest Elevation	940 FT.SPD
Crest Width	50 FT
Maximum Height (above river bed)	260 FT
Length (overall)	11,000 FT

Spillways	
Overflow Spillway	
Sill Level	860 FT SPD
Orifice Spillway	
Sill Level	785 FT.SPD
Cost of Project (1997)	5704 million US$

THE PROJECT BENEFITS

Kalabagh Project would store surplus water in the flood season and make it available for controlled utilization during the low flow winter season. This water would be used for sowing and final maturing of the Kharif crops and entire Rabi crops. Irrigation oriented operation of the project gives the highest overall economic return. Thus the full live storage of 6.1 MAF would be available for guaranteeing assured irrigation supplies throughout the year including replacement of the storage loss on the three existing reservoirs (WAPDA, 1994).

POWER

Kalabagh Project with its initial installed capacity of 2400 MW (ultimate 3600MW) would add to the system a very large chunk of the cheap hydropower. In an average year, 114000 million kilowatt / hours (MKWh's) of electricity would be generated at Kalabagh. Further, as a result of conjunctive operation, an additional 336 million KWh's and up to 600 megawatts (MW) of additional peak power would be generated at Tarbela. To put these figures in perspective, if Kalabagh was in position today there would have been no load shedding in Pakistan and the power tariff would also have remained within reasonable limits. The energy generated at Kalabagh would be equivalent to 20 million barrels of oil per year. It would therefore have positive impact both on national economy as well as on the environmental by reducing dependence on imported fuel and by generating pollution free hydropower.

FLOOD ALLEVIATION

Kalabagh Project would reduce the frequency and severity of flooding along the Indus, particularly between the dam site and Indus / Panjnad confluence, 480 km downstream. Due to large floods during the period 1973-88, national economy suffered losses of about US $ 1 billion. In addition, these floods caused loss of 1700 human lives and inundation of 57,000 villages (WSIPS, 1990). The proposed project would not only harness the floodwaters but would also mitigate extensive damages and misery resulting from high flood. For the riverain areas lower down in Sindh, it would enable conversion of the exiting 'Sailaba' cultivation to the year round lift irrigation.

ECONOMIC BENEFITS

On a conservative basis, the overall direct benefits of Kalabagh Dam would be around US $ 600 million per annum. Thus the investment cost of project would be repaid within a very short period of about 8 – 10 years.

CONSTRAINTS IN PROJECT IMPLEMENTATION AND THEIR REVIEW

As a part of controversy on Kalabagh dam, a number of apprehensions and doubts have been expressed by the upper (NWFP) and lower (Sindh) riparian provinces. The main concerns / issues raised by the upper and lower riparians are depicted in Box 6.1.

BOX 6.1
APPREHENSIONS OF UPPER & LOWER RIPARIANS

UPPER RIPARIANS

- Fear of flooding of Peshawar Valley including Nowshera town
- Adverse impact on the drainage of surrounding areas of Mardan, Pabbi and Swabi plains and Mardan SCARP
- Submergence of fertile culturable land in the reservoir area and displacement of population

LOWER RIPARIANS

- Fear of desertification of Sindh
- Non-availability of surplus water to fill Kalabagh reservoir
- Negative effects on cultivation of riverain areas
- Accentuation of sea water intrusion in Indus estuary and adverse impact on mangrove forests
- Diminishing of fish production and drinking water supply below Kotri

REVIEW / ANALYSIS OF THE APPREHENSIONS

The objections and apprehensions raised by the upper and lower riparians have been examined in great detail both by the implementing agency (WAPDA) as well as, the national and international experts. The factual position in response to the above apprehensions is presented below.

UPPER RIPARIANS

Flooding of Peshawar Valley. In the modified design of the project the reservoir conservation level has been lowered by 10 ft. from 925 ft. to 915 ft. above MSL, thus

eliminating the need for construction of any protective dikes near Nowshera. At maximum conservation level of 915 ft. the backwater effect of Kalabagh lake would end about 16 km downstream of Nowshera. A state-of-art computer based study, backed by physical modeling in Pakistan, has established that recurrence of record flood of 1929 would not affect the water level at Nowshera even after 100 years of sedimentation in reservoir (WAPDA, 1992). The concern of Peshawar Valley flooding is therefore no more relevant as it has been addressed in the revised project design.

