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Conjunctive Water Use and Management for Minor Perennial Irrigation Schemes in Balochistan – Key Issues and Revised Strategy for Investment

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1. Introduction of the Study

Despite availability of large tract of lands in the province constituting 43% of country's geographical area, the cultivated land is hardly 5.6% of the provincial geographical area. Out of this, two-third is irrigated largely due to shortage of water. Water resources of Balochistan can be broadly classified into two categories: a) Indus basin canal supplies; and b) water resources outside the Indus basin. The perennial sources of water outside the Indus basin mainly comprise of groundwater (springs, karezes, tubewells and dugwells) and minor perennial surface water resources. Most of the perennial streams and springs in the province are having smaller stream sizes with wide temporal variations. Two hypothesis identified for the study were: a) whether the inefficient use of water in the Minor Perennial Irrigation Schemes (MPISs) has generated shallow groundwater which can be used for improving adequacy and reliability of surface water supplies; and b) whether conjunctive water use and management in the MPISs can help to fulfill the requirements of water during droughts. ***The overall objective and purpose of the study was to assess the potential of shallow groundwater and to formulate a strategy and action plan for the conjunctive water use and management in the MPISs.***

2. Characterization of MPISs

Secondary data of MPISs were collected from the Irrigation and Power Department (IPD), which include: name, location, year of completion, number of share holders, discharge and command area of the scheme. Out of 469 existing MPISs, data of 294 schemes were used because of limited availability of required information (**Table 1**). Out of 294 schemes, 37% have discharge ≤0.028 m^3/s (1.0 cfs), 26% schemes have discharge ranging 0.029 to 0.057 m^3/s (1.0 to 2.0 cfs), whereas 31% schemes have discharge ranging 0.058 to 0.28 m^3/s (2 to 10 cfs). Only 6% schemes have discharge of >0.28 m^3/s (>10 cfs; **Table 2**).

Table 1. District-wise distribution of existing MPISs in Balochistan

District	MPISs	District	MPISs	District	MPISs	District	MPISs
Awaran	3	**Qilla Saifullah**	19	**Loralai**	76	**Kachhi**	7
Ziarat	23	**Qilla Abdullah**	21	**Les Bela**	3	**Jhal Magsi**	3
Zhob	71	**Pishin**	25	**Kohlu**	11	**Dera Bugti**	2
Turbat	23	**Panjghoor**	27	**Khuzdar**	31	**Chaman**	3
Sibi	53	**Musa Khel**	5	**Kharan**	3	**Chaghi**	3
Quetta	10	**Mastung**	15	**Kalat**	17	**Bolan**	15
Total							**469**

Table 2. Distribution of MPISs in Balochistan based on discharge

Discharge Range		Number of Schemes	Percent of total
(m^3/s)	(cfs)		
0.003 - 0.028	**0.1-1.0**	109	37.1
0.029 - 0.057	**1.1-2.0**	76	25.9
0.058 – 0.085	**2.1-3.0**	24	8.2
0.086 – 0.113	**3.1-4.0**	28	9.5
0.114 – 0.142	**4.1-5.0**	18	6.1
0.143 – 0.283	**5.1-10.0**	21	7.1
0.284 – 1.133	**10.1-40.0**	18	6.1
Total		**294**	**100**

Distribution of MPISs based on command area indicated that 28.6% schemes are having command area of < 41 ha. Around 31% schemes are having command area ranging 41 to 81 ha. Whereas 12.6% schemes are having

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command area ranging 82 to 120 ha. Around 21.4% schemes are having command area ranging 121 to 400 ha. Only 6.4% schemes have command area of > 400 ha (**Table 3**).

Table 3. Distribution of MPISs based on the command area in Balochistan

Command Area (ha)	Number of Schemes	Percent of Schemes
0.5 – 40.5	84	28.6
41 – 81	91	31.0
82 – 120	37	12.6
121 – 160	20	6.8
161 – 200	16	5.4
201 – 240	10	3.4
241 – 280	7	2.4
281 – 400	10	3.4
401 – 14160	19	6.4
Total	**294**	**100**

3. Performance of MPISs – Interactive Focus Group Dialogues

3.1. Water Distribution, Allocation and Marketing in MPISs

The water distribution in MPISs has generally been agreed among the water shareholders. The Warabandi schedule varies from 7 to 32 days in different MPISs. During the periods of low flows, duration of Warabandi schedule is normally increased. Each shareholder knows about time and duration of his turn. In some schemes, water share varies from year to year. Water scheduling is not systematic and losses are increased due to elongated nature of the commands. Informal arrangements exist, whereby several downstream users decide to irrigate their land and divide the initial infiltration losses among themselves, while wetting the dry channel. Shareholders have also adopted number of strategies to overcome the shortage of water. Exchange of water shares, in particular between the seasons, is practiced. A person will give up his water entitlement in the Rabi season in return for another person's share in the Kharif season, when orchards are being irrigated.

