Guide Book
on
Spate Irrigation in Pakistan

Spate Irrigation Network Pakistan

IFAD
Enabling the rural poor
to overcome poverty

META Research

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Contents

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Allah Bakhsh Baloch
Coordinator Pakistan Spate Irrigation Network

Forward

Spate Irrigation is neglected in the course of mainstream development at federal, provincial level and at donor level. Larger majority of planners in some of the provinces line departments and donor's community are unaware of the issues of the farmers in spate irrigation communities of Pakistan. The people living in spate irrigation areas are poorest of the poor with comparison to the conventional agricultural ecological zones of various provinces where agricultural returns make them well off. The services structures and public amenities are poor in spate regions throughout all provinces of Pakistan. Such areas are tribal and semi-tribal in nature where internal rivalries and in-equitable land holdings further aggravate the socioeconomic conditions.

This is first kind of Publication that carry the inside scope of the spate irrigation, land distribution patterns and gender issues prevailing in the system. The information given in this guide books consists on more personal and field experiences rather than an academic research. We confess at the time of this first publication that information given are not sufficient to the desired level, for example, Climate Change is becoming precedent to the shifting weather conditions in Pakistan and hence it would affect spate ecological zones in the country as well. Unexpected unseasonal flash floods are another reason for causing damages to the human settlements and change in rivers morphologies. Both paradigms are not discussed in this guide book.

Spate Information on districts Tank, Banu, Kohat, Laki Marwart and Karak in KPK, Mianwali in Punjab and Thar desert in Sindh are not given in this book due to none availability of credible information.

Spate irrigation is under researched issue in Pakistan and hence information related to it. We assure to our valuable readers that if time permitted, we shall improve the information level in our second additions of this document. Readers, experts, field researchers from all provinces are requested to share the added information, pictures, and research papers on spate irrigation for next publication. Please share your information at (kaisarani@gmail.com).
For more information on Pakistan spate irrigation please visit our web site www.spate-irrigation.org

HANDBOOK CUM INVESTMENT GUIDE ON PAKISTAN SPATE IRRIGATION

I Introduction and Historical Perspective

Spate irrigation is ancient form of irrigation that can be traced back in 3000 years BC. It uses seasonal floods for irrigation. Floods are diverted to embanked fields of 0.8-30 acres in size depending on the soil and topography of area. It is found in the Middle East, North Africa, West Asia, East Africa and parts of Latin America and Central Asia. This is the last resort of irrigation if other collapse for any reason. New era has found more modern techniques with advent of technology where perennial and fresh flows of waters have intensified the irrigation with modern technology and research. If the conventional irrigation systems that depends on technological input faces strike by natural or manmade disaster, the spate irrigation systems would still be working efficiently since they are defined on the century old knowledge and techniques which is possessed by farmers depending on such system.

Figure 1 Farmers Building Diversion in Eritrea

Figure 2 Farmers Building Diversion in Rajanpur Pakistan

Pakistan is comparatively the largest country in the world that is practicing spate irrigation. In Africa, spate irrigation is now emerging as a mean of livelihood, because of the increasing population. Traditionally, North-Eastern African countries have a pastoralist economy. Irrigation came up in last century due to migration of neighboring country traders for example Yamani migration to Eritria (Abraham Mahrihali el).

Spate irrigation is found in many parts of Iran that is illustrated by different terminologies used in different parts of the country to describe it. *Darband,* check dams made of dry masonry are called *khooshãb* or *bãgh* in northern Iranian Balochistan and *bandsar* in Khorasan, northeast Iran.

Diverting floods water from ephemeral streams and spreading it in relatively flat land that is known

Figure 3 Ancient Bundat at Mehergarh Balochistan Pic: Jamali

as *dagar* in southern Balochistan; *ta, goudtak, taghal* and *gaband* in the Izadkhast Plain, Darab and southeast Iran; *goorehband* in Sistan, eastern Iran; and *korband* (bund in rivers) in southern Fars, southern Iran, the Persian Gulf coast and the Qeshm Island. *Lavar* (silt bringer) is the name given to a spate-irrigated farm fields in the Dorz-Sãyehbãn area in southeast Fars. Moreover, the upstream spate-irrigated fields in Mazaijohn, south of the Izadkhast Plain, Darab, are called *bonakhoo*, and those on the downstream end are called *shatmãl* (sheet irrigation) in Darab and *takhtãbi* in Khorasan. In Pakistani Balochistan there are large and mainly unexplained ancient diversion bunds found in Khuzdar and Kalat districts, the so-called *gabar bundhs*. The similar, signs of irrigation are also found in Mehergarh Balochistan which is Old Civilization of human settlement in 9.000 BC closer to the King and Prophet Solomon time.

ii Spate Irrigation in Pakistan

Pakistan has utilized most of its surface water in the Indus basin by developing canal irrigation systems. After this, spate irrigation gives most potential for agricultural development land available for spate irrigation expansion is approximately 6.93 M ha–throughout all provinces, AJK and FATA (NESPAK 1998).The substantial land availability can be set against the current spate irrigated area of 0.34 to 1.28 Mha in dry and wet years and a maximum developed command area of 2.02 M ha. Allthough the estimate may be too high; it shows that there are opportunities to develop a larger area under spate irrigation. Apart from expanding the area, there is a considerable scope to improve the productivity of the existing areas. Developing spate irrigation will considerably improve the national food security and augment livelihoods opportunities in the poorest, unsettled, marginalized and low profile areas of the country. Even in spite of the current substantial extent (ranging from 3 to 10% of total irrigated area of country) with greater potential, spate irrigation in Pakistan is a largely unknown territory. Spate irrigation in Pakistan has a long history and has a large potential but is largely unknown and not well understood (Frank Van Steenbergen). Spate irrigation is practiced in the area west of the Indus River in all the four provinces. It is called *nai* in Sindh, *sailaba* in Balochistan and *RodhKohi* in Khyber Pakhtoonkhawa and Punjab. In the system, water from short duration flashfloods is diverted to irrigate land and fill drinking water ponds, water rangelands and forest ranges. Traditionally flood water is diverted from free intakes (on the piedmont zones) or (further down in the plains) with the help of earthen diversion bunds build across the ephemeral rivers.These structures are usually built in such a way that they wash out in very high floods – thus preventing that potentially destructive high floods play havoc with the command area. Once diverted, flood water is guided and spread over sometimes very long distances usually making sure the floods do not erode the command area. The following table shows the feasible sites in Pakistan that can be developed under spate irrigation.