Impaired Drainage of Mardan SCARP. Lowest ground levels at Mardan, Pabbi and Swabi areas are RL 971, 961 and 1000.4 ft. above MSL respectively, as compared to the maximum conservation level of 915 ft. for Kalabagh. This maximum Kalabagh reservoir level would be maintained only for 3 to 4 weeks during September and October after which it would deplete as water is released for Rabi crops and power generation. Ultimately it would go down to dead storage level of 825 ft. by early June. This operation pattern of reservoir would not block the drainage and thus would not cause water-logging or salinity in Mardan, Pabbi and Swabi areas. The invert levels of main drains of the Mardan SCARP are also higher than maximum conservation level of 915 ft. Further, the backwater effect of Kalabagh dam does not extend to the Mardan SCARP area. Thus operation of these drains would not be impaired by Kalabagh Project (Tarar, 1995).

Land Submergence and Population Displacement. Total culturable land submerged under the reservoir would be 11,000 ha (9,800 ha in Punjab and 1,200 ha in NWFP). The submerged irrigated land would be only 1,200 ha. It may be noted that about 400 ha of irrigated land were acquired for the drainage project of Mardan SCARP alone. It therefore implies that only limited area would be affected in NWFP as a consequence of the project implementation.

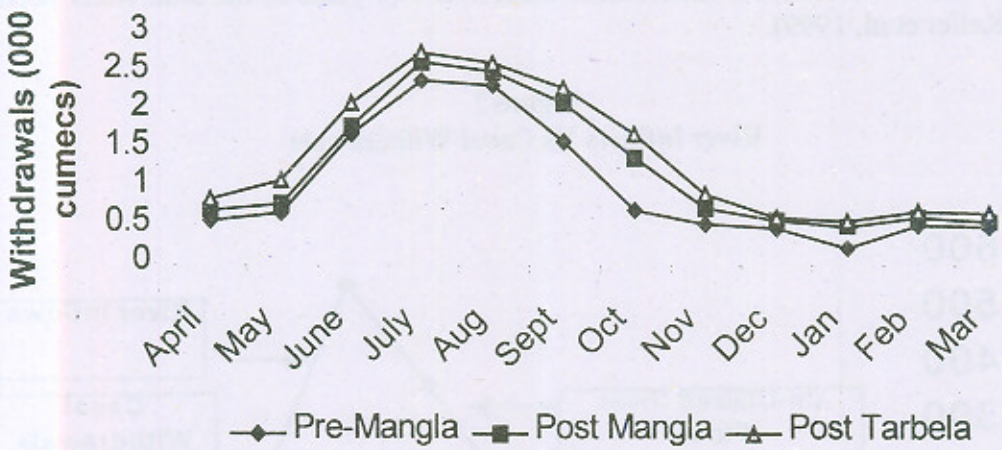
The estimated population to be affected by the project would be 83,000: 48,500 in Punjab and 34,500 in NWFP. A liberal resettlement plan would provide alternate irrigated lands to the affected families. The affected population would be resettled along the reservoir periphery in extended / new model villages with modern facilities of water supply, electricity, roads, dispensaries, schools and other civic amenities. The comprehensive resettlement package proposed for Kalabagh Project is in fact most innovative and attractive than those previously adopted for Mangla and Tarbela dams. The basic objective being that 'at the end of day' the affected population should find themselves in a better socio-economic environment (WAPDA, 1994).

LOWER REPARIANS

Fear of Desertification of Sindh. The fear of desertification of Sindh Province appears to be triggered by some misgivings. Kalabagh Project envisages storing surplus water during flood season and then making it available for the remaining dry periods of the year. The river storages in fact help in improving the overall irrigation water availability. This has been clearly demonstrated by the historic canal operations after construction of Mangla and Tarbela dams. During pre-storage era, the average annual withdrawals of Sindh were about 31 MAF, which increased to 40 MAF (29%) in the post-Mangla period

and to around 45 MAF (13%) in the post-Tarbela period. The overall increase in Sindh canal diversions as a result of storage projects thus work out to 45%. The critical Rabi canal diversions of Sindh increased for about 10 MAF in the pre-storage era to 15 MAF in the post-storage scenario, indicating a total increase of some 50% (Khan, 1998). It is estimated that after construction of Kalabagh Project, canal withdrawals of Sindh would further increase. As indicated in Figure 1, most of the increase would come in the crucial early Kharif cotton-sowing season. Thus the often repeated apprehensions regarding desertification of Sindh defies even the basic logic of a storage reservoir.

