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ROLE OF BARANI AREAS IN MITIGATION OF WATER CRISIS IN PAKISTAN

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ABSTRACT

Water is a precious resource and is becoming scarce with time as the population is increasing at a faster rate. Due to climatic changes, the mismatch of rainfall with the existing cropping pattern has further aggravated this problem. In Pakistan Agricultural is main water using sector, the domestic and other demands are negligible. With current rate of population increase, the country will run short of 33 and 86 MAF of water by the year 2013 and 2025 as has been projected by the experts. To overcome these deficits there is a need to create awareness among the end users. There are long term strategies on country level which include large storage for which there are no substitutes/alternate and new schemes need to be prioritized on national level. In addition to these there are many short-term measures which if acted upon will result in water savings. In Irrigated areas the different options include use of marginal quality tubewell water in conjunction with surface water supplies, application of safe industrial effluents to crops, application of high bicarbonate water after amending with gypsum/sulfuric acid and adoption of new cultural technologies to minimize the use of water for crops.

Water resourced in barani areas of the country can also play an effective role in mitigation of water crisis if properly managed. Rain water harvesting, water conservation, and new irrigation techniques such as drip and sprinkler irrigation will have to be adopted. This paper discusses site specific measures for optimizing the exiting quantum of water for irrigated and Barani areas in the country.

INTRODUCTION

Water is very precious resource and is becoming scarce with time as the population is growing at a faster rare. The increasing population needs more food and fiber for which more water for domestic, agriculture and industrial use will be required. Each demand is quite variable and has its own significance but the quantity of water required for domestic and industrial purpose is negligible as compared to agriculture demand. Pakistan's primary water resource is the Indus river and its tributaries and under the Indus Water Treaty (IWT) 1960, depends on three Western Rivers (Indus, Jhelum and Chenab) and the mean annual inflow is about 172 billions cubic meters (BCM) (106 MAF) and taking into account the estimated conveyance losses @ 50%, net field deliveries are 61 BCM (53 MAF). This water is not enough to meet the crop water requirement of the irrigated areas of the Indus Basin, which have been estimated to be 16.2 million hectare (MH) or 40 million acre (MA) out of total cultivated area of 21.4 MH (52.8 MA). Thus the available water is 2.5-acre foot (AF) per cropped acre whereas the crop consumptive use has been estimated to be 4.5 AF.

The projected water demand (Irrigated and non-irrigated) have been estimated to be 215 and 271 MAF for the year 2013 and 2025 respectively and is shown in table-1 (Afzal, 1997; Kohlown and Majeed 2002). The ground water availability in these years will be 42 and 45 MAF respectively. Thus Pakistan will run short of 33 and 86 MAF water in 2013 and 2025 respectively (table-2). To overcome this water deficiency, there is a need to adopt different strategies in irrigated and non-irrigated areas of the country. There are some long term strategies on country level which include larger storage for which there are no substitutes and new schemes need to be prioritized on national level, but still there are many short term measures which if acted upon will result in water savings.

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Table No. 1 DOMESTIC AND AGRICULTURE DEMAND

Year	2000*	2013**	2025*
Population	140	207	260
Domestic Water (MAF)	5.2	8.7	9.7
Agriculture (MAF)	188.3	206.4	261.1
Total	193.5	215.1	270.8

Table No. 2 WATER AVAILABILITY IN PAKISTAN

Surface Water	140	140	140
Ground Water	38	42	45
Total	178	182	185
Water Shortfall (MAF)	15.5	33.0	85.8

(Source: *Afzal, 1997 ** Kohlown and Majeed, 2002)

Table No. 3 EFFECT OF DIFFERENT QUALITY WATERS ON BIOLOGICAL AND GRAIN AND YIELD OF WHEAT

Treatment	Biological Yield (t ha-1	Grain Yield (t ha-1)
Canal	4.05 ± 0.5	1.69 ± 0.25
Tubewell	1.49 ± 0.2	0.55 ± 0.06
Blend	1.99 ± .01	0.82 ± 0.09
Alternate	2.12 ± 0.2	0.89 ± 0.03

(Source: Lone, 1995)

MANAGEMENT STRATEGIES FOR IRRIGATED AREAS

In irrigated areas, different water management strategies which of course are site specific and depend on many factors such as soil, climate, availability of both surface and ground water resources and genetic potential of crop species etc can be adopted. In areas where marginal ground water along surface water is available, it has been shown experimentally (table-3) that the alternate use of surface and ground water can be practiced for moderately salt tolerant crop like wheat (Lone, 1995) and good crop yields can be obtained. Whereas the water high in bicarbonate content needs to be treated with gypsum or sulfuric acid and experimentally very sound results have been achieved.

