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The Need of Efficient Water Management in Pakistan

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Abstract

Water is a sign of life, all living beings need it to remain alive. It is natural commodity and three fourth of this planet is water. Still not all is suitable for human consumption and sufficient to meet the ever increasing demands. Availability and supply of water is getting scarce with increasing population of states especially the developing societies. If we look at the history of life on this planet, we find that the humanity has suffered disasters on acquisition and possession of natural resources which are vital for survival of one group, may be at the cost of others. Water falls in that category where if not properly managed its scarcity and stress would lead to unending conflicts and wars till demands equals the supply with the destruction of extra consumptions.

Solution to the disastrous situation is in efficient management of water. The efficient and effective management combines awareness and justified storage and distribution of water by the states within their domains. Modern technology and management provides solutions for this efficient management of water by the states.

Introduction

Pakistan is among those countries which are endowed by nature with abundant natural water resources. However, these resources are depleting at a fast pace due to internal and external politics as well as misuse and mismanagement of water. Climatic changes are also adversely impacting water resources. Since the last two decades, Pakistan is facing two extreme situations, floods or droughts especially in lower Sindh areas. Population is one factor but its management is rather more serious. It implies that in years to come, societies may fight and get destroyed over water disputes. It is a matter of supply and demand where we need research and focus quantitatively. It is estimated that the worldwide

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demand of water is increasing by 2 per cent per year and almost over 90 per cent drinkable water is being used for agriculture purpose.[1] One apparent solution is enhancing storage capacities but it has cost which developing societies like Pakistan can ill afford coupled with socio-political reasons.

Pakistan constructed Mangla and Tarbela dams as water storage sites decades ago and created elaborate headworks and canal systems basically for agriculture purpose. With the passage of time, storage capacity of these mega sites has reduced due to overflows of silt. The question is how to overcome the issue; through enhancing storage capacity or putting in place efficient management or both. Do we have sufficient water for human consumption in our big cities, in particular, and rural areas, in general? How we would manage the crises because absence of water means absence of life? These are the questions which haunt every rationale mind. This is the basic theme of this study: to see it in quantitative terms, the requirements of water, the shortfall we have in our system of management and suggest a solution based on new technologies and administrative options / techniques.

Literature review

Water being the basic necessity, as ever, has become a major global issue right at the outset of 21st century. Agriculture has transformed from low productivity to a high yield practices, thus consuming more water than ever before. Changes in life styles like urbanization, massive industrialization, unprecedented increase in population especially in developing countries and matching needs for growing more food have changed the awareness about water; instead of being a free gift of nature for human consumption, it has turned into an economic compulsion.[2] According to Asian Development Bank 'Pakistan is one of the most water-stressed countries in the world, not far from being classified as "water scarce" with less than 1,000 cubic meters per person per year'.[3] Water demand has exceeded manifold, which has caused maximum withdrawal from reservoirs. At present, Pakistan's storage capacity is limited to 30 days' supply, well below the recommended 1,000 days for

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1 Asia Development Bank, *Asian Development Outlook 2013*. Retrieved from Asain Development Bank: https://www.adb.org/sites/default/files/publication/30205/ado2013-pakistan.pdf

2 Dr. Sardar Riaz Ahmed, *Retrospect's of Pakistan's Agriculture,* Government of Punjab, Department of Agriculture, *Annual Report*, 2011-2012.

3 Asia Development Bank, *op.cit*.

countries with a similar climate.[4] Direct rainfall contributes less than 15 per cent of the water supplied to agriculture of Pakistan.

Being alive to the upcoming crisis, countries like USA, China, India, Russia and Turkey have increased their water storage capacity manifolds. In USA, for example, the storage capacity caters for 6000 cubic meters per individual and almost similar is the case for other countries mentioned above.[5] The natural capacity of Kalabagh dam, if materializes, is 6.1 million acre feet. However, it is not likely in the near future because of political reasons. Pakistan had a storage capacity of 15.74 million acre feet in 1976 which has been reduced to 12.10 million acre feet[6] due to excessive sediment inflows. It is expected that by 2025, our storage capacity would reduce to 6.27 million acre feet. The freshwater availability is being further declined due to exponential population growth. The looming threat of water scarcity is an issue that is not much talked about in Pakistani politics, and yet it constitutes one of the biggest challenges to our survival. With a projected population of 260 million in 2050,[7] Pakistan needs to put serious thought into how it will provide adequate water for agriculture, industry and human consumption. The Himalayan glacier, whose ice-melt replenishes the Indus river's annual freshwater, is receding by about one meter per year due to global warming. This phenomenon has had a staggering impact on Pakistan's water availability. In 1950, Pakistan had around 5,000 cusecs per capita per year of freshwater. Now it is less than 1,000 cubic meters. In the list of top 36 water stress countries, Pakistan stands at 31.[8]

