

## THE CHALLENGE OF WATER SHORTAGE IN PAKISTAN

*Dr. A. R. Kemal*

### **Introduction**

Despite rapid growth of the industrial sector, agriculture sector still accounts for 23 percent of GDP and 43 percent of the labour force. Water is the major input for the growth of agricultural output; an increase in the cropped area, optimal utilization of inputs and higher levels of productivity per hectare is inconceivable in the absence of optimal levels of water. Unfortunately the water availability has declined and at present with the annual per capita water availability of about 1,050 m<sup>3</sup>, Pakistan is approaching the situation of chronic water stress.<sup>1</sup> Drought over the last few years<sup>2</sup> has been so severe that it has created a situation of water crises in the country and has deepened the inter-provinces water conflicts. At the same time it has also highlighted the need for creating reservoirs if such crisis is to be avoided.

The shortage of water in an area called “The Great Indus Food Machine” is quite disturbing [see Cool (1977)]. Planning Commission (1978) noted that “the Indus Basin with proper management could be several times as productive as it is now, and such a vast improvement will be necessary to maintain and enhance the welfare of the people of Pakistan”. Unfortunately, since the commissioning of Tarbela Dam in 1976, Pakistan has not undertaken any mega project to meet the growing water demand. As a matter of fact, due to silting the total reservoir capacity in the country has declined.<sup>3</sup> Considering that Indus River System (IRS) rim-station inflows on average are 169.8 BCM, there is a possibility to increase the surface water availability by another 31.6 BCM [see PCST (2003)]. While harnessing the water requires huge amount of resources, it also requires that there is consensus amongst the various provinces on the construction of water reservoirs. It could also be used for generating hydroelectricity and thus reducing the cost of business for all the sectors of production, especially for the industrial sector.

In view of the sharply rising demand for water and limited potential of surface water, the need for optimal utilization of water cannot be over-emphasized. The water pricing rules, development of water market, and better irrigation systems and methods would help a great deal in this regard. Moreover, it needs to be noted that since 1976-77 average amount of water escaping to the sea exceeds 44 BCM which seems to be quite excessive. The non-availability of sufficient storage reservoirs for regulating the flood supplies of rivers particularly during monsoons is the main factor behind this wastage.

The need for an increase in the water availability through construction of reservoirs and optimal use of water resources is imminent. The present study examines major issues in the water sector in section II, and the development strategy for optimal utilization of water in Section III. Major conclusions are drawn in Section IV.

### **Major Water Issues**

#### **Low Storage Capacity**

The average annual water inflow of watersheds of the Indus River over 1992-93 to 1999-2000 has been about 173 BCM<sup>4</sup> [see PCST (2003)]. However, these flows have not been uniform across the seasons. For example, flows for Kharif (summer) and Rabi (winter) crop seasons have been 84% and 16% of the total annual flows [see Ahmad, Mohammad and Khan (2001)]. The storage capacity of Colorado and Nile rivers as a percentage of the average inflows is 500 and 175 percent respectively, and even in India it is 33 percent. Considering that slope of Indus can be used for generation of hydro power the need for reservoirs are even greater.

*The Challenge of Water Shortage in Pakistan*

**Table 1: Average Annual Flow & Storage Capacity at Some Major River Basins**

| <b>River Basin</b> | <b>Average Annual flow (MAF)</b> | <b>No. of Dams</b> | <b>Storage Capacity (MAF)</b> | <b>Percentage Storage</b> | <b>Power (MW)</b> |
|--------------------|----------------------------------|--------------------|-------------------------------|---------------------------|-------------------|
| Colorado           | 12                               | 4                  | 60+                           | 500                       | 4,167             |

water charges are ascertained and as such the farmers have been using excessive water resulting in problems of water logging and salinity. Because of the low per unit of water employed and as such the productivity has been low. At present the government is implementing various schemes with the involvement of the communities with a view to ensuring that the water is optimally utilized. However, better water pricing and the development of water markets can go a long way in improving the water productivity.