Table: Potential sites in Pakistan

S/No	Area/Province	Numbers of Potential Sites
1	Federal Area	-
2	(Northern Areas, and AJK)	120
3	Khyber Pakhtoonkhawa	417
4	Punjab	211
5	Sindh	33
6	Balochistan	423
Total		1204

NESPAK 1998

1) NESPAK. 1998. Master Feasibility Studies for Management of Hill Torrents of Pakistan (summery Volume)

2) Based on an experts estimate

3) Practical note1: Potential for the spate Irrigation in Pakistan (*www.spate-irrigation.org*)

SPATE IRRIGATION IN BALOCHISTAN PROVINCE

Chapter -I

Spate Irrigation in Balochistan, History Current Status and Practices

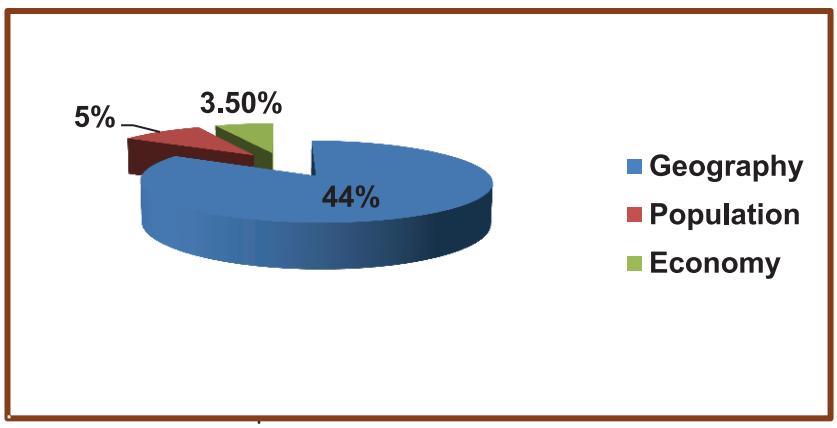
Balochistan is a South Western Province in Pakistan sharing international borders with Iran in the south and Afghanistan in the west. The province has two types of topography: The northern high land and south-eastern lowland plains and sandy deserts. Balochistan is 44% of Pakistan in terms of geographical area with a population of 7.2 million (Pakistan Population Census Report 1998). Out of total 6.39 million acres of land only 0.334 million acres are irrigated, making 13% of the total irrigable land. The province is arid and dry in its climate with a low rainfall rate. The north-western highlands get snowfall and rains (8-20 inches or 22-500mm) in Dec-April. The lowland and southern Balochsitan gets monsoon rains in Jun-August at low intensity ranging 1-2 inches or 25-50mm. The highlands are severely cold in winter and moderate in summer's months. The lowlands are severely hot in summer months. Ethnically, the North is occupied by Pashtoon Tribes, while the south, southeastern and coastal regions are inhabited by the Baloch Tribes. The area is tribal in nature. Traditional kinship and tribal bondage makes a strong social tribal culture.

1.1 Geographical Setting

Balochistan has many natural resources such as irrigable arid lands, rivers, huge rangelands, oil, gas and coal mines and gold reserves. In the south, Balochistan makes up two third of the coast line of Pakistan. This opens the corridor for international trades with especially Aghanistan, Iran, central Asian Republics.

Balochistan as share of Pakistan *(Source: GOP* 1998 and World Bank 2008; 2012)

The province of Balochistan remains largely underdeveloped. The province has a, poor infrastructure, a severe water crisis, and the weakest fiscal base. The poor economic performance has led to poor living standards. Balochistan has the highest poverty rate along with KPK, and, in parts of the province, the weakest state institutions.



Paradigm shift in water needs and availability occurred at high intensity in the mid-seventies when traditional crops cultivation trends shifted to commercial after the advent of tube wells. This tendency has gradually deteriorated the groundwater level. Thousand of tubewells had been installed in the years 1977 to 1988. The provincial

government provides subsidy on tube wells connections throughout the province. However this policy has been changed in 2006 and now no new agricultural connections are sold to farmers in Balochistan. There is more harmony and cohesion among the tribes living in Balochistan. However, tribal feuds within the tribes and neighboring tribes do occur from time to times.

The main crops in the highlands are fruits and fresh vegetables. This has to do with the good climate and subsurface water availability. Agriculture is the main source of income, followed by government employment, and trade in northern Balochsitan, livestock rearing. The cash crops horticulture in the Northern and some parts of the Southern highlands further boosted up after the arrival of skilled agriculture labour from Afghanistan as a result of the Russian invasion in 1982.

Generally, Balochistan is water scarce province and depending on seasonal rain and snowfall to recharge the water aquifers. A small proportion of land in lowland Balochistan is irrigated by canal fed irrigation systems from the Indus River. The two main canals (i) Pat Feeder and (ii) Kirther are irrigating land in two districts of province, Jafferabad and Naserabad with land size (0.365m hac).The Rest of the province is depending on rainwater, groundwater from tube wells and karezez. Shallow water resources have dried up significantly after the installation of deep tube wells. At some locations, dams are delivering water for agriculture on minor scale due.

There are 19 major water basins emanates in the province. Water in basins either drains finally in Indus River or in sea. Pishin River water basin ends up in the Chaghi deserts. Lori Tang, Zhob River drains in the Indus in Punjab and Khyberpakhtoonkhawa. Sasool River is bound at Hub Dam near Karachi and it provides domestic water to Karachi City and also used for irrigating small tracts of lands in District Lasbella. The major River Basins in Balochistan with seasonal surface water availability are shown is the following table.

1.2 Major Water Basins in Balochistan with Surface water Situation

Table 1 Balochistan Water Basins with Surface Water Avaibility[3])

Basin	Surface Flows	People	Livestock	Agriculture	Nature	Total	Balance
DashtRiver Basin	0.660	0.003	0.006	0.008	0.066	0.083	0.577
GajRiver Basin	0.233	0.000	0.002	0.000	0.023	0.025	0.207
Gawadar – Ormara	0.546	0.001	0.001	0.008	0.055	0.064	0.482
Hamun-e-Lora	0.189	0.000	0.001	0.008	0.019	0.028	0.161
Hamun-e-Mashkel	2.078	0.002	0.003	0.099	0.208	0.312	1.766
HingolRiver Basin	0.942	0.005	0.003	0.033	0.094	0.136	0.806
HubRiver Basin	0.380	0.001	0.001	0.041	0.038	0.080	0.300
Kachhi Plain	1.902	0.011	0.006	0.428	0.190	0.634	1.268
KadanaiRiver Basin	0.077	0.000	0.002	0.000	0.008	0.010	0.067
KahaBasin	0.515	0.000	0.002	0.049	0.052	0.103	0.413
KandRiver Basin	0.018	0.000	0.000	0.000	0.002	0.002	0.016
KunderRiver Basin	0.103	0.000	0.000	0.016	0.010	0.027	0.076
MulaRiver Basin	0.338	0.000	0.001	0.008	0.034	0.043	0.295
NariRiver Basin	0.817	0.001	0.002	0.041	0.082	0.126	0.691
PishinLoraBasin	0.302	0.010	0.014	0.115	0.030	0.169	0.133
PoraliRiver Basin	1.106	0.002	0.001	0.123	0.111	0.237	0.869
RakhshanRiver Basin	0.320	0.001	0.001	0.000	0.032	0.034	0.286
ZhobRiver Basin	0.267	0.000	0.001	0.082	0.027	0.110	0.157
Balochistan	10.793	0.038	0.045	1.059	1.079	2.222	8.571