Water is sold in 4 out of 17 selected schemes. Water shares are leased on seasonal basis. This is a clear indication that water markets are in practice in the MPISs and on an average price of water is Rs. 750/hr of water share in the Kharif season. This is reasonably low value of water share in the MPIS having higher discharges (>0.057 m^3/sec) compared to the groundwater markets prevailing in the province. Apart from the annual varying shares, the Warabandi schedule is of about 30 days for most of the schemes which is very long and not suitable for cultivation of vegetables or orchards. This clearly indicates the need to abstract groundwater to have flexibility required to grow orchards and vegetables.

3.2. Water Conveyance and Application in MPISs

Water conveyance losses usually occur in main and field channels. Headworks or water intakes often operate poorly. Some of the structures have completed the end of their useful life. Others are inadequately designed and some are partially completed. There is a considerable scope to increase irrigation supplies through rehabilitation or expanding the capacity of these schemes. Around 84% length of main channel in selected schemes has been lined. Seven schemes out of 17 have completely lined main channels. Only 11% length of the field channels has been lined in the selected schemes. Field application efficiency depends upon leveling of fields and method of irrigation used. Data indicated that no scheme has precisely leveled fields, whereas 53% schemes have fairly leveled fields and 47% have poorly leveled fields.

There is a large potential of saving water through improvement of main and field channels and leveling of fields. It will have direct impact on improving water productivity in the MPISs. Water allowance varies 0.40 to 1.75 m^3/s per 1000 ha, except the two schemes solely run on groundwater (Kareze or springs; **Figure 1**). ***The surface water allowance of most of the schemes is quite high resulting in considerable losses of water confirming the hypothesis of the study that "improved water management will help to bring more area under command".***

3.3. O&M of the MPISs

Communities are responsible for the O&M of the MPISs. Each shareholder knows about time and duration of his turn. Generally, there is a loose informal organization dealing with O&M. Field visits indicated that repair of weir off-takes, pipe conduit, road culverts, super-passage, diversion structures, conveyance and field channels is required. The initiative of O&M is taken by the village elders. One person is appointed to organize the labour, but he receives no compensation. Occasionally money is collected for hiring tractor, but this is not done on regular basis. The repair of intake and Kareze is a collective task; the responsibility of channel cleaning is segmented, with each person taking care of the channel passing through his land. Under this system, coordination of the work is problematic, since upstream water users may start cleaning after the downstream users. Channel cleaning is done 3-4 times a year. Sometimes the donation for maintenance is also given by the local politician from development funds.

The irrigation system is currently maintained by community initiatives as well as with the assistance of the government. Labour and cash contributions for maintenance are assessed in proportion to an individual's share of water. When someone is unable to attend the channel cleaning operation, he/she will pay in cash the expenses of labour. The total amount devoted to irrigation system maintenance is modest in most of the cases. The repair and maintenance of structures have been neglected. In some schemes government appointed *Beldars* for routine cleaning of the channel. These *Beldars* ought to be accountable to community organizations in order to improve water management. In the long-run community organizations need to be strengthened for better O&M of the MPISs.

Among the selected schemes, around 14 schemes have poorly maintained main channels and 3 schemes are fairly maintained. Similarly, 15 selected schemes have fairly maintained field channels and 2 have poorly maintained field channels as farmers are having full ownership of the field channels.

3.4. Current Use of Shallow and Deep Groundwater in MPISs

The study revealed that MPISs of Kan Mehterzai, Let Gat, Zandara and Kawas have more than 300 wells. The MPISs of PUI, Loni and Sazoo have minimum number of wells. Out of 17 schemes, 10 are having more than 25 wells. Currently, the groundwater is extensively used in 25% of the schemes having 300-430 wells (**Figure 2**).