In addition to the ground water, the irrigated areas are also rich in industries and according to Saleemi (1993) these industries are discharging 9000 million gallons day effluents into water bodies. A survey work has shown that all the effluents which are coming out are not hazardous but variable in quality (Lone et al. 1999). It has been found that the effluents which are coming out of paper and Board Mill and Food industry are useable and do not deteriorate the soil quality (table 4 & 5).

Improving the exiting methods of irrigation from border to furrow will also help in saving the water. Most of the crops including wheat can be sown on ridges which would save about 30% to 40% of water with zero tillage (Hafizullah, 2002).

Table No. 4 POLLUTION LOAD SUBSTANCE (mg1-^{1}) IN DIFFERENT INDUSTRIAL EFFLUENTS IN LAHORE

Name of Industry	TSS (mg1-^{1})	PH	SAR	RSC (m mol 1-^{1})	Cu	Cd	Zn	Pb	Mn	Fe	Al	Ni	Cr
Papers & Board Mills	900	8.0	6.7	-	0.03	0.01	0.06	0.2	0.02	0.36	0.4	0.08	0.03
Fertilizer Industry	1534	8.8	10.2	-	0.03	0.01	0.06	0.02	0.02	0.03	0.4	0.08	0.03
Leather Industry	3650	7.2	-	-	0.03	0.01	0.09	0.02	0.06	0.23	0.4	0.08	0.02
Chemicals Industry	44160	10.0	41.7	6.0	0.1	-	0.1	3.0	0.2	1.45	-	1.7	-
Ravi Rayon Industry	2912	8.2	6.0	15.5	0.01	-	0.04	2.0	0.8	1.0	-	0.2	-
Nabil Industry	4851	12.2	3.85	-	0.01	-	0.04	1.8	0.07	0.2	-	0.2	-

Table No. 5 POLLUTION LOAD AND TOXIC SUBSTANCE (mg1-^{1}) IN DIFFERENT INDUSTRIAL EFFLUENTS IN KARACHI

Name of Industry	TSS (mg1-^{1})	PH	CO mg/1)	BOD (Kg/d)	Cu	Cd	Zn	Ni	Mann	Pb
Ahmad Food Industry	218	6.0	1778	7.7	0.430	0.028	-	0.270	0.073	0.230
Burma Oil Mills	1160	7.6	4296	4210	0.027	0.027	2.187	0.648	0.217	0.480
Adamjee Textile Mills	1390	10.3	5530	340	0.020	0.045	5.320	0.514	0.085	-
Karachi Tannery	1140	4.1	6784	26	0.300	0.153	7.000	1.142	0.440	1.800
Indus Alkalies	3560	9.2	2235	-	0.138	0.028	0.220	1.180	0.258	0.660
Buxley Paints	8.0	2.1	8080	-	0.065	0.940	0.480	0.203	0.073	3.880
Karachi Shipyard	286	2.1	30	-	0.280	0.100	1342.5	0.740	5.300	11.750
Javedan Cement Indus	7740	6.3	54	-	0.330	0.330	2.660	1.000	5.130	0.790
Recom. Max. Conc.	-	-	-	-	0.200	0.010	2.00	2.000	0.200	5.000

MANAGEMENT STRATEGIES FOR BARANI AREAS

The Barani area in Pakistan varies from uninhabited high mountains and deserts to densely inhabited and intensively farmed areas. Generally, however, the area is sparsely populated and poorly developed, although lot of water and power development potentials exits. Large areas of agricultural land, Pothwar Plateau, the west of Indus regions and large undeveloped areas in the interior Baluchistan and Makran coastal areas constitute valuable resources that need to be investigated.

The Punjab Barani Tract spreads over an area of 18 million acres in one contiguous block and comprises the districts of Attock, Rawalpindi, Jhelum and Chakwal and part of Sialkot, Gujrat, Sargodha, Jhang, Mianwali, Muzaffargarh and DG Khan. The tract exhibits a wide range of physical and climatic conditions based purely on rainfall, topography and principal soil types.