The major consumption goes to irrigation where due to poor management, its wastage is about 50 - 60%. Wastage includes seepage, evaporation, poor distribution and theft. Since there is no system of water management or measurement, these figures are estimates of various studies. There is no centralized water resource database, so is realization

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4 Adnan Falak, 'A Future Without Water, Pakistan', 12 February 2014. https://nation.com.pk/12-Feb-2014/a-future-without-water

5 J.S. Thor Kerr, *Indian Ocean Futures: Communities, Sustainability and Security* (Cambridge: Scholars Publishing, 2016).

6 Adnan Falak, *op.cit*.

7 'Water, a shared responsibility', *The United Nations World Water Development Report 2*, 2006. Retrieved from http://unesdoc.unesco.org/images/0014/001444/144409E.pdf

8 Pakistan Council for Research in Water Resources (PCRWR), Water resources management – achievements and success stories of PCRWR, 2013. Retrieved from https://pecongress.org.pk/images/upload/books/4-(17-28)WATER20RESOURCES20MANAGEMENT20M.20A.20Malik20New.pdf

to comprehend the issue in quantifiable terms. Water logging, salinity, brackish groundwater and seawater intrusion are the constraints to agriculture sustainability and development in the lower Indus plain.[9] Another issue specific to all under developed and developing counties is huge generation of waste water. Its unsafe disposal and indiscriminate pumping results into water contamination, quantitative depletion and qualitative deterioration of groundwater. Therefore at places where we have excess water, it turns into salinity and at other points we face drought; water levels are so deep that even boring does not bring positive results.

Water sources – data of demand and supply

There are two major seasons of rainfall in Pakistan i.e. monsoons which brings about 70 per cent of annual rainfall from July to September every year. The catchment areas are basically Indus plains and some parts of Khyber Pakthunkhwa (KPK), southern Punjab and lower Sindh. The density of rainfall varies from 212 to 53 mm. In most part of Balochistan, especially its southern parts, the rainfall season is December to March. Apart from rainfall, God has His own system of water storage in solid state and that happens in the glaciated areas of Pakistan. It is about 13,680 square kilometres and on average 3 per cent of mountainous region of upper Indus basin and accounts for most of the river turnoff in summer. In the Karakoram range, total length of glaciers is 160 kilometres. Approximately 37 per cent of the Karakoram is under the glaciers, Himalayas has 17 per cent and rest about 22 per cent. Pakistan's five main rivers provide running storage of water as they act as tributaries to Indus and these include Jhelum, Chenab, Ravi, Beas and Sutlej. Other minor but significant rivers are Haro, Soan, Siran, Kunar, Punj, Kora, Gomal and Kurram.

The Indus system and its tributaries bring about 154 million acre feet of water annually. Three western rivers contain 144.91 million acre feet of water and eastern rivers 9.14 million acre feet. From total of this water, 104.73 million acre feet is utilized for irrigation, 39.4 million acre feet flows to sea and about 9.9 million acre feet is consumed by the system losses which include seepage, evaporation and spill during floods. The flow of the Indus rivers varies from year to year and within the year. The water of Indus basin rivers is diverted to main canals

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9 Pakistan Council for Research in Water (PCRWR). Satellite Based Monitoring of Groundwater Storage Variations Over Indus Basin. Islamabad: Ministry of Science and Technology, 2016. Retrieved from http://www.pcrwr.gov.pk/satellite/Current%20Synopsis.pdf

through reservoirs/ barrages. In addition to that we also consume ground water which is pumped throughout the year. In the last four years, availability of ground water has increased from 3 to 40 per cent of total water available at farm gate. The water is used for irrigation purposes and pumped through tube-wells. The total potential of groundwater in Pakistan is 55 million acre feet.[10] Pakistan's water needs can be categorised as those for agriculture (elaborated above), industrial and domestic uses. Being predominantly agrarian, irrigation consumes over 95 % of the total quantity available and contributes about 22% in our GDP.[11] This means that out of total available portable water, less than 5% is available for industrial and domestic use. Based on the data of year 2011 /2012, total water needs of Pakistan and its availability are as given below:

- Water available - 125.56 million acre feet
- Water required - 164.48 million acre feet
- Water Shortage - 38.92 million acre feet (31%)

Whereas the industrial sector meets its requirement adequately, clean drinking water is not available to the entire population of Pakistan. The drinkable water is not available in greater part of Sindh, Balochistan and southern Punjab. The population of Sindh and Balochistan, in particular, and some other parts of the country, in general, is dependent on rain water accumulated in natural and manmade ponds. The problem of drinkable water is compounded in cities where population has grown out of proportion to the availability of water like Karachi, Lahore, Faisalabad and Rawalpindi / Islamabad. The water requirements for various sectors of Pakistan are as given below:-

- Irrigation - 159.54 million acre feet
- Domestic uses - 3.82 million acre feet
- Industrial use - 1.1 million acre feet

Domestic and Industrial use is likely to increase to 12.1 million acre feet by 2025.

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10 S.R. Khan, *Crop Management in Pakistan: With Focus on Soil and Water. Punjab (Pakistan)* Government of the Punjab, Agriculture Department, 2014.

11 E. Naseer, December, 2013. *Pakistan's Water Crisis.* Superhead Research. Retrieved from https://www.waterinfo.net.pk/sites/default/files/knowledge/Pakistans20Water20Crisis20Special20Report20-20Part20120-20Spearhead20Research20-20December20,2013.pdf

Analysis of problem areas

In view of the ever increasing population and consequent pumping of ground water, there is a possibility of salt water intrusion into the underground water aquifer. This would give rise to soil salinity, the more serious threat to agriculture thus limiting crops production. The storage capacity of main dams has been reduced by 27 per cent. A report from Water and Power Development Authority, Government of Pakistan (2014) says that the live storage capacity is declining at the rate of 4.37 million acre feet over the past 10 years. The storage capacity will further drop considerably by the end of 2025. The construction of dams in Pakistan was initiated in 1955, when the country faced acute water shortage. When India stopped water supplies to water network of canals in Pakistan, it became imperative to build the canals structure and water storage dams. As a result with World Bank financial assistance, provided under the Indus Water Treaty concluded between India and Pakistan in 1960, Mangla and Tarbela dams were constructed with the capacity of 5.88 million acre feet and 11.62 million acre feet respectively.[12] Thereafter, hydro-politics came in and it blocked the road towards further construction of new dams.

As sea levels rise about 20-60 cm in Pakistan's coastal zone in the next 50 years, it will retransform the coastal physical setting and adversely impact underground water resources. At the same time, underground water has become unsafe either due to mixing of sewerage systems or seepage of toxic industrial waste in underground aquifers. On an average, about 39.4 million acre feet of water flows to the sea annually. During the last 25 years, a total flow of 984.75 million acre feet of river water has flowed into the sea. This is equivalent to more than 9 years of average canal withdrawals during the same period. Pakistan possesses a huge irrigation system having long canals, distributaries, minors and watercourses. Flat topography, porous soil and very long length of water channels leads to seepage of water into ground at an enormous scale. Average delivery efficiency is, therefore, from 35 to 40 per cent from the canal head to the root zone. The loss of such huge quantity of surface water not only reduces available water for crops, it also contributes to water logging and salinity. The canals system in Pakistan is operated on the basis of historic withdrawals. This leads to some of the systems receiving surplus supplies, while other face periodic

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12 M. Hassan, *Water Security in Pakistan: Issues and Challenges* (Islamabad: Maryah Printers, 2016). Retrieved from http://www.pk.undp.org/content/dam/pakistan/docs/DevelopmentPolicy/DAP20Volume3,20Issue420English.pdf

shortages. The incidents of tampering the outlets and breaches of irrigation channels adversely affect the performance of system. The monitoring and performance assessment remains a low profile activity. There are no incentives that could motivate the managers to improve their performance and undertake the necessary measures. One of the main reasons for system deterioration is the deferred maintenance due to consistent shortfall in funding which threatens the operational integrity of the irrigation system.