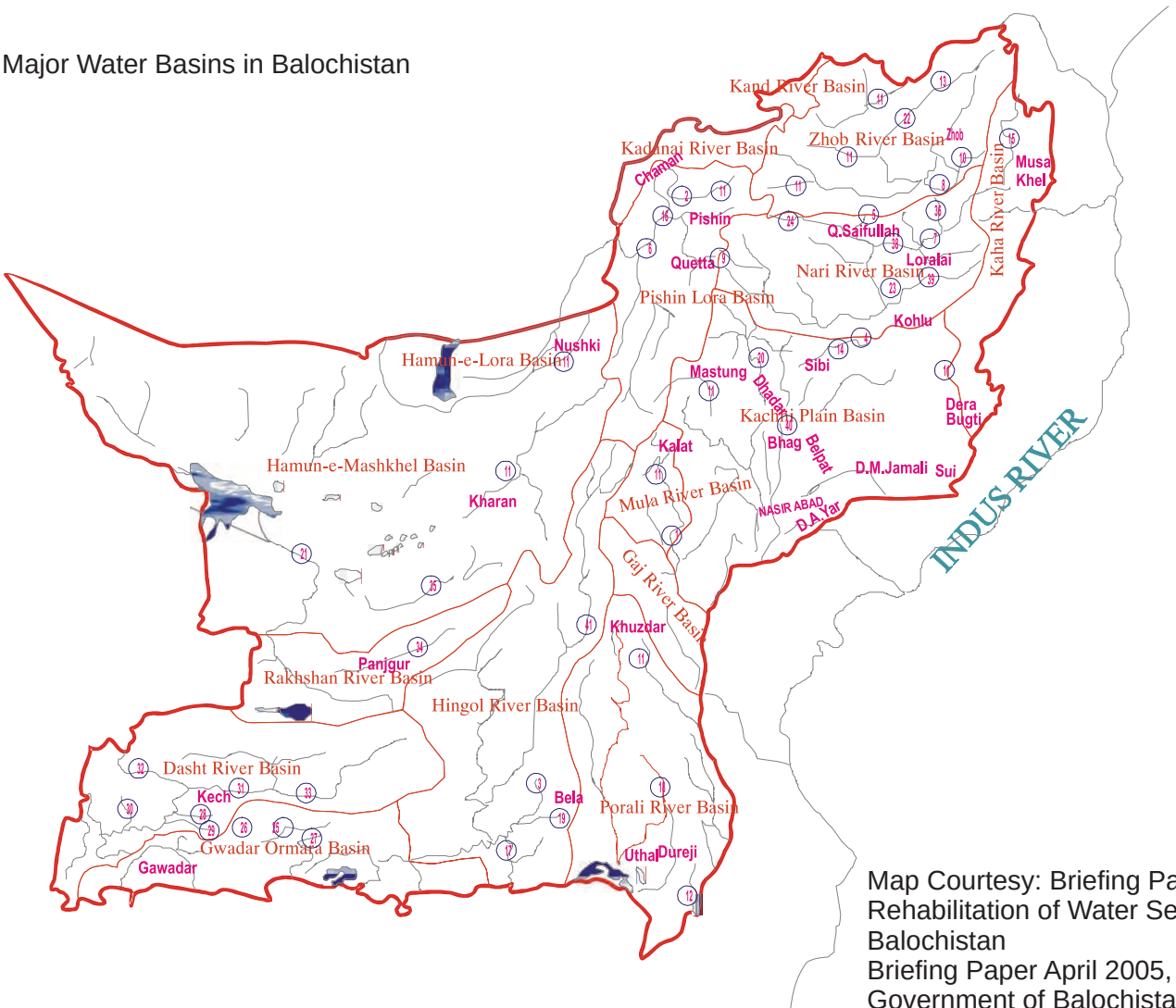
The rivers are taking a lot of fertile sediment with them before they finally disperse either in Indus, Afghanistan orArabian Sea. A few delay action dams are build in the river basins, either on their tributaries or sub basin, mainly to recharge the groundwater. As mentioned, there is a huge potential for spate irrigation expansion. Below 2 examples are given that highlight the scope of spate irrigation in Balochistan that can be multiplied in other water basins easily.

1.3 Administrative Overview of Balochistan

Balochistan is divided in 6 administrative divisions:

S/No	Name of Division	Numbers of Districts	Name of Districts in Division
1	Quetta Division	5	Chaghi, Noshki, Quetta, & Killa Abdullah Pishin
2	Kalat Divison	7	Awaran, Khuzdar, Kalat, Mastung, Washuk Kharan and Lasbella
3	Mekran Division	3	Kech, Panjgure, Gwader
4	Sibi Division	5	Sibi, Dera Bugti, Kohlu, Harnai & Ziarat
5	Zhob Division	6	Zhob andSherani, Killa Saifullah, Loralai, Musa Khel & Barkhan
6	Naseerabad Division	4	Bolan, Jhal Magsi, Jafferabad, &Naseerabad

Major Water Basins in Balochistan



Map Courtesy: Briefing Paper on Rehabilitation of Water Sector in Balochistan
Briefing Paper April 2005, Government of Balochistan

1.4 History of Spate Irrigation in Balochistan

Exampe: 1 Chakar River Basin- Sibi Balochistan

Chakar River emanates from Mawand Tehsil of Kohlu district. The catchment runs north - south and joins larger plains towards Kachhi plains. It lies between the Beji River basin to the north and Phujal (Lehri) River basin to the south. The measured characteristics of the Chakar River are given in table: 2

Chakar River in SIbi Balochistan

Mountain catchment area	1480 skms
Proportion of area	Mountain : 70% Alluvial :28% Valley :02%
Length	85kms
Concentration Time	7 hours

Chakar River joins the plain in the north of Talli village in SIbi District. Reportedly, there are no spate water diversions constructed in this river until it reaches the Sultan Kot village in Sibi. The magnitude of the flood intensity is estimated on 120,000 cusecs in 50 year return period. The same level spate extent reported in July 2010 which was 50 years high return.