The Pothwar upland commonly called the Pothwar Plateau, lies to the south of northern mountains and is flanked on the west by river Indus and on the east by river Jhelum. This plateau is 400 Km long and about 129 Km wide, and has a semi arid landscape with denuded and broken terrain characterized by undulations and irregularities. There are a few out lying spurs of Salt Range in the south and Kala Chitta range in the north (Bhutta, 1999). The Pothwar Plateau consists of Sub-mountainous region with severely eroded soils. Two thirds of the total land surface is being affected by erosion annually. Twelve to thirty thousand hectares of land are being lost annually due to sheet and rill erosion (Cheema, 1999). The sediment in Soan, Kanshi, Kahan, Bunha streams ranges from 6100 to 8600 m3 per year (Shafiq et al., 1996). This situation is aggravated by human manipulation like bringing more land under cultivation, ill planned construction on cultivated land and construction of other social amenities like school, roads and hospitals. Delay action/mini/small dams are the only possible solution of soil erosions problems and reduction of the sediments being thrown in main irrigation systems.

The mean annual rainfall varies from 1500 mm in the northeast to around 500 mm in the extreme southwest of the Plateau. Nearly 70% of this rainfall occurs from April to September (Shafiq et al., 1996). The total amount of rainfall received in the region is considered enough for crop production. However, temporal distribution and sequence does not match with crop demand. This deficiency can be over come by water conservation, storage and rainwater harvesting techniques.

Total run off water in Pothwar has been estimated at 3.5 MAF (Bhutta, 1999), which if captured cannot be transferred to the main irrigation system, yet is has its own benefits on main irrigation system directly or indirectly. The direct benefits could be its contribution in total national production of different crops which at presently ranges between 10-23% of different crops (Khan, 1988). Indirectly it will improve the overall recharge in the area which ultimately will travel to the main basin due to natural flow from north to south, from where it will be pumped out with tubewells.

There are four major different ways of storing water viz. in the soil profile, in underground aquifers, in small reservoirs, and a large storage reservoirs behind large dams. Storage in the soil profile is extremely important for crop production, but it is relatively short-term storage. Small reservoirs have the advantage of being operationally efficient. They are flexible, close to the point of use and require relatively few parties for management. The options of large resviors are beyond the scope of this study. The only viable option in Pothwar Plateau is small storage.

The option of small storage could be in the form of mini dams with storage capacity of 3-15 acre feet (AF) maximum up to 25 AF, small dams with storage capacity of above 25 to 10,000 AF (Asharf et al, 1999). This option has been implemented and giving its fruits. However, the real potential has not been exploited yet, which if exploited could contribute its share in real quantity in national production. According to Punjab Barani Commission Report there are more than 400 sites for small dams and about 8000 sites for mini dams (Anonymous, 1976).

Table No. 6 EXISTING & POTENTIAL SURFACE STORAGE IN POTHWAR

EXISTING SOURCES				POTENTIAL		
Source	No.	C.C.A	Live Storage AF	No.	C.C.A	Live Storage AF
Mini Dams	405	945	1452	8000	37600	57280
Small Dams	30	35269	42349	400	470252	564552

These existing and potential resources (table 6) will contribute in terms of recharge to ground aquifer. Heavy evaporation from large area (live storage) will be helpful in bringing more rains in the area which will ultimately benefit the main irrigation system. Besides the development of these potential sources; still there is a large scope for further expansion of more small surface storages. After the completion of small storage over the entire plateau the establishment of a net work of these small reservoirs could be studied and if feasible may be implemented.

The major constraint of the barani areas is the water shortage. Rainfall is the most critical element in the barani environments. Without it the crops wilt, and yields are decreased. Although the total rainfall in many areas is adequate for crop production, the seasonal pattern of precipitation often is not conducive to plant growth. Variability and irregularity of rains brings uncertain and intermittent water supplies to crops. Periodic droughts bring about reduction of grazing, livestock mortality and untold misery to human beings. Intermittent and periodic dry spell affects are being mitigated by small-scale site-specific interventions. These small scale interventions such as dugwells, ponds, sprinker and drip irrigation are giving their fruits (table 7). If these interventions are spread over whole the barani tract, they could bring positive change in agriculture and overall livelihood of the masses.

Table No. 7 SMALL SCALE INTERVENTIONS IN POTHWAR

INTERVENTIONS	UNIT	AREA IRRIGATED (ACRES)
Dugwells	1140	5631.6
Ponds	1015	7528.6
Sprinker	149	736.0
Drip	53	130.9
Conveyance Network	163	2013.1

Source: Project Management Unit, ABAD - Rawalpindi.

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