Figure 1
Seasonal Variation of Canal Withdrawals



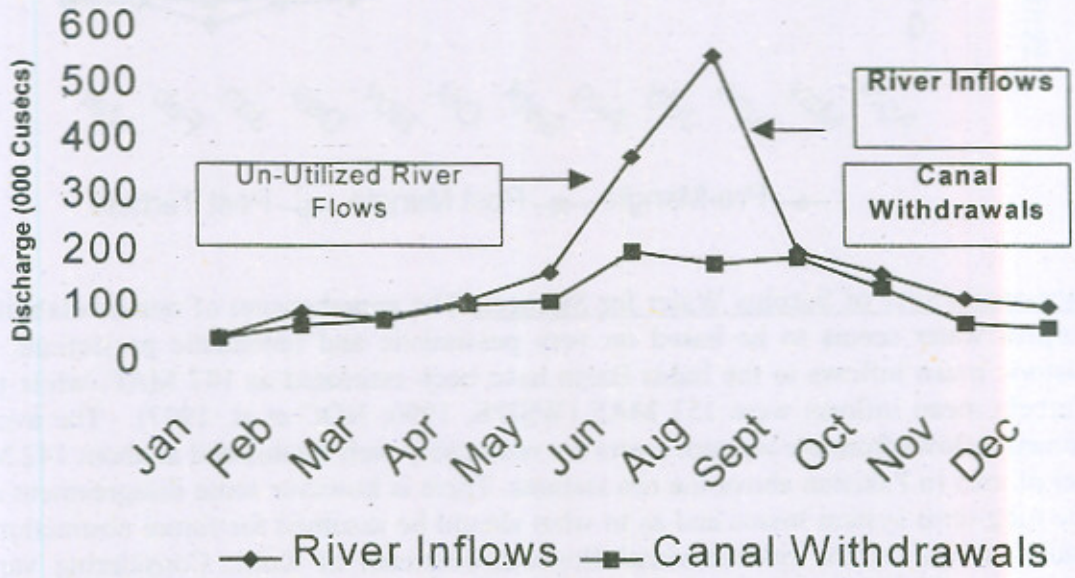
Non-availability of Surplus Water for Storages. The apprehension of non-availability of surplus water seems to be based on very pessimistic and unrealistic projections. The historic mean inflows to the Indus Basin have been estimated as 147 MAF, while post-Tarbela mean inflows were 153 MAF (WSIPS, 1990; NDC et al. 1997). The average annual inflows from the western rivers are reasonably well established at about 142 MAF net of uses in Pakistan above the rim stations. There is however some disagreement as to the long-term system losses and as to what should be assumed for future abstractions in India as well as for environmental flows downstream of Kotri. Considering various scenarios, the long-term future water availability has been estimated as 143 MAF by WAPDA. As against this, Post-Tarbela average canal withdrawals have been 105 MAF, while the average escapages downstream Kotri have been estimated at about 40 MAF. After accounting for the eastern rivers contribution, Indian uses on the western rivers and releases d/s Kotri for environmental consideration; it has been estimated that on average 25-30 MAF of surplus water would be available for future development and storages (Mashhadi, 1998). The Kalabagh Project with a storage capacity of only 6.1 MAF, would store and re-distribute only small part of the river surpluses, presently going waste to sea (Figure 2).

Another scenario is that Water Apportionment Accord (WAA) of 1991 has allocated about 12 MAF of water to the provinces over and above the post- Tarbela average canal withdrawals. Out of this about 6 MAF of water has been allocated during low-flow

Kharif and Rabi periods, when the entire river supplies are already committed. Use of this allocated water would only be possible through storage of the river flow during flood season. Water to fill Kalabagh reservoir is thus already available and provided within the additional provincial allocations of the Water Accord.