New thoughts on improving water management

Modern irrigation and water management is basically for better crop yields, allowing farmers to grow additional crops each year while saving the water globally. Effective water management requires planning, developing, distributing and managing optimum and efficient use of available water resources. The first step is water storage which is often associated with dams. Dams are just one means of storage, it must be considered as both surface and sub-surface storage. Surface storage includes natural wetlands and reservoirs and subsurface storage consists of groundwater aquifers and soil water storage that can be accessed by plant roots, tanks, and ponds. Storage makes more water available by capturing water when it is plentiful and making it available for use when there are shortages. Water recharge is the link between surface and groundwater storage. Canals and reservoirs now provide opportunities to recharge groundwater and to act as a buffer between water supply and demand for irrigation. Canal irrigation is synonymous with surface flooding basins, borders and furrows. On a world scale this is the most dominant irrigation technology. 95 per cent of irrigation still relies on surface flooding, most of the remaining 5 per cent is sprinkler irrigation and a small percentage uses trickle methods. This balance is unlikely to change in the next 50-100 years, particularly in Pakistan. For this reason, technologies that seek to improve canal irrigation should have a high priority. The extensive canal networks cannot be easily abandoned and replaced with small pump schemes. The challenge is to find ways of using existing canal systems by making it as responsive as groundwater irrigation. Canals are difficult to manage hydraulically, and in many systems tail-enders suffer from lack of water because those at the head tend to take more than their share to the detriment of those at the tail end. This is the classic ‘Top-Ender, Tail-Ender’ problem. In the Indian state of Maharashtra, a water user association installed pipelines to replace canals in order to distribute water from tertiary canals and to ensure a more equitable share of water. In another scheme, farmers have invested in a storage tank which distributes water through specially designed equal discharge pipelines. Indeed pipelines, although initially more costly to build than canals, can offer much better control over water supplies, making the system more responsive to farmers demands.

Most domestic and industrial water is not consumed; rather it is used and returned to the catchment either directly discharging into rivers or seeping into groundwater. When discharged into the sea or into the desert, it is beyond economic recovery. Wastewater is a resource that can be re-used, particularly for agriculture. In most European countries wastewater, suitably treated to a high standard, is regularly discharged into rivers where it is diluted within the main flow, then re-used downstream by households, industry, agriculture and the environment. In the Syrian Arab Republic, 67 per cent of sewerage effluent is reused; in Egypt, 79 per cent; and in Israel, 67 per cent, mostly for irrigation and for environmental purposes. Egypt's water strategy for 2017, which shows more water being used than is available from the country's water allocation from the Nile River, suggests that this entire amount of water reuse is already accounted for in Egypt's water balance. Large cities use treated wastewater in local fruit, vegetable, dairy and poultry markets. In Mexico, for instance, approximately 25 per cent of municipal wastewater is reused to irrigate 300, 000 hectares of land. Wastewater requires treatment to avoid health risks even when the crops are not directly consumed. Municipal wastewater comes mainly from cities and larger towns where there is a high concentration of people and industry, which may make it feasible and economically viable to invest in the required infrastructure. Also the timing of wastewater availability does not coincide with agricultural water demand; therefore some means of water storage is essential if all the water is to be effectively used.

Desalination is a process that removes salt from saline water to produce fresh water. Desalination processes have evolved significantly over the past 30 years and this has led to the general acceptance of two main technologies, thermal and membrane, which together account for almost 98 per cent of the world's current desalination operating capacity. Desalination is used mainly for drinking water and for industry. Estimates suggest that less than 10 per cent of desalinated water is used for irrigation and this is mostly in Spain where desalination is heavily subsidised. Both processes are energy intensive and produce good quality water. There are also concerns about the water being too pure and lacking micro-nutrients for irrigation. Planners and policy makers still look at desalination as a 'silver-bullet' solution to water shortages.