As per defined water rights, spate water in Chakar is used and diverted by farmers in Talli, Sultan Kot, Raza and Chandia, Chachar, Qaiser. Approximately 15,000 acres is irrigated. Surplus water further drains to the Kachi plain that causes problems of havoc in Bakhtiar Abad and north of Naseerabad district. This surplus water can be diverted to Eastern and Northeastern plains by excavating new canals near the mal Gishkori village and irrigate the land around Mal Gohramzai and Theri Baramani Village. There is huge parcel of land lying barren further downstream where surplus water can be used for forest and range land development. There is a need for an integrated approach to better manage water. Furthermore surplus water can be utilized to bring new land under cultivation further downstream of Chakar River. The poverty can be addressed by expanding spate irrigation to the other areas along Chakar River, for example in Baktiarabad. Approximately, 50-100,000 acres of new lands can easily be irrigated by surplus water from Chakar and Phujal River through building and rehabilitating new and old earthen canals in the area with low cost engineering solutions. The state land along the Chakar River can be allocated to neighboring Marris and Jatts who are economically extremely poor and depending on livestock for their livelihoods. The present poor life style of the local tribes Jatt and Marri nomads can be improved by settlement through state land allotment and better education for their children.

Example 2: Narri River in Bolan District

Narri River is one of the largest water basins in Balochistan. It drains water to Kachi plains which ultimately enters in Dadu district in Sindh Province. Main catchment starts in the highlands of the Ziarat District, Loralai District and Part of Zhob District. The river is flowing north to south from Loralai until it finally disappears in Manchar Lake in Sindh Province. It passes through the hilly terrain of Kohlu district, vast sub plains around Mekhtar and Duki in Loralai Balohistan. Narri is the principal stream of the water shed which drains an area of 22,525 sq kms (8,700 miles). The Narri River has different names while it passed through different areas.

In different areas along the Narri River, spate irrigation is practiced. This is done on minor scale by tapping minor flows in creeks within the catchment in Mektar, Duki area in Loralai District.

The largest proportion of the flow passes unutilized through Kohlu district, where large parcels of irrigable areas are available. Only if Karahi Maidan in Kohlu district would be irrigated either through perennial flow or flood, it can meet the food supply of entire Kohlu district. Such plains in many cases are not distributed among people and are lying under communal tenure or under the ownership of the provincial government. The communal ownership hampers the interest for development of the irrigation projects along the river. But if the efforts would be invested in first hand investment before the commissioning of project, this could be settled through negotiation within the owner tribe/tribes.
Perennial water in Narri River is used by the farmers of Sibi tehsil settled in 6 distinct villages. An average irrigated land under perennial flow is approximately 5,000 acres.

Spate water in Narri River is used beyond Sibi town. A spate irrigation system can be found in Bolan district close to SIbi. Spate irrigation is practiced here from the times of Kalat state. From Mithri to – Khokhar 6 diversion bunds *(gandas)* are irrigating the lands on both sides of the river. During the Kalat state, there has been properly employed staff for the management and operation of the system and in return the state government had collected taxes against the services. The labor contributions, maintenance of the main diversions and water distribution are well defined and recorded in the cadastral record of Revenue department of Bolan District.

Lands are registered in Revenue Department against individual titles. There are two types of land (i) *Ghami* and *Be-ghami*. Ghami literally means contribution of *Gham* (labor, cash for system maintenance)the land with water rights. Be-ghami land means, lands without water rights. These two kinds of land and water titles are known in the area.The adjoining plains are lying barren under the communal ownership due to command problem and water shortage and proper infrastructure.

The provincial department of irrigation is currently building 6 dispersal structures at different locations with the cost of Rs 4.9 billion. The proposed scheme will approximately irrigate 100,000 acres of (both types of land) and generate livelihoods for 5,000 households directly.

1.5 Scope of Spate Irrigation in Balochistan

The province lowland has at least fresh water resources for irrigation and domestic purpose other than runoff or groundwater. Surface runoff is hardly utilized to the desired optimum level though provincial government is building 100 dams throughout the province. It is general estimate that dams have no significant impact on the irrigated agriculture of the province due to certain reasons (i) absence of proper water distribution among the farmers (ii) farmers are not sure for the secure water supply throughout the year so no permanent crops like orchards can be considered (iii) silt laden flood water is filling the dams before its projected life capability (iv) these dams are small in size and does not cater the larger needs of the local farmers.

Such dams can make a substantial affect in the areas where shallow aquifers are being utilized for irrigation and domestic use. Unfortunately, in many parts of the province the ground water has dropped to the depth of 500-1,000 ft and such dams may not make any change on the recharging of deep aquifers. Construction of dams in Balochistan may not yield revolutionary affects on the livelihood enhancement over all due to small in numbers and water bearing and storage capacity

By managing flood water in various water basins In Balochistan Province millions acres of new land can be brought under crops and forest cultivation. A buffer in sub soil water can be created through building new canals and dispersal structures in plains. Additional and surplus water has to be catched and utilized in Balochistan plains valleys which are currently draining off to Indus River, Manchar Lake and ultimately sea.

2 Spate Irrigation in Quetta Division

2.1 Chaghi and Nushki District

Quetta Division consists of 5 districts: Quetta, Pishin, Killa Abdullahand Nushki and newly established Chaghi districts. The first three districts lay in the highlands north of Quetta Provincial Capital.The other two districts are situated in the south-west along the RCD Highway Quetta – Iran – Turkey. District Nushki and Chaghi are bordering Afghanistan in west and Iran in south. 2/3rd of Chaghi and Nushki district comprises of sandy desert and do not offer much in term of irrigated agriculture with the exemption of piedmont areas. Spate Irrigation is practiced in the valleys of the hilly region. There is a substantial scope of spate irrigation in district Nushki where large areas of flat valleys lay barren. In these areas, spate water can be dispersed through building diversion structures with canal network in line with locally defined water rights. Development of such lands can be turned into seasonal green patches. The Northern part of Nushki, which constitute Chagi district (differed in recent times), consist of sandy desert and offers no agricultural based livelihoods opportunities to the local inhabitants. In a wet year, isolated alluvial parts in desert are cultivated to meet the animal fodder needs. Groundwater in Chagi area is essentially brackish with no use of domestic and other purposes. The main source of income of the local population in this district is trade with Iran and Afghanistan. Agriculture and government jobs are considered the second largest

income for households. Both districts are ethnically occupied by different Baloch Tribes mainly Mengal, Jamaldini, Mohammad Hasni, Sherzai, Mohammadzai, Notezai, Sanjrani Kubdani and Nausherwani. It is estimated that 50% of the population is living below the poverty line in both districts. Road communications other than RCD Highway in the area is poor due to absence of provincial government plans. Sandy deserts further hamper the development and seasonal dusty winds pours more miseries on the life particularly women and children.