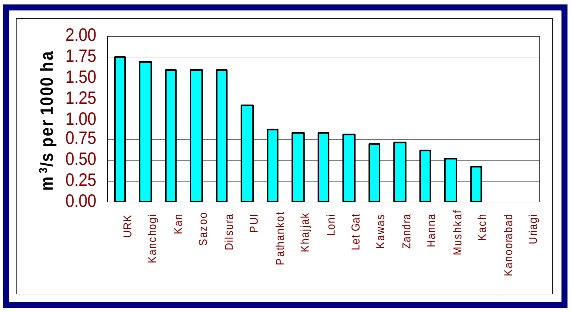

Figure 1. Water allowance of selected MPISs

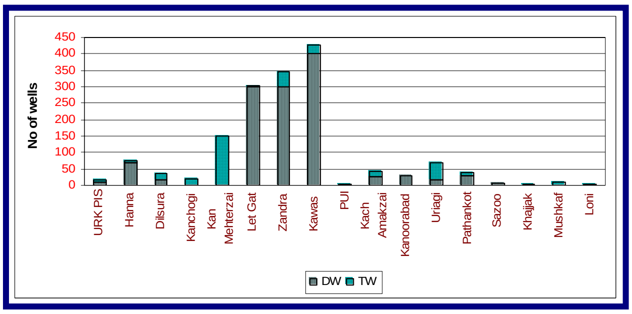

Figure 2. Number of wells in selected MPISs

The climate of Balochistan is largely temperate dominated with winter rainfall. Thus, surface water available in most of the MPISs is during the Rabi season. This is evident from the fact that pumping of shallow groundwater during the Rabi season was observed in only three schemes located at Kanoorabad, Pathankot and Sazoo (**Figure 3**). Pumping of deep groundwater during Rabi is only in two schemes of Uriagai and Pathankot (**Figure 4**). The annual abstraction of groundwater <15 million m^3 having higher abstraction of groundwater in some schemes resulted in wastage of water (**Figure 5**).

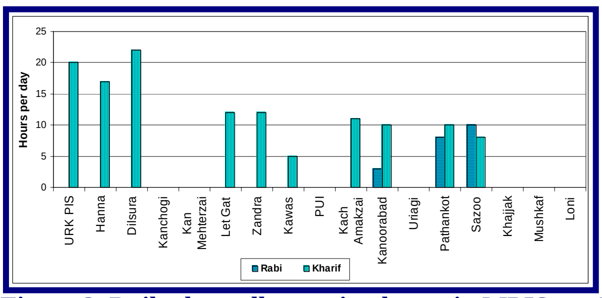

Figure 3. Daily dugwell pumping hours in MPISs

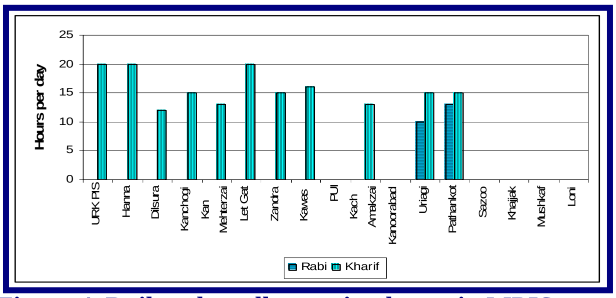

Figure 4. Daily tubewell pumping hours in MPISs

3.5. Productivity of MPISs

Fruits and vegetables are grown in the MPISs. Apple fruit yield varies from 14.2 to 51.4 tons/ha. Potato yield varies from 2.7 to 44.5 tons/ha. Value of production per irrigation is highest for apple and lowest for wheat. Despite the exchange of water shares and the conjunctive water use, the present economic utilization of water is sub-optimal in many of the MPISs.

3.6. Sustainability of MPISs

Poverty targeting has been effectively addressed by developing and renovating MPISs. Valuable community assets have also been created. Farmers' Organizations (FOs) have been formed to maintain the infrastructure under different projects but they require longer-term support for capacity building. Some of the studies revealed that the FOs may collapse. At the same time there are stronger traits of FOs, such as conflict-resolution and fund raising for O&M, indicating that they can perform in a sustainable manner. There current organization might be in a different form than of the proposed FO structure, but they do provide enough resources for the O&M of the schemes. Many MPISs are being maintained without government support and are producing attractive economic and social returns. Nonetheless, the government certainly has a role to continue with the institutional support to FOs that aims at further building of their capacity.