Sprinkler irrigation is one of the four basic methods of irrigating the crops. A sprinkler throws water through the air to simulate rainfall whereas the other three irrigation methods apply water directly to the soil, either on or below the surface. In certain areas of Pakistan, fresh groundwater is available at a depth of 10 to 12 meters and soils are light textured. The portable rain gun sprinkler system is highly suitable in such areas. The system is quite simple and it is indigenous. Sprinkler irrigation is the best method to use on lands that have steep slopes or are undulating and irregular in shape especially with shallow soil which cannot be levelled or whose water intake rate is very small. Similarly drip plantation is a method of applying water directly to plants through a number of low flow rate outlets placed at required intervals. Specially designed trickles supply water to individual plants or to a row of plants from these points. Unlike sprinkler or surface irrigation, only soil near the plant is watered rather than the entire area. Trickle irrigation has been generally found feasible in the more arid regions for irrigating high value crops, such as; fruits and nut trees, grapes, sugarcane, flowers and vegetables. It is, however, not yet well adapted to field crops. Drip irrigation can be a great aid to the efficient use of water. A well-designed drip irrigation system practically loses no water to runoff, deep percolation, or evaporation. Irrigation scheduling can be precisely managed to meet crop demands, holding the promise of increased crop yields and quality. Through this system water used is often less than 50 per cent as compared to that used by the conventional method or surface irrigation.

One of the modern way of irrigation is through flexible gated pipes which is much suitable for plants / crops in rows. It uses Poly-Ethylene (PE) pipes of 6 to 20 inches diameter fixed with sliding outlets for controlling water flow. This system is much more suitable for sandy area crops where it is difficult to construct water channels. It is simple to operate as it just needs opening and closing of outlets and much larger area can be irrigated with limited amount of water. This Irrigation system occupies much lesser area than watercourses and helps in efficient transfer of water from one point to other in less time without any conveyance losses due to deep percolation and evaporation. Similarly roof top harvesting is a new technology which uses the roof tops of residential, commercial and industrial buildings in many countries of the world to meet the declining groundwater requirements for domestic and industrial purposes as rain water is the only fresh water alternative. The system comprises of roof top rainwater collection and recycling device. The system has been made mandatory in many Indian cities to reduce ground water exploitation. Even the annual requirements of Indian president's palace are met from its roof top water harvesting and recycling. Nevertheless, the roof top water harvesting technology is now expanding in the US, Cyprus, and many other countries of the world to meet their domestic, agricultural, lawn, fish pond requirements and groundwater recharge. In Pakistan, this technology has selectively been employed especially in earthquake hit areas. One of the reports from 'Earthquake Rehabilitation Regulatory Authority (ERRA) says that rainwater harvesting project has been completed in 20 union councils of earthquake affected districts and installed 40,000 systems.[13] The prime objective was to lessen miseries of womenfolk whose precious time was consumed for fetching water from the meadows.[14]

Surge or pulse irrigation is the cyclic application of water in contrast to continuous water application. In surging, irrigation is completed through a series of pulses of water onto the field. Potential benefits of using surge rather than continuous irrigation include faster water advance, a reduction in the total volume of water required for irrigation, and less irrigation times. Another thinking on water improvement is to increase rainfall through weather modification i.e. cloud seeding. It is basically converting water vapours contained in clouds into rain. Operating costs of cloud seeding are relatively low, and the capital equipment is neither excessively costly nor specialized to a single use or area. Artificial glacier melting is another technique of meeting requirement under extreme drought conditions. Artificial melting of glaciers has been successfully experimented in USA and Russia.[15]

Our canals and watercourses are porous in nature, seepage through which causes a great loss of water and also raises salinity of soil. It is, therefore, important to brick line the canals and water courses under a viable program. Due to excessive seepage soil salinity occurs which is a major threat to crop production in arid and semi-arid areas worldwide. In Pakistan alone, salt affected soils occur on more than 6 million hectors and over 70 per cent of the ground-water wells in saline areas are pumping out brackish water. As a result, the areas are now subjected to degradation and desertification. Numerous efforts have been made for profitable use of the saline areas and water resources in Pakistan. Bio-saline Agriculture Technology (BAT) has been developed, demonstrated on a larger area and delivered to the end-users (farmers). This is a low input technology and is employed for developing sustainable farming

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13 *The Nation*, 24 November 2014.

14 J.S. Thor Kerr, *op.cit.*

15 The Arid West—Where Water Is Scarce - Desalination—a Growing Watersupply Source. (n.d.). Libraryindex. Retrieved from https://www.libraryindex.com/pages/2644/Arid-West-Where-Water-Scarce-DESALINATION-GROWING-WATERSUPPLY-SOURCE.html

systems involving agro forestry and livestock. To demonstrate the feasibility of BAT in areas facing salinity problem, the first Bio-Saline Research Station (BSRS-I) was established near Lahore. Soon, it will start giving better results.