The point that needs to be made here is that the construction of storages in semi-closed basins (like that of Indus Basin) represent major opportunities for adding value to water by its reallocation over various seasons and from wet years to dry years. The worst conditions of river flows during dry years / seasons should therefore not be implied for assessing the availability of surplus water. A relevant case in point is High Aswan Dam on the river Nile which has the storage capacity as large as three times Egypt's annual allocation from the Nile, and sufficient to meet over two years of the total water needs of Egypt (Keller et al, 1999).

Figure 2
River Inflows Vs Canal Withdrawals



Negative Effects on Riverain Areas. The impression that after construction of Kalabagh dam, riverain areas of Sindh, commonly called 'Sailaba', would go out of production due to control over floods is not well founded. The 'Sailaba' crops are grown on the land adjacent to the main river and the creeks. Though crops are sown on the soil moisture soon after the floods, this need more than one watering to mature. Consequently, farmers are generally required to provide irrigation facility through shallow tube wells or lift pumps. Prime movers on these tubewells have to be removed during the flood season to avoid damage. Sindh presently has 267,000 hectares of 'Sailaba' cultivated area. This area is initially sown with the moisture provided by flooding with river stage 8.500 cumecs and above. Flood peaks above 8,500 cumecs would still be experienced after

construction of Kalabagh without much detriment to the present irrigation and cultural practices, while large damaging floods would be effectively controlled. This would, in fact, be conducive to agricultural development in riverain areas.

Sea Water Intrusion. The fear that present extent of seawater intrusion in the Indus Delta would be further aggravated by Kalabagh Dam is not substantiated by investigations and field data. Studies indicate that at present, the total effect of Indus estuary is only limited to the lower most portion of delta. This is further confirmed by the fact that gauge heights in the low delta are completely insensitive to Indus discharge of up to 70,000 cumecs. Therefore, the seawater intrusion, which seems to be at its maximum even now, is unlikely to be aggravated any further by Kalabagh Dam (WAPDA, 1992).

Out of the total 1.5 MA tidally inundated historic Indus delta, mangrove forest cover an area of almost 0.31 MA. In this forest, spreading from Karachi in the west to Rann of Kutch in the east, 95% of the population now consists of a salt tolerant variety. Extent of the active delta area (as distinct from the historic delta area described above) is about 287,623 Acres. Out of this, the mangroves cover only 23.5% of the area. Most of the remaining area is in form of mud flats. The reason for this area being too small could be a combination of factors. These include frequency of tidal inundation being too small instead of fresh water reduction caused by upstream abstractions, which started with Sukkur Barrage in 1932. Other major causes are uncontrolled over-grazing and cutting due to extreme population pressure of Karachi. Therefore, in order to revive the mangroves, real need is for replanting salt tolerant varieties with provision for controlled doses of fresh water. Obviously, this possibility would be much enhanced with an upstream storage facility like Kalabagh (WAPDA, 1994).