There are hill torrents and small water basins that flow for short durations of time after seasonal rains and drain a sizeable quantity of water. The larger part of the rain water goes to waste. In some parts of both districts, spate irrigation together with conjunctive use of ground water is practiced. The following areas are identified that have new potential for intensification of spate irrigation. This can be done by installing spate water management structures that would augment the livelihoods potential leading to enhanced food security and poverty alleviation.

Table 2 Catchment Streams and Small to Medium River in Chaghi and Nushki District

S/No	Name of Sub Basin /River	Potential for Spate Irrigation	Remarks
1	-	Kirdgap Valley	Needs more head works, flood protection bunds, water course, land development, water deflector, River bed fixers and introduction of new crops and farmers networks
2	-	Mall, Baghak and Ahmad Wall area	
3	-	Plain strips in Glangoor area	
2	Kaisar River	Spate Irrigation - throughout its length until Nushki City and surroundings	
4	Lijay Jhal	Spate Irrigation is practiced	
5	Hapursi Jhal	Spate Irrigation is practiced	
6	Babki Jhal	Spate Irrigation is practiced	
7	Talri Jhal	Spate Irrigation is practiced	
8	Shori Kaur	Spate Irrigation is practiced	
9	Munjro	Spate Irrigation is practiced	
10	Hamun Lora	Spate Irrigation is practiced	Chaghi dist

2.2 Quetta, Pishin and Killa Abdullah Districts

Quetta is the capital of the Balochistan Province. The City is mainly occupied by Baloch, Pashtoon, Hazara and other migrants from elsewhere Pakistan. Killa Abdullah Khan is occupied by Achakzai and Kakar Pashtoon Tribes. Similarly, Pishin district is predominantly occupied by Kakar, Achakzai, Syed and Tareen Tribes of Pashtoon. Quetta, Killah Abdullah and Pishin are bordering Afghanistan in west and north-west.

The main population in all the three districts is depending on agricultural returns and is largely engaged in border trade and local businesses. The famous dam Bund Khushdil Khan and Shebo head works are in situated in Pishin district and were build in colonial times for irrigation purposes. Both structures were designed to store off seasonal water utilized in the summer months for crop cultivation.

Shebo headwork's can be considered as an exemplary spate irrigation structure in Baochistan which can be easily replicated in other spate irrigated areas of the Province. Shebo headwork diverts seasonal water to off shore earthen reservoirs that is used by local farmers in the dry summer months for supplementary crop irrigation. Spate canals are constructed to divert flood water to a tank which distributes water with tertiary canals to irrigate the total command area. The tank stores water particularly in the winter months through snow melt.

The area in these 3 districts comprises hills, high peaks and valleys where irrigation is practiced. Currently irrigation in Quetta is done mainly with spring water in Orak Valley, sewerage water in Quetta City and Nauhisar area west of Quetta airport. Killa Abdullah and Pishin are dependent mainly on groundwater mining for irrigation and domestic use. Major crops are apple orchards and fresh vegetables. These are sold in all three districts and consumed locally in Quetta City. The surplus is sold on country markets. Fruit is supplied and sold on large country markets of Karachi, Rawalpindi, Lahore, Multan and Peshawar. The area has one crop (Rabi crop) in a year. October – April are slack seasons and no crops are cultivated in this season than only barley and wheat at minor scale.The crops remain dormant through winter months Jan-March and start re-growth after mid March due to snow and harsh cold temperatures.

Dependency on groundwater in Quetta, Killa Abdullah and Pishin has marked serious decay starting mid 1990 that has led to serious decline in crop production. This let to a decrease of the groundwater level mainly in Kuchlagh valley, Khani Baba, Mian Khazai, and Gulistan area. Irrigated land reduced to 30% with comparison to pre nineties conditions. As a result, drinking water availability in Quetta, Pishin and Kuchlagh has become a serious problem. The local population largely depends on tractor imported water on cash payment for domestic use. The current rate of the one tanker water is Rs. 800 and the sale of domestic water has emerged a new business trend in Quetta and Kuchlagh valley specially. The provincial government is now maintaining strict order on installation of new tube wells in these valleys to protect the ground water storage that is utilized by the local population at present and in future as well.

Quetta, Pishin and Abdullah Khan District do not offer scope for the development of spate irrigation system. The water infrastructures are reasonably builtin these districts. However, there is good scope of spate irrigation in Toba Achakzai, Toba Kakari and surrounding of Quetta area. The highlands receive sufficient snow and rain fall every year. Small water body infrastructure like check dams, valley dikes, and land leveling can further offer good scope for spate irrigation and groundwater recharge.

Table No 3 Small and Medium Rivers Basins in Quetta, Pishin and Killa Abdullah District

S/No	Name of Sub Basin /River	Potential for Spate Irrigation	Remarks
1	Habib Nullah Quetta	Irrigation in Nauhisar area. The nullah carry the sewerage water of Quetta City which is utilized around the City Airport and Killi Nauhisar	There is need to treat the water before it is applied to the crops specially vegetables grown around Quetta City.
2	Syed Hameed	Pumping by tractors during flood from Saranan Afghan refugees' camp to the proposed dam axis of Bridge Aziz Khan.	
3	Pishin River all tributaries	In the reaches of Bund Khushdil Khan and Karbala plains	
2	Khani Manda	Water stored in Dams for off season utilized and main source of ground water recharge in the area	
4	Creaks in Tauba Area	Entire plains in Tauba Kakari area of district Pishin	Need to put water diversion structures. Land development.

3 Spate Irrigation in Kalat Division

Kalat Divison is large in size with comparison to other administrative divisions in Balochistan Province. There are 7 districts in Kalat divison; Mastung, Kalat, Khuzdar, Awaran, Washuk & Kharan and Lasbella

3.1 Awaran District

District Awaran is arid in terms of irrigated agriculture and water availability except of some karezez in and around the Awaran and Mashkay. Mashkay River is the main source for irrigation where seasonal semi-perennial flow is diverted to the land. Due to Mashkay River, the groundwater in the vicinity is available throughout the year and pumped up for irrigation.