The drinking water has become an issue not only for urban areas also but for rural areas. Urban and rural areas both have their own distinct characteristics and dynamics. Similarly with respect to the availability of water in urban and rural areas again there are two issues: non availability of water at the consumer end and availability of water but in polluted form. Both the areas and their problems need separate approaches. Our urban areas have grown out of proportion to the availability of services especially the supply of fresh water. Even within the cosmopolitan cities like Karachi, Lahore, Islamabad, Faisalabad, Peshawar, Quetta, Hyderabad and Multan there are certain pockets which are over populated as compared to adjacent colonies. To manage water supply to such a large population, all put together at one place, is a gigantic task which needs enormous resources and effective management and administration. Their maintenance is even difficult through heavy traffic and population especially in narrow streets and apartments. Secondly we do not have distinction between drinking water and the water required for gardening / vegetation. Water supply system is the same from where consumers take water for drinking, bathing / washing as well as for gardening. Whereas water requirements of both the categories are different, but our supply system is the same. In this way, we waste precious drinkable water for washing and vegetation. Furthermore to the wastage of fresh drinkable water, we do not have the accountability mechanism of water consumption. With negligible water tax our consumer has unlimited supply of water at his disposal according to his status / approach to the concerned departments. In the same colony or street one may find people without water even for drinking purpose and certain privileged ones having overflowing water in excess to their lawns and gardens.[16]

The big cities like Karachi, Lahore, Faisalabad, Hyderabad, Peshawar, Quetta and Rawalpindi – Islamabad have become unmanageable under the management cum administration of a district. Since at this stage it is not possible to undo their sizes, there is the need to do two things: First, stop their further growth and organize the existing population to make it manageable. Second, divide these cities into distinct manageable units which should be autonomous and accountable

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[16] Dr. Bashir Ahmad, *Socio-Psychological Complexities of Pakistan* (Karachi: Pakistan Publishing House, 2014).

for the availability of essential services including water. Management of water should be devolved to the level of district government / administration under self-sustenance mechanism. There is again the need to get out of the mindset of free water supply. It should be a community based transparent water supply system where one has to pay for the quantity of water he desires to consume. The culture of free supply of water even to the government departments should be stopped forthwith. Rather all government offices be authorized certain scales for which the money should actually be paid to the district water management authority. The system would work effectively only when the district water management authorities would offer two types of connections to the consumer i.e. one, water connection for drinking, cooking, bathing, washing and second for gardening, vegetation, cleaning the toilets etcetera. Both the water supply connections would have different rates for payment of water service charges. The consumer would be billed at the end of every month according to his usage of water. At the same time we would need to improve the water supply system including repair of the water supply lines to reduce wastage. Improvement of services through an efficient management mechanism would encourage the consumers to pay for the water services.

Our rural areas have also expanded over larger areas with new settlements particularly of those who migrate from village to towns in search of livelihood. Wherever they find a suitable place, get settled, may it the river bed or under a bridge. Thereafter these settlements start growing in sizes and turn into villages and towns. Most of the settlements and villages are washed away by the floods whenever flooding takes place especially those constructed in the river beds and low lying areas. There are basically two issues with the availability of water in rural areas. One, increase in population, exerting more demands of water supplies and shrinking water sources closer to populated areas. Second, over pumping has lowered the water table in certain areas and now it is getting deeper and deeper, making it almost impossible to get more water even with better technologies. The water available on the surface of the earth is either the rain water accumulated in natural and manmade ponds or river water which flows in various canals. None is drinkable till the time it is cleaned and made it useable. Under this category, we have different kinds of rural areas. In rural areas of Punjab baring some parts of southern Punjab and Khyber Pakhtunkhwa sufficient quantity of underground drinking water is available. Therefore here the problem is how to extract the water and subsequently make its supply to the consumer’s end. Its implication is the requirements of pumping motors and water supply lines. In terms of expenditures it is not an expensive issue. It requires only the division of areas into manageable units and provision of underground fresh water to the consumers. In order to conserve the underground resource of fresh water, its pumping by the individual consumers needs to be stopped. It should rather be organized on area basis under the community based government mechanism as that of urban areas.