### **Extensive Seepage Losses in the Irrigation System**

Due to inadequate drainage system Pakistan is facing problems of water logging and salinity. The continued use of lesser quality groundwater in the face of short and uncertain canal supplies have also added to the problem of salinization and alkalization of productive lands. Besides there have been watercourse losses of around 45%. The application losses have been around 25% {Ashraf et al., (1977); WAPDA; Trout and Kemper (1980); PARC-FAO (1982)}. Efficiency levels of canal, watercourse and field application have been 79, 60 and 75%, respectively and the over all irrigation efficiency has been around 36% {Ahmad (1990)}. This shows enormous potential for improvements in the efficiency levels of water use.

### **Inadequate Operations, Maintenance and Poor Cost Recovery**

The water charges are just a fraction of the total cost required to maintain the irrigation system. The allocations to irrigation declined due to severe fiscal constraint resulting in rather sharp deterioration in the irrigation infrastructure. Through the Community Participatory Development Programs (CPDP) the government is hoping that it would be able to protect the infrastructure. Besides the government has launched an ambitious water course development project and that would help in an improvement in the irrigation infrastructure.

### **Excessive Ground Water Pumpage**

The indiscriminate use of ground water especially the brackish water has resulted in the loss of land. Moreover, in various areas especially of Balochistan, water table has gone down rather significantly. There is a danger of arsenic problems especially in the province of Balochistan.

### **Deteriorating Institutional Capacities**

The irrigation departments of provincial governments are responsible for maintaining the irrigation infrastructure though some of the responsibilities are being devolved to the communities. WAPDA is responsible for development projects and in the recent past has not been able to get the requisite finances for the development of water resources from the Federal government. The capacity of all these institutions has deteriorated over time.

### **Water Availability and Poverty**

Increased water availability enables households to improve crop productivity, grow high-valued crops, and generate higher incomes and employment. This helps in reducing the incidence and severity of poverty, especially if landholdings are equitably distributed. However, irrigation may also have negative implications for poverty. Poor canal design and faulty structures, inequity in water distribution, untimely water deliveries, and insufficiency of irrigation water results in the loss of agricultural productivity especially for the poor. The irrigation may also result in the conversion of fertile land to wasteland and resultantly loss of crops, fisheries and navigation, and arsenic contaminated groundwater for irrigation which could create serious health hazards. Less access to surface water and poor quality of groundwater at the tail-end reduces productivity and consequently has negative welfare impacts for the poor farmers.

## **Water Resource Development**

For the long run growth of the economy development of water resources is absolutely important. The strategies for water development must address all the issues mentioned above, particularly the development of additional storage facilities, rehabilitation and optimal utilization of existing reservoirs, ensuring maximum crop per drop, overcoming the environment problems, and fairer distribution of water.

As noted earlier WAPDA has recently formulated vision 2025 for water development. Its effective implementation, however, is predicated on the availability of resources as well as the consensus of the provinces regarding the construction of dams. We may note that Kalabagh or Bhasha Dam would each cost around \$8 billion and even if its implemented over an 8 years period, an allocation for just one of the dams annually would be Rs. 60 billion and exceeds total allocations for water in the Medium Term Development Framework (MTDF): 2005-10. MTDF allocated Rs. 293 billion for the water sector under the PSDP comprising allocation of Rs. 242 billion for the federal and of Rs. 51 billion for the provincial projects. With a throw-forward of Rs. 258 billion of the federal programme, it does not leave room for any new project in the plan.

Despite the Water Account of 1991, there have been disputes over the water. No doubt Indus River System Authority (IRSA) has been set up but the distribution of water on the historical basis has been causing confusion. With the system of telemetry and implementation of the 1991 Water Accord in a transparent manner would help in ensuring each of the provinces that construction of dams would not adversely impact them. The dams also involve displacement of the population and there could be problems of flooding and seepage. These need to be effectively tackled.

WAPDA Vision 2025 needs to be supplemented with sustainable groundwater development and exploration of non-conventional sources including hill torrents, saline waters, drainage effluents, and sweage water. Furthermore, optimal utilization of water through market mechanism; exploring latest irrigation

technologies and management tools; regulating framework for groundwater use; pollution control and management; promoting saline agriculture; artificial recharge of depleting aquifers; watershed and river sediment management; improving drainage facilities; and developing flood and drought management mechanism etc. would also go a long way in ensuring better water productivity.