Groundwater is a common resource. Its development and management depends upon interest groups that benefit from it. The groundwater resource is threatened by the existing and new users. Social differentiation needs to be mentioned as well as it always involves the risk of the resource being monopolized by elite, excluding the original users. Another problem of groundwater management is lack of knowledge, both of the sustainable potentials and the behavior of users. In established regimes, experience has indicated some kind of sustainable levels of exploitation. For new areas, knowledge of recharge potential is lacking and unfortunately the limits will only be discovered by trial and error. In many schemes the groundwater has already been exploited in a modest degree without rules and rights being in place: faced with the discontinuous development and the risk of its depletion. In Zadra Scheme water table has been almost maintained during the past 40 years, whereas in Kan Mehterzai, it has been dropped from 15 to 76 m during the past 40 years (**Figure 6**).

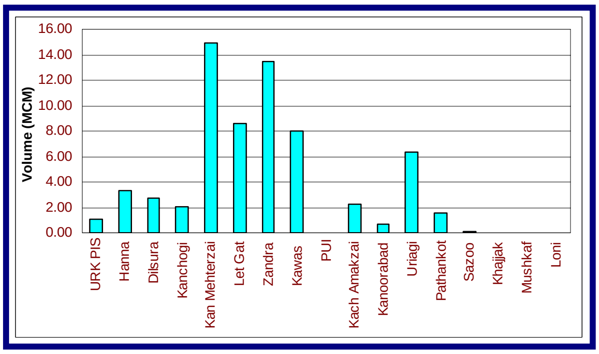

Figure 5. Annual groundwater abstraction in MPISs

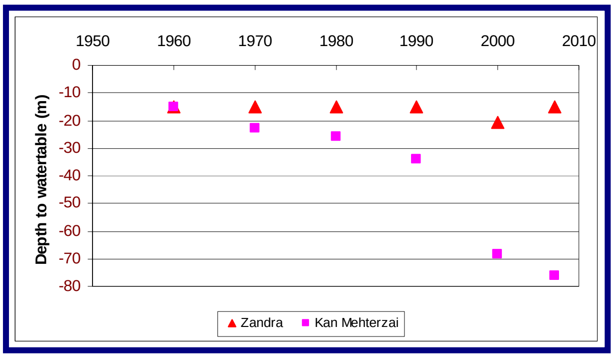

Figure 6. Temporal variations in depth to water-table in MPIS

During floods of 2007, the water table has been raised in many MPISs but in some of the schemes the effect was insignificant. The rate of lowering of water table in the selected schemes varies from 0.60 to 10.66 m/year (**Figure 7**). Farmers are of the opinion that groundwater use is sustainable in 10 MPISs and in the rest of the 7 schemes they feel it is not sustainable.

4. Potential of Shallow Groundwater in the MPISs

Uriagi scheme depends solely on groundwater. Kanchogi scheme depends equally on both the surface- and groundwater. PUI has no groundwater supply for irrigation and entirely depends upon surface water. It is clear that farmers are already practicing conjunctive water use in most of the schemes, but the present use of shallow groundwater is not sustainable (**Figure 8**).

The groundwater abstraction is more than the recharge. In addition water conveyance system and field application are in-efficient in most of the MPISs resulting in low water productivity. Dugwells are normally constructed to abstract shallow groundwater. If yield of aquifer is low, the use of shallow groundwater will be

limited by restricting the abstraction. Number of dugwells were increased in the MPISs from 6 in 1960's to 606 during 2007 almost 100 times increase in number of dugwells (Figure 9).