We have more pronounced problem of water scarcity in most of the rural areas of Sindh and Balochistan, where underground drinkable water is seldom available. In parts of Sindh, especially adjoining areas of Arabian Sea, the underground water is available but it is brackish. In its desert part, the underground drinkable water is not available at the extractable depths. In both the cases, canal / rain water is required to be stored in ponds, clean it to make it drinkable and then supply to the population scattered over larger areas in the form of hutments and villages. In Balochistan, the situation is different, here the groundwater is mostly not available therefore majority of the population is dependent on natural springs and underground water tunnels known as *Karez*. Here also, the solution lies in developing the water sources and handing them over to the community based water management mechanism or administration to maintain it on self-sustaining principles. In underdeveloped areas like most part of Balochistan, the water supply has to be subsidized to make it affordable to the population. The solution is not cost prohibitive, it is affordable and requires only management. However, it should not be free in any case otherwise no supply system can sustain for long.

Construction of new mega dams has been contentious issue over the last many years. This is the reason that after late 60s, there has been no worthwhile breakthrough in construction of new mega dams. At the same time, the bigger dams have become cost prohibitive especially initial investment and large scale rehabilitation is required. The solution lies in having smaller dams in suitable areas all over the country. Even the sites already planned for mega dams like Kalabagh may require to be redesigned for lesser capacity dams so as to avoid large scale resettlement. River bed transit storage capacity can be enhanced by selecting suitable sites at appropriate distances in our existing rivers, where less effort is required to raise the banks and create water storage capacity. The main idea behind is to hold some water in the river bed by constructing auto-overflowing spillways according to the capacity of its banks. In this way we would be able to hold the water at certain levels and, thereafter, it would automatically flow over the spillways. Its benefits would be one, at all times, some water shall always be available in the river for grazing animals as well as for vegetation or plantation;

second, during dry spells, the water may be released to meet requirements downstream and third, anticipating (forecasted) rains, the storage ponds may be emptied to hold upcoming more water and regulate it as required. This means that in flood like situations we will have all our rivers holding water as per their designed capacities of banks and spillways. With this storage, we would be able to divert excess water to other areas through safety valves canals especially designed and constructed for the purpose. Construction of safety valves canals provides a solution to the flood waters in monsoons when water becomes surplus and beyond the capacity of our rivers and barrages.

Safety valve canals are suggested to be constructed in relation with the construction of transit storage spillways as explained above. In case of excess water in flood like situations, the safety valve canals would lead water to the dry river beds like Sutlej and Ravi which remain dry most of times even when there is high flood situation in other three rivers. Secondly these canals would also take the excess water to dry parts of the country like southern Punjab, some parts of Sindh and Balochistan. The idea behind is that why not to take this excess water to the dry and desert areas of the country where there is always shortage of water instead of throwing it into the sea. Unfortunately during the floods of 2010, when some parts of the country especially in Sindh and Balochistan were worst hit by the floods, the other parts were facing acute shortage of water. This happened in Sindh on 5 September 2010, when Dadu and Thatta were under water, three farmers set themselves to fire as protest for non-supply of irrigation water in Sukkur. The safety valve canals would not only control the flood waters, also provide life to the barren and water scarcity parts of the country.

Diagram showing auto-spillover structure in river

This diagram is shown on the next page. Mass public awareness about water management is essentially required to take the people along with the campaign at the government levels. The most effective instruments are television and radio for the general, comparatively less educated, population and print media focusing on the educated segment of the society. Awareness and motivation at the national level is one aspect of the issue, the other segment of the campaign is equally important and that pertains to making the masses realize that through their contribution they pay for the services they avail. What has been observed in our mass public perception is that they become careful when they know that whatever one consumes, he would require paying for that, may it be a very small amount. Mere motivation does not work as free services do not convey severity of the issue.