Second reliable water sourceis Nal Kaur which is passing through Jhao and Korak area of tehsil Jhao of district Awaran where perennial water is available in the upper and middle reaches and utilized for irrigation. A large part of the harvest in the district is consumed locally accept onions that are sold in Karachi market. Jhao is the major producer of the onion in district Awaran. Beans, barely, wheat and date palm are the major crops. There are large tracts of land available on both sides of the Nal River that can be irrigated with better planning of flood water use. The rest of the district is exclusively depending on rains and small scale run off from the neighbouring hills yet spate

irrigation. Due to scarcity of water, agriculture is currently not the main source of livelihoods. A large amount of local male population migrates to Utahal, Hub and Karachi in search for employment. Intensive development of spate irrigation through investment in diversion structures, land development, embanking can generate livelihood opportunities at larger scale in Kolwah, Mashaway, and Jhal Jhao area. The following areas are identified as potential spate irrigation areas other than hundereds of minor creeks around the entire human settlements in the district.

Table 4 Hill Torrents in Awaran Disttrict

S/No	Name of Sub Basin /River	Potential for Spate Irrigation	Remarks
1	Mashkay Kaur	Already Irrigating large tracts of land	Needs more head works, flood protection bunds, water channel lining, land development, water distributors, River bed stabilizers and introduction of new crops and farmers networks? There is need to define the water rights at lower areas and more land and farmers may be included in new developments
2	Khalir Kaur	Spate irrigation is practiced	
3	Dher Kaur	Spate Irrigation practiced	
4	Parkini Kaur	Spate Irrigation is Practiced	
5	Babro Kaur	No Evidence of spate irrigation	
6	Hibo	No Evidence of spate irrigation	
7	Wal Kaur	No Evidence of spate irrigation	
8	Gazi Kaur	No Evidence of spate irrigation	
9	Madak kar	No Evidence of spate irrigation	
10	Nal Kaur	Spate and conventional irrigation practiced with perennial flows.	

3.2 Khuzdar District

Khuzdar comprises mountainous regions and plain valleys. There are two main water sources in the district (i) Mula River and (ii) Karkh River that have significant perennial water availability throughout the year. These are locally utilized for irrigation and domestic use. The areas along the Karkh river are comparatively greener than the areas along the Mula river, due to water and land availability .Small areas along the banks of the Mula River are irrigated throughout the year. The harvest in Mula Valley is consumed locally and a minor part of the surplus harvest is sold outside the area. Contrary to Mula, a major part of the harvest of Karkh valley is marketed. Especially wheat and onions are sold in Khuzdar, Karachi and other parts of the province.

Seasonal Irrigation in Khuzdar City and its surrounding is notable depending on Chil Jhal Passing through the city where seasonal vegetables are produced at large scale. Wadh tehsil area is the second largest source of income of the local farmers and communities were BDA has developed tube wells in the area.

Tehsil Nal and its surrounding are entirely irrigated by spate irrigation. There are minor water springs in some areas which are used as a source for irrigation as well but at a meager scale. Similarly, entire Ornach and Sarona tehsil areas are depending on seasonal rainfall. These pockets are economically poor with comparison to above mentioned areas in the district.

Tahsil Zheri is entirely spate irrigated with exemption of some areas where farmers use minor water springs for irrigation. A large part of the district is arid in nature and depending on seasonal rainfall. Perennial water sources are hardly available and water rights are mainly owned by some powerful farmers. These water resources are in many cases properly lined and protected by the Provincial Irrigation department.
Farmers migrate from the highlands of Khuzdar to Sindh province when there is lack of rain in the rainy season. However, a large number of livestock owners seasonally migrate to the lowlands in Jhal Magsi, Shahdad Kot and Kuba Qaiser Khan in Sindh Province in search of fodder for their animals. The major roads for migration are through Karkh and Mula Valleys east of Khuzdar passing Kirther range and Zehri through Kachi plains.

In line with the rest of Balochistan, hardly attention is paid to the development of spate irrigation in the district. People living and depending on spate irrigated areas in the district are economically poor with hardly any communication structures and access to roads. The following areas are identified for development of spate irrigation areas.

Table – 5 Potential in Khuzdar District[vi]

S/No	Name of Sub Basin/River	Potential for Spate Irrigation	Remarks
0	Chil Jhal	Irrigating both sides of the river	Passing through Khuzdar City
1	Langreji Jhal	Spate Irrigation is practiced on both Bnaks of Jhal on large scale	Along Mahander and Killi Badri. It needs more spate water management structures and diversion
2	Gider Dhoor/Rej	Irrigating large tracts of lands in and around Nal, Leso and Lambi area	Along Guruk-Ornach Road. Spate Irrigation needs to be improved
3	Nal River	Irrigating large areas on spate irrigation from Nal towards Jhal Jhao along Central Route and Nal town itself	South west of Giddar-Nal Road, No spate irrigation infrastructure have been constructed
4	Kakuri Khaur	Irrigation in some tracts along the River/Kaur	

5	Mashkay River	The sections of Maskhay that passes in Khuzadr District is also irrigating large tracts of lands in its upper catchments up to Nal Town	West of Nal Town
6	Bini Jhal	Spate Irrigation at small scale	When dissects from Gaj Kaur
7	Kolachi River	Irrigating both side of banks in semi plains area.	Together with Lagh Jhal, Khori Jhal and in south east of Khuzdar City
8	Lop	Irrigating sizeable land on spate	Spate water management structures are needed
9	Sorgaz Jhal	Irrigating sizeable land on spate	Spate water infrastructures needed
10	Karkh Valley	Entirely irrigated with Perennial flow in Karkh River with water management structures	Does not offer much scope for Spate Irrigation.
11	Hab/Sasool River	Small scale spate irrigation is practiced in upper area. Sasool is feeding Hub Dam	South of Zidi Town
12	Mai Gati	No evidence of spate irrigation	Tributary of Karkh River In
13	Nar Jhal	Small Scale Spate Irrigation on both banks of the Jhal	Flood Protection and water distributors
14	Anjera Plains	Surface run off need proper water management	Zheri Tahsil Area along Karachi-Khuzdar Road
15	Mundar Jhal	No information is available	-
16	Langrech Jhal	No information is available	-
17	Sarap Kaur	No information is available	-
18	Pugti Kaur	No information is available	-
		No information is available	-
20	Sarona	Inside the River Bed and at the plain valleys spate irrigation together with surface perennial water is practiced	At Certain location where Sarona name is changed as Ahmad Nadi. It irrigates large tracts of land in southern side of Ahmed Nadi.
21	Siap Jhal	No information is available	-