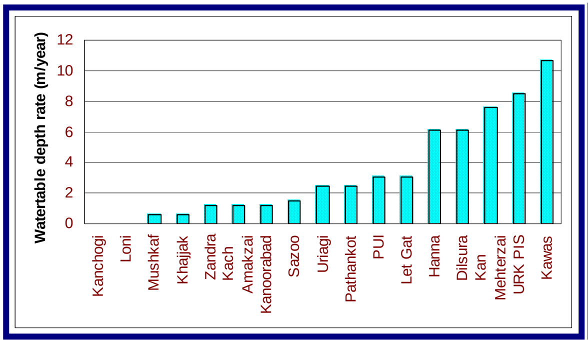

Figure 7. Rate of lowering of water table in MPISs

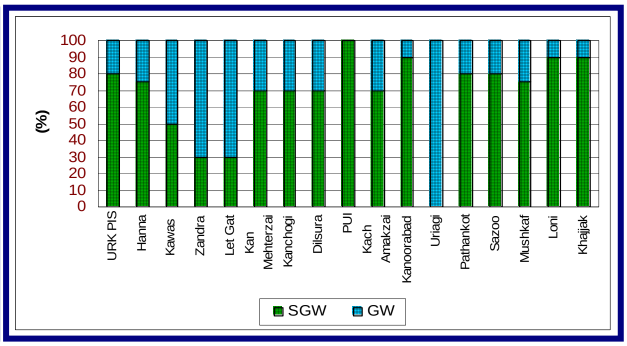

Figure 8. Dependence of MPISs on surface- and groundwater in the MPISs

The abstraction of shallow groundwater was computed by multiplying number of dugwells with utilization factor and discharge (**Figure 10).** Annual usage of shallow groundwater of Zandra and Let Gat schemes is > 8 million m^3. There is no annual usage of shallow groundwater in the seven selected schemes. One of the main reasons for non-availability of shallow groundwater is pumpage by tubewells. When deep and shallow wells are working in the same aquifer, the shallow well will become dry with the passage of time. Second reason is lack of effective recharge.

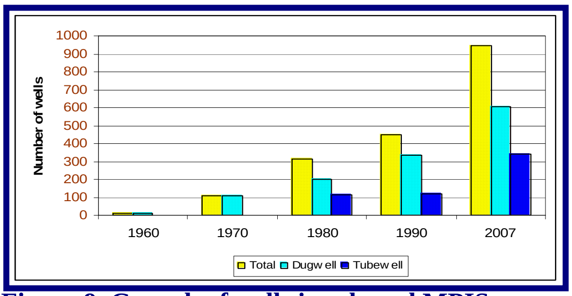

Figure 9. Growth of wells in selected MPISs

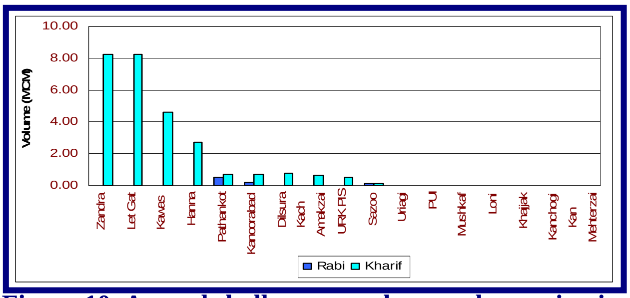

Figure 10. Annual shallow groundwater abstraction in selected MPISs

4.1. Current Groundwater Balance in MPISs

Recharge components include rainfall, seepage from conveyance and field channels and deep percolation from the fields. Abstraction component of groundwater is based on dugwells and tubewells. A simple water balance method was used to estimate groundwater potential which indicated that in half of the schemes abstraction of groundwater exceeds the recharge (**Table 4)**.

Table 4. Groundwater Balance of Selected MPIS in Balochistan

No.	Schemes	Recharge (acre feet)			Discharge	Balance		
		Irrigation	Rainfall	Total	(acre feet)	(acre feet)	(ft)	(m)
1	URK	3199	6.6	3206	905	2301	5.8	1.754
2	Hanna	1066	7.4	1073	2709	-1635	-3.6	-1.108
3	Kawas	400	5.7	406	6496	-6090	-17.4	-5.305
4	Zandra	613	4.3	617	10878	-10261	-39.2	-
5	Let Gat	666	3.5	670	6942	-6272	-29.0	-8.853
6	Kan Mehterzai	1066	5.7	1072	12087	-11015	-31.5	-9.595
7	Kanchogi	1066	4.1	1070	1674	-604	-2.4	-0.739
8	Dilsura	666	2.2	669	2250	-1581	-12.0	-3.652
9	PUI	2666	9.8	2676	0	2676	4.5	1.369
10	Kach Amakzai	800	8.2	808	1801	-993	-2.0	-0.606
11	Kanoorabad	0	5.7	5.7	558	-552	-1.6	-0.481
12	Uriagi	0	12.8	12.8	5114	-5101	-6.5	-1.989
13	Pathankot	5332	26.2	5358	1302	4056	2.5	0.773

14	Sazoo	1813	3.6	1816	89	1727	7.9	2.394
15	Mushkaf	5332	44.3	5376	0	5376	2.0	0.607
16	Loni	4265	16.4	4282	0	4282	4.3	1.305
17	Khajjak	7065	34.7	7099	0	7099	3.4	1.024

4.2. Potential of Shallow Groundwater

Groundwater is now available in the MPISs mainly due to continuous recharge of many years from irrigation and rainfall but the quantities are limited because of smaller commands. However, with the passage of time the recharge will increase if the abstractions are sustainable. The depth of aquifer is different for different schemes. The strata between depth to water table and ground surface represents the un-saturated zone. The strata between depth to water table and total depth of aquifer represents saturated zone (**Figure 11**).