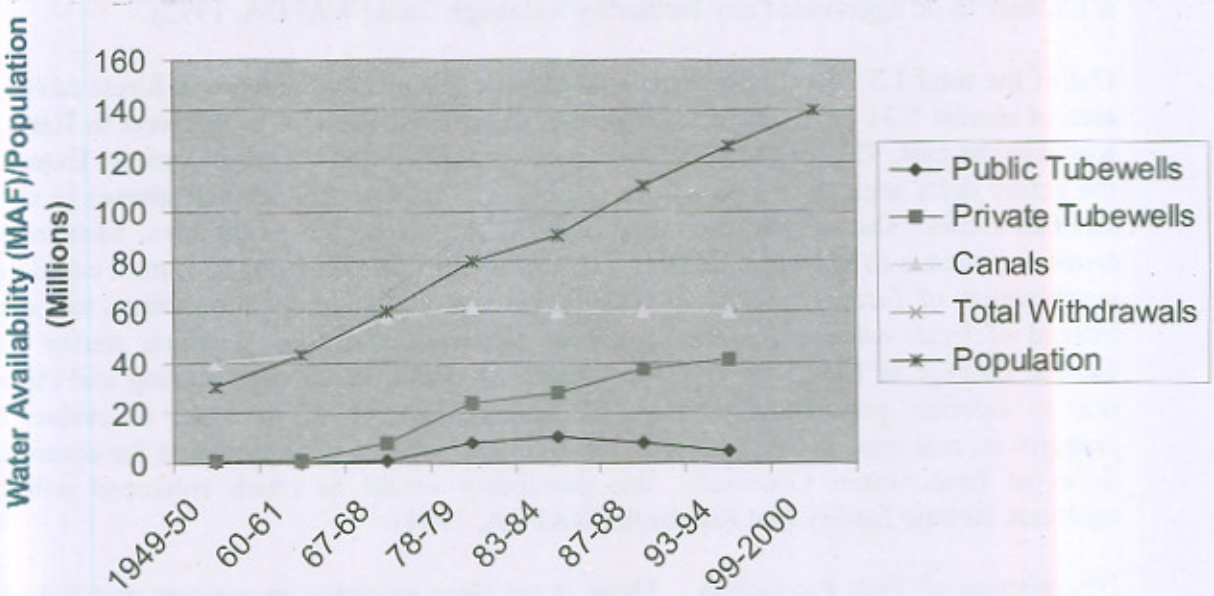
Diminishing of Fish Production. There is no clear evidence to suggest that fisheries stocks in the river reach below Kotri have declined due to progressive reduction in the surface water supplies. On the other hand, fish production has been constantly increasing as indicated by statistical data (Tarar, 1995). As such, Kalabagh dam is unlikely to have any adverse effect on fish production in the area. In the riverain area downstream of Kotri Barrage, groundwater is predominantly saline or brackish and as such unsuitable for either irrigation water supply. After construction of Kalabagh, winter supply in the river would improve, which would help in providing more drinking water to the inhabitants of the area.

CONSEQUENCES OF NOT BUILDING KALABAGH DAM

Water resources development has acquired new dimensions in Pakistan because of the growing demands of rapidly increasing population. In the past, it was possible to keep the agriculture production in pace with population growth by progressively increasing the irrigation water availability. The future prospects are however much gloomier and the very sustainability of irrigated agriculture appears to be in jeopardy. The main factor responsible for this state of affair is that overall water availability has now been frozen because no major surface water development project has been implemented during last two decades and the groundwater abstraction has also touched the peak (Figure 3). In

fact, the overall water availability may even decline in the absence of new reservoirs due to dwindling capacities of the existing storages. Due to rapid development of groundwater in fresh water aquifers by the private sector, a host of issues have emerged that include mining of groundwater, secondary salinization due to use of marginal groundwater and intrusion of saline water into fresh water aquifers. Additional input of surface water supplies is thus urgently needed to meet growing water demands and to check the build up of salinity in the root zone (Shakir et al, 1995).

Figure 3: Farm gate Water Availability Vs Population



The Water Sector Investment Planning Study (WSIPS, 1990), estimated a 23% shortfall in total grain production by the year 2000 without investments in water development. Therefore, any further delay in implementation of Kalabagh Project could threaten national food security and subject the economy to additional burden of huge bill for import of food grains.

In addition to the above, following are some of the more important consequences of not building Kalabagh Dam:

- For implementation of Water Apportionment Accord 1991, a new storage project like Kalabagh is essential to avoid bitter inter-provincial disputes particularly in dry years. Dispute between Punjab and Sindh on shortage of about 0.20 MAF water during Rabi maturing Kharif sowing 1993-94 should be an eye-opener. The current Rabi Crop is already under stress and further critical water shortages are apprehended during the Rabi maturing and Kharif sowing period because of the prevailing drought

conditions, which can not be addressed due to the inadequate existing storage capacities.

- The energy to be generated annually at Kalabagh is equivalent to 20 million barrels of oil. This annual import of fuel for thermal generation, including augmentation of transportation infrastructure, would be an additional burden on the already fragile economy.

- A few years ago the Federal Government entered into agreements with international private sector to install over 9,000 MW of thermal power over 4-5 years. Though it helped in overcoming the load shedding, the power cost has increased substantially, which has adversely impinged on the ability of the country's exports to remain competitive in the global markets. Therefore, large-scale input of cheap Kalabagh hydropower is essential to keep cost of electricity within affordability of the consumers; otherwise sustainability of the industrial and agricultural sectors would be jeopardized.