22	Lukh Jhal	No information is available	-
23	Gaj Nadi	Small scale spate irrigation practiced	Improved Infrastructures needed
24	Kolachi	Spate Irrigation is practiced in both sides of the river through it length	Large scale infrastructures needed
25	Kud River	No information is available	-
26	Porali River	Irrigating Southern parts of Khuzdar district	Diversion and spate water controlling structures needed
27	Aranji Jhal	No information is available	-
28	Chorani Jhal	Spate Irrigation is practiced	Along – Nal Khuzdar Road
29	Duni Jhal	Spate Irrigation is practiced	Along Nal Khuzdar – Road
30	Khisun Jhal	Irrigating large tracts of land	Along Nal Khuzdar Road
31	Landao Jhal	Irrigation large Tracet of Land	Along Nal Khuzdar Road
32	Bhala Jhal	Irrigation Large Tract of Land	Along Nall Khuzdar Road
33	Soinda Jhal	Irrigating larger area on the east of Zheri Town	Noorgama area
34	Mohna Jhal	Both banks of Jhal and its surrounding	Khuzdar Tehsil area
35	Chap Shah Lake	All sides of Lake are irrigated on spate irrigation	Khuzdar Tehsil Area
36	Chal Jhal	Spate Irrigation is practiced both side of the Jhal	North of Khuzdar.
38	Kun Jhal	Spate Irrigation is practiced at large scale	Along Ornach Road
39	Hurro Nadi	Spate Irrigation is practiced at large scale	Along Ornach Road

3.3 Kalat and Mastung District

In Kalat and Mastung district mainly apple production takes place. This is different in comparison to all Baloch belt in South - East Balochistan. The area has been brought under irrigation through sink tube wells in the mid eighties with agricultural loans of the National Bank and Agricultural Development Bank of Pakistan. Baghbana, Mangocher, Mastung, Kanak and part of Spezand valleys expanded its net irrigated area with 100 % since 1978 (???) with advent of tube wells and groundwater mining.

During the five year drought period of 1995-2000, Mastung and Mangocher valley has suffered water shortage due to serious decline in the groundwater aquifers and excessive groundwater mining coupled with long drought spells. The area is arid and extremely cold in winter.

Spate irrigation in practiced in both districts on minor scale. The major focus is still on groundwater for cash crop agriculture mainly fresh vegetables, onions, and potato and apple orchards. The rural population depending on the spate irrigation is pastoralist, and migrate seasonally from local areas to lowlands in Kachi plain. The main reason for seasonal migration is fodder for livestock and to protect the families and animals from the harsh winter. Large areas of plain land in Kalat district is situated in Baduzai area south-west of Kalat City on the main RCD highway. Agriculture is mainly rainfed. No significant river is passing through this area. Farmers utilize moisture directly captured from rains and minor runoff of the surroundings hills.

Migration starts in December in the beginning of the winter rain season. Usually during this period, farmers plough their land and sow wheat and barley. After this, they leave the fields unguarded. Afew people stay in the area to protect the houses and properties. During their stay in Kachi plains, Dec-March, the elder male and female work as agricultural labour to harvest Rabbi Crops cultivated on spate irrigated lands. Major passing routes are Bolan, Zehri, and Gazg.

There are dozens of small catchments in the districts but this does not cater to spate irrigation directly. District Kalat and Mastung are bound by Rocky Mountains that do not offer much scope in terms of land availability for irrigation. The following areas are identified having a potential for spate irrigation.

Table 6 Spate Irrigation Potential and areas in Kalat District

S/No	Name of Sub Basin/River	Potential for Spate Irrigation	Remarks
1	Shrin Ab River	Spate Irrigation is practiced at Low level	Zard – Kalat City area
2	Koshk Jhal	Spate Irrigation is practiced	-
3	Kachi Jhal	Spate Irrigation is practiced	-
4	Kani Jhal	Spate Irrigation is practiced at small scale	South of Kalat Along RCD Highway
5	Madian Jhal	Spate Irrigation is practiced at small scale	South of Kalat along RCD highway
5	Rej River	Spate Irrigation is practiced	Along Surab area
6	Sumungian Jhal	Spate Irrigation is practiced	Area Between kalat and Mangocher

Table 6 Spate Irrigation Areas and Potential in Mastung District

S/No	Name of Sub Basin/River	Potential for Spate Irrigation	Remarks
1	Shura Rud	Spate Irrigation is Practiced at small scale	Panjpai area
2	Bhalla Dhoor	Spate Irrigation is practiced	
3	Nil	Spezand Plains	Rain Fed only with Minor creeks runoff
4	Nil	Bashkaram Area	West of Mastung City
5	Nil	Takri	West of Mastung City
6	Nil	Pringabad Surroundings	Eastern and western foot hills
7	Kidgap Dhoor	Spate irrigation together with rain fed is practiced	Kirgap dhor can be developed for spate irrigation

3.4 Kharan District

The **Korakan River** rises at the Zhal pass in the Garr hills and runs south-westward under the name of the Zhal River. Curving south-westward it runs parallel with the Baddo It joins the Baddo at the Khargushki Band. After entering the plain, it is called the Korakan. Near Langen Kahur, it is joined by the Gazno River from the north-east and by the Chutok River from the east. From the east numerous other torrents also meet Korakan. In the Kharan valley, the water from the river is used for irrigation in places where dams are construced. However, because of its narrow bed, about 50 yards, and the heights of its banks, little water can be obtained. Important dams are situated at Naurozabad, Tagazzi and Gazzi. However those are often destroyed by floods.

Korkan River has a great potential for spate irrigation development. Reportedly there are 5.000 households depending on 11 diversion bunds along the Korkan and its different tributaries. River bed erosion in Korkan River and difficulties of farmers in construction of diversion bunds on soft soils causes that the real potential for spate irrigation returns is not made. Improvements in the management of spate systems will bring change in the life of the poor communities. The following catchments are identified as high potential spate irrigation areas. Implementing new spate irrigation structures in the district, will lead to an enhanced food security and improved livelihoods at local level:

Valleys near Patkin

Bado River– construction of improved 11 off-takes in Buddo RiverKorkan River – diversion structures with intake and outlet structures are recommended.

Sarap and Gurruk River– More investment in spate irrigation is recommended.

Plains in the foot hills of Char Kohan area – water diversion and land leveling is recommended

3.5 Washuk District

The Washuk District is recently established by dissecting itself from the Kaharan District. It has its headquarters in Besima. Washuk is completely dry in nature with no significant agricultural produce. The entire land in the district is depending on rainfall. Very small patches of land are green and irrigated with groundwater from tubewells. There are no remarkable rivers in the district except of some temporary running streams that only flow after the rainy seasons. South west of the district entirely consists of arid land with large sandy deserts and hills.

The Shimshi area of the district is protected by the Arab Sheikh who comes here every year in the winter season to hunt. This is an opportunity for locals to work as temporary labour. There are some people who work as a guard and keep the hunting area the entire year free from outsiders.

There is no perennial water availability in the Washuk District except minor scale perennial flows in ephemeral rivers. Those are used by farmers for irrigation. Spate irrigation or rain fed Khushkaba agriculture is the major source of livelihood for people. Local employment opportunities through other means like business, government employments and trade are very meager to cater the local needs. The following areas can be considered as potential spate irrigation areas.