Kach Amakzai has maximum depth of aquifer and Kan Mehterzai has no shallow aquifer. The groundwater is stored in the pores of stratum of aquifer. If the volume of saturated zone of aquifer is multiplied by porosity it gives volume of actual available shallow groundwater. The porosity of each scheme will differ and these values are also not available. An average porosity of 0.15 was used for computing volume of water in the aquifer. Depth of aquifer is multiplied by porosity of 0.15 to estimate the volume of water in each of the scheme (**Figure 12**). This varies from 0 to 0.062 million m^3 of water. Based on the availability of shallow groundwater, the schemes can be categorized into three groups: a) low water availability of ≤0.015 million m^3 of water per ha; b) medium water availability of 0.015 to 0.030 million m^3 of water per ha; and c) high water availability of >0.030 million m^3 of water per ha (**Figure 13**).

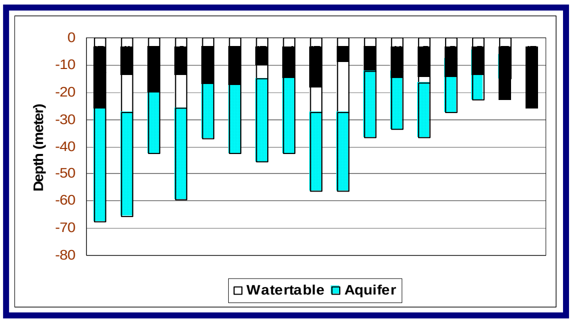

Figure 11. Available shallow groundwater in selected MPISs

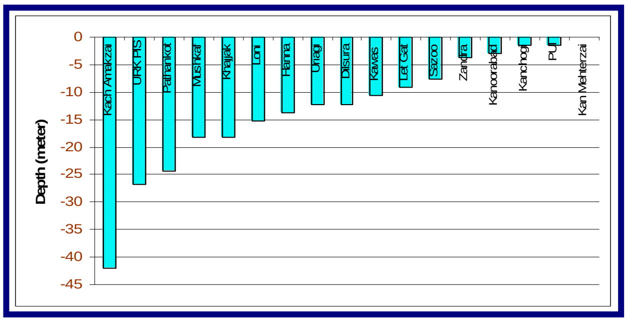

Figure 12. Net Depth of available shallow groundwater in selected MPISs

5. Current State of Conjunctive Water Use and Management

The main sources of water are precipitation, canal and groundwater (shallow and deep). Precipitation is used for agriculture whereas snowfall is stored for short periods, which recharge the aquifer and produce streamflows. Floodwater is also used for Spate irrigation without any planning and management of groundwater, although these schemes could help to increase recharge of aquifer. Similarly, deep and shallow groundwater is used with surface water but it is not integrated with Spate irrigation schemes.

Government provides subsidy on electric tariff for agricultural tubewells, which has encouraged farmers to abstract more water from deep aquifer. Therefore, aquifer in many parts of the province is rapidly depleting due to over abstraction. Despite that the groundwater is still a most dependable source of irrigation water in the province.

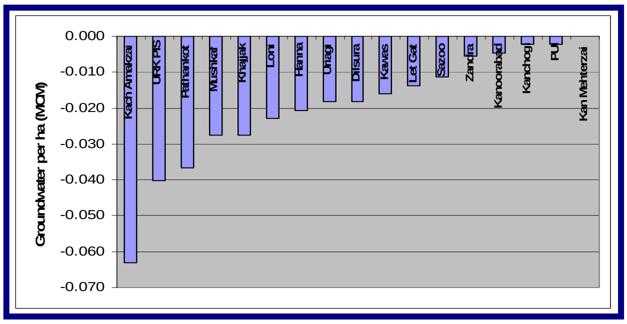

Figure 13. Net shallow groundwater in MPISs

Shallow groundwater is available in many of the MPISs. It is abstracted by using: a) dugwells; and b) shallow or deep tubewells. In the areas where all the three options are used for pumping groundwater, the dugwells got dry first and followed by the shallow tubewells. Resource-poor farmers can only afford cheap and simple technology for groundwater abstraction – dugwells or shallow tubewells. Past studies have revealed that 15% of small farmers have already been deprived from groundwater because it is below the reach of dugwells and shallow tubewells.

Realizing the gravity of the problem, the IPD has introduced delay action dams for recharging the groundwater. During the last few decades the department has constructed around 300 delay-action dams. However, the most significant impediment in recharging groundwater with delay action dams is the accumulation of sediments in the reservoir bed resulting in reduced infiltration and subsequently the reduced recharge to the aquifer.