The Medium Term Development Framework 2005-10 provides an integrated and holistic approach and suggests an increase in water availability by 14.67 MAF by conservation and augmentation means. Strategy of the plan includes:

- Increase in the availability of water through augmentation and conservation measures, including development of a consensus on large storage projects and efficiency improvements. Ensuring 'more crop per drop' through improved irrigation methods and practices, extensive research in developing crops with high yields, and lower water consumption and water saving techniques;
- Protection of groundwater from pollution and unsustainable abstraction. Detailed action plans including legal provisions for individual ownership of groundwater and possible metering would be prepared and various technologies used for undisturbed extraction and skimming of fresh groundwater layers overlaying saline water would be evaluated and improved techniques will be adopted; and
- Promotion of groundwater recharge wherever technically and economically feasible, with abstraction from the aquifer restricted to the sustainable recharge.

In the perspective of water shortages it needs to be conserved by improving the water-courses, land levelers and other instruments. The MTDF proposes acceleration in the watercourse improvement because it is the cheapest available option to minimize water loss. The MTDF estimates that average unit cost of water saved per acre-foot from watercourse improvements is around Rs. 12,000. It

proposes improvements of 68,500 water courses resulting in water saving of about 6.8 MAF. In addition, about 81,600 ha (20,1680 acres) of agricultural land will be precisely leveled. Watercourse improvement would also be vigorously monitored to enhance its effectiveness.

It is argued that by raising the user price of water to its true scarcity values would induce farmers to conserve water resulting into optimal use of water [World Bank (1993)]. However because of serious practical and political problems it has been rather difficult for the government to raise the water charges. Thobani (1997) argues that water markets need to be developed and such markets have worked well in various Latin American countries. He argues that in the absence of formal markets informal water markets get developed. However, such informal markets may be sub-optimal and he points out that in parts of South Asia, wealthier farmers with deep wells charge neighboring smaller farmers a high "monopoly" price for water. Moreover, in the informal water markets buyers lack the security of an enforceable contract.

If formal water rights are granted to the farmers it will provide an incentive for conserving water and reallocating it to higher-value uses. Tradable water rights allow leasing of water and spot sales and the government can monitor operations and effectively enforce laws and regulations aimed at preventing the abuse of monopoly power as well as protecting the environment. It also increases user participation in allocating water and planning new investments, while allowing businesses to invest in activities that require assured access to water.

### **Conclusions**

Major conclusions of the study are summarized below:

- With the annual per capita water availability of about 1,050 m<sup>3</sup>, Pakistan is approaching the situation of chronic water stress. Drought over the last few years has been so severe that it has created a situation of water

crises in the country and deepened the inter-provincial water conflicts;

- Considering that Indus River System (IRS) rim-station inflows on average are 169.8 BCM, there is a possibility to increase the surface water availability by another 31.6 BCM;
- While harnessing the water requires huge amount of resources, it also requires a consensus amongst the various provinces on construction of various water reservoirs which could also be used for the generation of hydroelectricity;
- The water pricing rules, development of water market, and better irrigation systems and methods would help a great deal to optimize the water resources;
- Since 1976-77 the average amount of water escaping to the sea exceeds 44 BCM which is quite excessive and the non-availability of sufficient storage reservoirs for regulating the flood supplies of rivers has been the main factor behind that;
- Major water issues include low water storage capacity; absence of holistic, integrated and sustained approach to water development; low productivity of water; widespread seepage losses; inadequate operations and maintenance; excessive ground water pumpage, deteriorating institutional capacity and the unequal water distribution;
- Effective implementation of WAPDA vision 2025 for water development is predicated on the availability of resources as well as the consensus of the provinces regarding the construction of dams. However, MTFDF allocation for water resources does not have nay fund for new dams;
- Despite the Water Accord of 1991, there have been disputes over the water. With the system of telemetry and implementation of the 1991 Water Accord in a transparent way would help in ensuing each of the provinces that construction of dams would not jeopardize their share of water;

- The dams also involve the displacement of the population and there could be problems of flooding and seepage. These need to be effectively tackled;
- Sustainable groundwater development and exploration of non-conventional sources including hill torrents, saline waters, drainage effluents, and sewage water, and optimal utilization of water through market mechanism; exploring latest irrigation technologies and management tools; regulating framework for groundwater use; pollution control and management; promoting saline agriculture; artificial recharge of depleting aquifers; watershed and river sediment management; improving drainage facilities; developing flood and drought management mechanism etc, would also go a long way in ensuring better water productivity;
- Through improvements of 68,500 watercourses, there will be water saving of about 6.8 MAF; and
- Granting of formal water access to the farmers will provide an incentive for conserving water and planning new investments, while allowing businesses to invest in activities that require assured access to water.