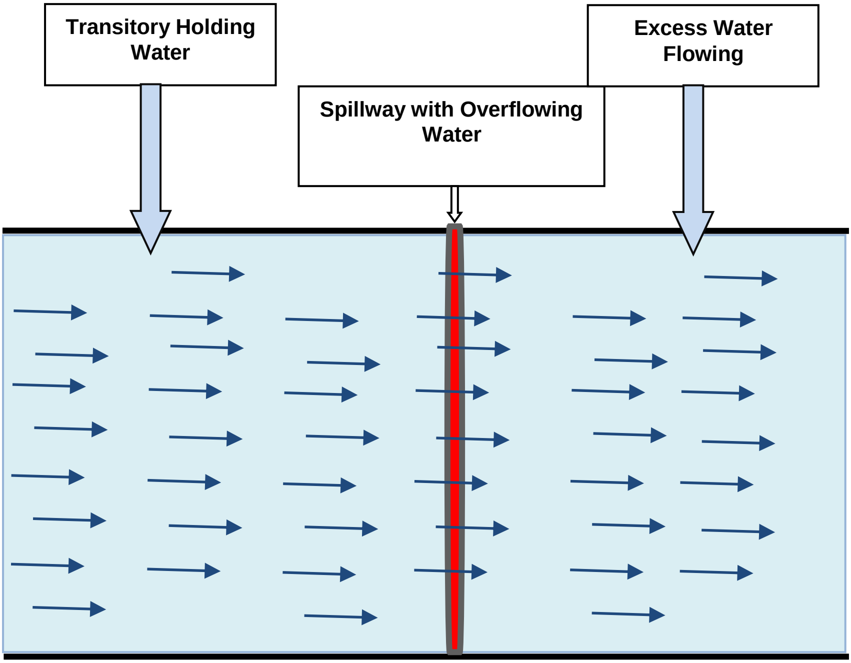

Figure-1: Straight Part of a River with Flowing Water as shown with Arrows

Proposed model of water management

Outline Model of Water Management in Pakistan

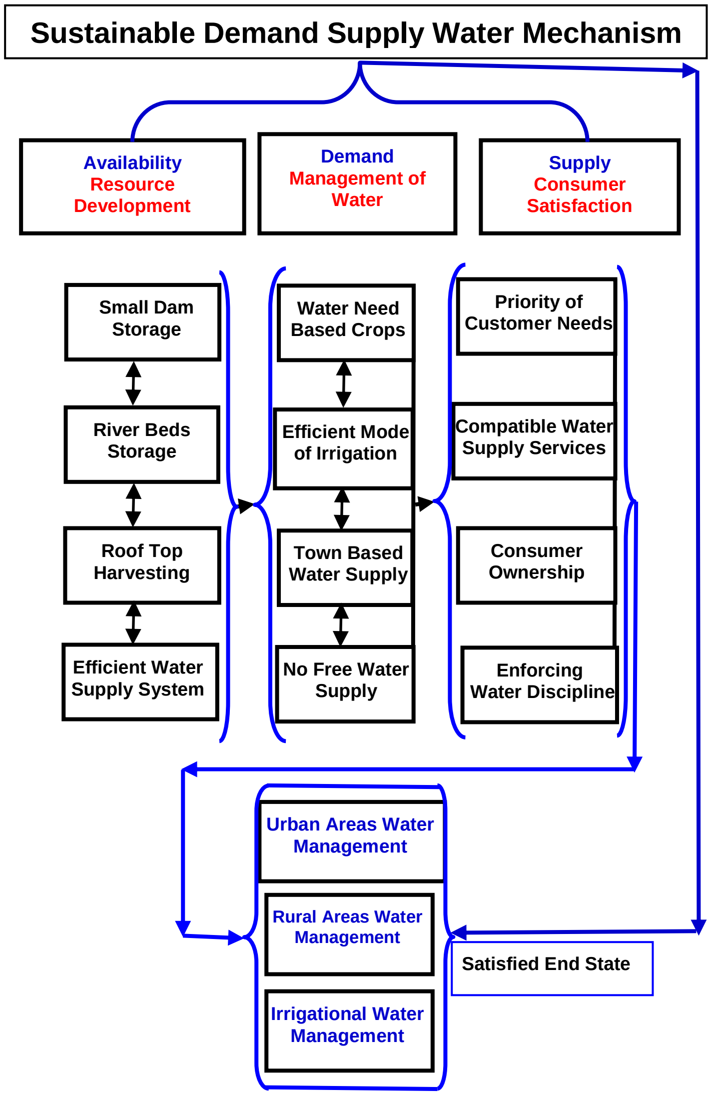

Figure 2: Outline Model of Water Management in Pakistan

Conclusion

Water resources are depleting the world over. In the case of Pakistan problems are more severe due to fast pace of population growth. Before it becomes too late, we need to create awareness among the people like civilized societies. We become careless about a commodity when it is free. Water management needs rationing on payment of price. This is how we can stop it diminishing at an alarming rate. Hydro-politics would continue, we need to find out the solutions without hurting socio-political sensitivities. That is possible with superior strategic management through use of appropriate technologies and awareness amongst citizens.