Subsidy issue should be addressed considering the sustainability of the groundwater use. There is also a need to build capacity of farmers and mass awareness to educate them for the sustainable use of shallow groundwater.

6. Building Sustainable Strategy for Conjunctive Water Use and Management

6.1. Options for Conjunctive Water Use and Management

The options for conjunctive water use and management were evaluated considering the current state of Minor Perennial Irrigation Schemes in Balochistan and are listed as under:

- ***Integrating MPISs with Spate Irrigation, Storage Dams and Groundwater Recharge:*** Assign higher priority for recharging the aquifer by developing Spate irrigation and storage dams for expanding the Sailaba farming in the province of Balochistan because floodwater represents around two-third of the total water resources available in the province and currently 80% of the floodwater is wasted or drained to the Indus river or the Arabian Sea in an average year;
- ***Integrating Use of Shallow Groundwater with High Efficiency Irrigation Systems:*** Encourage abstraction of groundwater using dugwells and shallow tubewells during drought periods to sustain agricultural productivity by imposing limits for safe abstraction of deep groundwater. The abstracted groundwater must be used through high efficiency irrigation systems;
- ***Improving Performance of MPISs through:*** a) introduce systematic programmes for improvement of water conveyance system by reducing the operational losses; and b) introduce technologies and arrange demonstrations for improvement of water application systems at the farm level; and
- ***Adjusting Crops and Cropping Pattern with Water Availability:*** Adjust crops and cropping patterns with water availability in the MPISs through conjunctive use of water for raising high value crops including the use of plastic-tunnels for off-season vegetables.

6.2. Key Issues

The key issues related to the introduction of conjunctive water use and management strategy in the Minor Perennial Irrigation Schemes in Balochistan are:

- ***Technical***: a) low irrigation efficiency and unreliability of flows (low and high) result in higher abstractions of groundwater; b) lack of reliable data of water availability and use at the MPISs level; and c) inadequate or in-appropriate design of MPISs results in reduced supplies during droughts and flood damages during wet years.
- ***Social***: a) socio-political set-up of the province (tribal system, low literacy rate and extreme poverty) and recent experiences of partial devolution pose some concerns for sustainable development of MPISs; and b) lack of awareness and education.
- ***Institutional***: a) inadequate participation of beneficiaries; b) lack of monitoring and evaluation of the MPISs; c) ineffective coordination between irrigation and agriculture departments; and d) inadequate and deferred O&M of the MPISs.
- ***Managerial:*** low water productivity due to excessive losses of water and low crop yields.

6.3. Strategic Objectives

The strategic objectives to improve livelihood of farmers living in the MPIS are:

- Sustainable use of groundwater especially during the droughts through conjunctive water use and management;
- Improved performance of MPISs through adequate and efficient O&M; and.
- Increase in water productivity by improving water use efficiency and enhanced crop yields.

6.4. Strategy for Conjunctive Water Use and Management

The strategy for conjunctive water use and management for the Minor Perennial Irrigation Schemes is presented as under:

- Expansion of existing MPISs through conjunctive use of surface and groundwater for expanding the command area with an objective to generate new sources of livelihood and to enhance groundwater recharge through diversion of Spate flows;
- Storage of excess surface water supplies in ponds, reservoirs and dams for multiple uses including irrigation during the dry spells and droughts and recharging the groundwater.
- Rehabilitation of MPISs through: a) replacement of ineffective headworks or intake structures in MPISs; b) improvement of water conveyance channels; and c) improvement of water application at the field level through precision land leveling, adoption of efficient irrigation methods and training of farmers.
- Introduction of innovative recharge options where recharge potential within the command area is limited using: a) spreading channel (alluvial area); b) recharge pits (alluvial area); c) recharge ponds or percolation ponds (alluvial area); d) percolation tanks (hard rock); and e) check dams.
- Effective implementation of Groundwater Rights Administration Ordinance 1978 to enforce licensing of surface and groundwater.
- Enforce participatory scheme development, management, O&M processes considering conjunctive use of water using all sources of water.
- Initiate action research to implement the participatory scheme development and management process within the context of conjunctive use of water.