### **Bibliography**

1. Ahmad, S. (1990) Soil Salinity and Water Management: Keynote Address. Proceedings of the Indo-Pak Workshop on "Soil Salinity and Water Management", IWASRI, UNDP and PARC, Islamabad. Vol. II, p. 3-18.
2. Ahmad, Shahid, Amir Mohammad and Sardar Tariq Khan (2001), Country Report on "Water Resources of Pakistan", Paper presented in Workshop on Water Policy at Sandiago State University, Institute of World Peace.
3. Ashraf, M., W.D. Kemper, M. M. Chaudhary, B. Ahmad and T. Trout. (1977). Review of Watercourse Loss Measurement in Pakistan. MONA Reclamation Experimental Project, MONA, Bhalwal. Pub. No. 71.
4. Cool, John. (1977), "The Great Indus Food Machine" The Ford Foundation, Islamabad.

5. PARC-FAO (1982), Farm Water Management. Proceedings of Expert Consultation on Farm Water Management, Islamabad, Pakistan Agricultural Research Council and Food and Agriculture Organization of the United Nations.
6. PCST (2003), Report of National Committee on Water Resources Development and Management, Pakistan Council for Science and Technology.
7. Planning Commission (1978), The Report of the Indus Basin Research Assessment Group. Research Issues Affecting Agriculture Development Policy, Government of Pakistan, Islamabad.
8. Planning Commission (2005), Working Draft: Medium Term Development Framework, Planning Commission, Government of Pakistan. Islamabad.
9. Thobani, Mateen (1997), Formal Water Markets: Why, When, and How to Introduce Tradable Water Rights, The World Bank Research Observer, Vol. 12, No. 2.
10. Trout, J.T. and Kemper (1980), Watercourse Improvement manual. Water Management Technical Report No. 58, Colorado State University, Fort Collins, Colorado.
11. WAPDA (1979), Revised Action Programme. Master Planning and Review Division, WAPDA, Pakistan.
12. WAPDA (2004) Water Development Vision 2025. Water and Power Development Authority, Lahore.
13. World Bank (1993), Water Resources Management. A World Bank Policy Paper. Washington, D.C.

---

### **End Notes**

- <sup>1</sup> It needs to be underscored that countries with per capita water availability between 1,00 and 1,700 m<sup>3</sup> can be subject to frequent water stress and countries with per capita availability of below 1,000 m<sup>3</sup> experience chronic water stress [see PCST (2003)].
- <sup>2</sup> Drought had been so severe that the annual river flows have been less than the historical minimum of 118.5 billion cubic meters (BCM) since 1922.
- <sup>3</sup> No doubt, use of groundwater has increased significantly to offset the short surface supplies. While this gives more control to the farmers on the

---

availability of water at the required time, it has adversely affected the quality of soil. Almost 70% tubewells in the irrigated areas are now pumping sodic water.

- <sup>4</sup> Indus River provides 65% of total river flows, while the share of Jhelum and Chenab is 17 and 19% respectively.

### Author

*Dr. A R Kemal, is the Director of Pakistan Institute of Development Economics (PIDE). He holds Master's Degree from Stanford and a Doctorate from Manchester University. He has not only served the Government on many important positions, but has also contributed significantly on national and international economic issues, through his research work. He has been widely published in national and international journals and is quoted by other researchers.*

*He has been associated with Pakistan's premier economic research organization, the Pakistan Institute of Development Economics, in various capacities for more than two decades and has also taught economics at the Quaid-i-Azam and International Islamic University, Islamabad. He has held the position of Joint Economic Adviser, Member and Chief Economist at the Planning Commission.*