PROPOSED FRAMEWORK FOR RESOLVING THE CONFLICTS

The constraints in the way of Project implementation can broadly be categorized as technical and socio-political. The above analysis indicates that most of apprehensions / issues raised by provinces are based on lack of appreciation of the project details. The technical issues raised by the upper and lower riparians were examined at the time of review of project design and most of these were addressed by making appropriate adjustments in the final design. Despite all these efforts and technical clarifications, project implementation has remained stalled. This stalemate is mainly due to the over-exploitation of the socio-political factors, which have created an environment of polarization and distrust. Some of the politicians from the upper and lower riparians had initially taken extreme stand on this project, which is proving to be the main impediment in the way of resolving the differences (Shakir et al, 1997).

The existing framework for resolving conflicts on large national projects has not worked well. Therefore, there is a need to evolve new strategies for addressing such conflicts in the implementation of projects of vital national interest. These may include:

i) Water Apportionment Accord of 1991 reflects the consensus of all the four provinces over the vital issue of new storages. The need for storages, where feasible, on Indus and other rivers has been admitted and recognized by the sharing of river waters and therefore should serve as starting point for going ahead with Kalabagh Project. In fact, implementation of the Accord necessities construction of a storage about 6 MAF capacity in order to make available additional water allocated under the Accord during low-flow Kharif and Rabi seasons.

ii) Formulation of a long term National Water Resources Development Program. It should be a package based on the concept of unified approach. The implementation of this program should be linked with the approval of the entire package. Considering the immediate need for additional surface water supplies and cheap hydropower, Kalabagh Project would be a high priority component of the overall program.

iii) A comprehensive briefing and project review needs to be arranged by the Federal Government. Eminent professionals, engineers and experts from all the four provinces and engineering institutions should be invited to discuss the project details and formulate proposals for addressing the unresolved issues in more effective and responsive manner. Suitable modifications may also be incorporated in the final project design, if indicated as a consequence of these consultations.

iv) As a step towards confidence building, representatives of the provinces should be closely involved in decision making at all levels of project implementation. The operational plans shall also be evolved in close collaboration with the upper and lower riparians in order to reflect their viewpoint. To further guard against the concerns of upstream inundation and downstream desertification, the project operation should be entrusted to a panel of experts from WAPDA and Provinces. This would help in bridging the differences, and in confidence building amongst the various stakeholders.

v) To hold a series of seminars, conferences and public debates for educating the people about the project throughout the country. The press and electronic media can play a very important role in raising the public awareness.

vi) To evolve a rational and agreed formula for distribution of net project benefits amongst the Provinces.

vii) To diffuse political tension, there is need to hold a Round Table Conference of the stakeholders / provinces. The experts should make presentation highlighting the project details, its benefits and measures for addressing the controversial issues. This forum will provide an opportunity for clarification of the controversial points and thus help the parties in taking more rational stand on Kalabagh Project.

viii) Formation of a high-level Committee with representatives of all stakeholders from all the provinces. This forum should discuss and formulate a comprehensive package for implementation of Kalabagh Dam Project. This package should include resolution of technical matters in the light of the experts reports, satisfactory rehabilitation of displaced families, assurance of uninterrupted water supplies to the downstream

users, and suitable ecological and environmental protection measures that are found necessary.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions can be drawn from this study:

- For sustainability of irrigated agriculture and for generation of cheap hydropower, there is an urgent need to build storages on Indus river. Kalabagh is the only storage project ready for implementation.

- This analysis indicates that the apprehensions of upper and lower riparians against the construction of Kalabagh Dam are based on inadequate appreciation of the project details and the issue has been unduly politicized.

- There is a need to evolve a mechanism to resolve the conflicts over the project by initiating a process of mutual consultations amongst the federating units. This may include the review of the project by a panel of experts from all the four provinces and making appropriate modifications in the project design, if so indicated.

- In order to dispel the misgivings about the project and to set in the confidence building, the upper and lower riparians should be closely associated in the decision making process. Towards this end, the operation and regulation of the reservoir may be entrusted to an experts committee from WAPDA assisted by all the four provinces.

- There is a need to educate the people about the project by holding a series of seminars and public debates.

- The Government should constitute a high-level committee to discuss and formulate a comprehensive package for construction of Kalabagh Dam Project. The Federation may also provide necessary assurances for satisfactory implementation of the agreed package.

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