7. Way Forward – Action Plan for Implementing the CWU Strategy

Investment projects are needed for the development of MPISs in Balochistan with special emphasis on conjunctive water use and management with the following components:

- ***Building the Resources*****:** The potential sites identified for MPISs and for shallow groundwater use should be developed for generating new livelihoods in the province using all sources of water.
- ***Recharging the Groundwater during Floods***: The experts of climate change have consensus that in arid environments of Balochistan, the extremes are going to be more severe - droughts and floods. The province has experienced persistent drought during 1998-2006 and severe floods during 2007. Strategy is needed to manage the floods considering floodwater as an opportunity for arid environments of Balochistan. The real solution lies in an integrated approach including: a) Watershed management to reduce and delay flood peaks and extend the duration of flood flows; b) Storage of excess water for availability during dry spells for multiple uses of water; c) Further development of minor perennial and non-perennial irrigation schemes for expanding the command area to generate new livelihoods and to enhance the groundwater recharge; d) Although government has already been constructing the delay action dams for this purpose but with very little success. The Indian experience can be helpful for recharging the aquifer by using options like spreading channels (alluvial area), recharge pits (alluvial area), recharge ponds or percolation ponds (alluvial area), percolation tanks (hard rock) and check dams; and e) Initiate action research for development of innovative groundwater recharge interventions which are cost effective and suit well to the arid environments.
- ***Reduce Mining of Groundwater in MPISs*****:** In the MPISs, deep tubewells should be discouraged and phased out by introducing the shallow dugwell technology. The subsidy on electric tariff for deep tubewells should also be phased out in the MPISs. It can be initiated by implementing the Groundwater Ordinance 1978 in letter and spirit.
- ***Enhance Harnessing of Shallow Groundwater*****:** Utilization of groundwater resources has to be cost-effective and sustainable. In Balochistan excessive groundwater exploitation has resulted in rapid decline of water table by deep tubewells which are mining the aquifer. Deep tubewells are costly and are not cost-effective for resource-poor farmers as around 15 % farmers in Balochistan have already lost access to groundwater. Development of groundwater in the MPISs should be limited to the potential recharge in these schemes. In the future projects, dugwells and shallow tubewells should be encouraged and installation of deep tubewells may be restricted in the MPISs to sustain the groundwater resources.
- ***Improve Irrigation Efficiency through***: a) improvement of intake/diversion structures; b) improvement and lining of conveyance channels; c) land leveling; d) sprinkler, drip and furrow

irrigation systems; and e) mulching for reducing soil evaporation losses.

- ***Demand Management***: With all the possible water developments it will not be possible to match the ever increasing demand. Therefore demand has to be managed through: a) introducing low water requirement crops like barley, oilseeds, pulses, etc.; b) introducing vegetables of short duration and fruits like Olive, Pistachio, Almond, etc.; and c) development of Sailaba and Khushkaba farming systems.
- ***Water Conservation***: Plowing of fields before and after the rainfall helps to store moisture in the root zone, which can be extracted by drought tolerant cultivars. Mulching for vegetables and gardens can reduce soil surface evaporation losses.
- ***Financial Sustainability***: At present, MPISs are not sustainable. Many structures are broken and channels are in deteriorating state. Participatory approach should be encouraged for introducing collection of Abiana by the FOs to have financial sustainability of the organization.
- ***Monitoring of MPISs***: Build regular monitoring program for improving performance of the MPISs.
- ***O&M of MPISs***: Build capacity of FOs for effective O&M of the MPISs.
- ***Institutional Setup and Capacity Building***: An institutional set up for the MPISs should be established in which IPD and users should be properly represented. In some schemes, FOs were established but sufficient follow up was missing. As a result, these are not very active. It is important that a regular capacity building programme for the FOs should be initiated so that the strategy and action plan are implemented effectively.

The Policy Briefings is a Series of Issues, which will be prepared and circulated to the policy and decision makers in the province of Balochistan and in other provinces of the Country with an objective to synthesize and disseminate the studies outputs under the TA-4560 (PAK).

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Reference: *Javaid, I. and S. Ahmad. 2008. Conjunctive Water Use and Management for Minor Perennial Irrigation Schemes in Balochistan – Key Issues and Revised Strategy for Investment. Vol. (4), No. (6), TA-4560 (PAK), Quetta, Pakistan.*

The topic to be addressed in the next Issue of Policy Briefings is "Re-assessment of Water Resources Availability and Use for the Major River Basins of Balochistan – Major Findings, Policy Issues and Reforms". The topic includes: a) Need for Reassessment of Water Resources; b) Methodology for Reassessment of Water Resources; c) Reassessed Water Resources at Basin Level; d) Water Use; and e) Policy Issues and Reforms.