Table 7 : Spate Irrigation Potential in Washuk District

S/No	Name of Sub Basin/River	Potential for Spate Irrigation	Remarks
1	Guruk River	There is potential for spate irrigation	New structures, water distribution
2	Nihand River	There is scope for spate irrigation	Along Kharan-Besima Road
3	Nil	Both side of Basima – Panjgur Road	Land Lreveling and field water management structures.
4	Nag	Entire Nag Area has potential for spate irrigation	Needs, flood diversion, land leveling
5	Gazi Kaur	Land Development and Water controlling structures	-

3.6 Lasbella District

Lasbella had an independent state status and was ruled by Jam of Lasbella before the colonial occupied the Balochistan. In 1948 the state merged with Pakistan. Lasbella is situated in the neighborhoods of Karachi. Karachi city, Hub Industrial state and ship breaking industry employ locals in large numbers. Local population belongs to

various Baloch tribes Jam, Lasi, Rind, Mengal and huge numbers of Hindu. Urdu is the main language. Furthermore Sindhi and Lasi is widely spoken. Besides the local population, large numbers of other households migrate from the Mekran coast of Balochistan in search for better opportunities in Lasbella. There are significant numbers of commercial poultry farms in the area who deliver their produce to Karachi city.

Some parts of the district are water rich. For example along the whole basin of the perennial Porali River water is used for irrigation. Moreover, Porali River Basin is a large source of groundwater re-charge. The development of groundwater irrigated agriculture started in the mid 90's and gained a high scale rise when a rich segment of farmers in the province started to produce commercial fresh vegetables and green fodder for livestock.All the products are sold in the Karachi market.

Similarly, irrigation is also practiced in the Hub Dam area where two minor canals from the dams are feeding the lands in the Gaddani area. Mainly, vegetables, wheat, barley and green fodder are produced. Furthermore in the north-west of Hub dam, Dureji area is also rich in water availability Farmers in this area are using perennial streams and spate flows diverted through constructed irrigation canals successfully. Still there is a large scope for further expansion of the new projects by building and diverting spate water in the plans of Dureji Tashil in Lasbella.

There is a famous archeological site in Lasbella as well called Cave City. Its ruins are from 1.500BC. In 1845 British Colonial rulers mentioned it as an important historical site. The site is situated 40km from Bella City. There are many Sufi Shrines in the district and for them Shah Norani is quite a famous place.

The following areas are identified as potential spate irrigation areas that will lead to poverty alleviation in the local area and add to the Provincial exchequer on annual basis:

Table 8: Spate Irrigation Pontential in Lasbella District

S/No	Name of Sub Basin /River	Potential for Spate Irrigation	Remarks
1	Dureji Sub Basin	All Tehsil comprises hill terrain and plans in the southern side that can be converted into green field for managing spate water	Large proportion of spate water is dispersed in sea without any utilization. New lands can be irrigated by introducing spate irrigation and where needed new land distribution can be undertaken and new villages can be settled in the area.
2	Hari Dhora	Both banks can be irrigated by constructing new water diversion structures	
3	Porali Water Basin	Diversion Wears, canals off shore water storage tanks can be constructed. Land is not limited factor	
2	Thadai Dhora	Entire Tehsil Bella Offers large scope for spate irrigation development	
4	Khud River	Large scope of spate irrigation development alongside the both banks till the major length	
5	Hub River	Perennial and spate water cab be utilized upstream the Hub Dam	
6	Around Coastal High way	Large tract of barren lands can be converted into green lands by managing small flows in the area	
7	Tehsil Utal	Need Investment in spate infrastructures development	
8	Tehsil Kanraj	The is scope for new land development through managing small flows in Tehsil Kanraj	
9	Wayara Dhoor and Gajri	In Tehsil Bela offers reasons investment for spate irrigation development	

4 Spate Irrigation in Mekran Division

Mekran division consists of the following 4 districts Panjgur, Kech and Gwader respectively. Mekran Division situated in south west of Balochistan, bordering Iran and Baloch Gulf. Recently the Federal Government has developed Gwader Port which will contribute to the bright future of Balochistan through generating revenues, development of road sector transport. The port is currently functional and connected to other cities in country through a newly build coastal highway. Particularly it is connected to Karachi City and Indus Highway through Rato Dero – Larkana via Khuzdar. The entire population in the area is Baloch and speaks Balochi.

The South West of Balochistan along the coast lines is a dry area. Only some small scale seasonal irrigation takes place in and around the banks of different flood rivers. In Turbat (Kech district) the major source of irrigation is the Kech River which is passing through Turbat city. The major crops cultivated are dates and fresh vegetables which are seasonally grown. The dates are exported to other parts of country. The vegetables are consumed locally. Similarly, in Panjgur the major source of irrigation is the Rakshan River which is passing through the Panjgur city. There is surface-subsurface water availability in the reaches of Panjgur city which irrigates the both sides of River. Major crops cultivated in Panjgur are dates, fresh vegetables and wheat on small scale. Apart from the dates, crops are consumed and sold locally. The third important district in Mekran Division is Gwader which is devoid of fresh water too. For the drinking purpose Akra Kaur dam was build in mid 1990 which is the main source of drinking water. The water is pumped through a large network of pipe lines from a pumping station which supply water to the Gwader and Jewani cities and to small hamlets settled along the sea. Local PHE department at Gwader is managing the drinking water network and supplies from the dam.

The major source of income is daily wage labour in Karchi City and surroundings. Many people are engaged in trade with Iran. There are also people who migrate to the gulf state such as Muskat and Oman serve in the local government or earn their income from selling sea fish.

Small vehicles that are imported or smuggled from Iran are locally used for commutation in all three coastal districts'. Similarly, POL is also coming from Iran. POL is further traded in other provincial markets and towns within Balochistan.

Gwader is entirely dependent on Iran for food supply. Fish production is considered a major trade in district. Jewani, Peshokan, Gwader, Pasni and Ormara are the coastal cities where fish and other sea food are sold on daily basis and purchased by the local traders who further sell it in Karachi, Quetta, Khuzdar markets. Yet a large and surplus portion of sea food is catched and sold by foreign fishing trawlers that are operating in international seas.
Small scale irrigation is also practiced around the Ephemeral Rivers

4.1 Panjgur District

The main source of irrigation water in district Panjgur is seasonal. However Rakhshan River, that is passing Panjgur city, delivers water to farmers on the left and the right bank of the river that have developed small water channels to

their land locally called (korjo). Water right is divided among the farmers on the basis of having land on the left or right river bank. As per local rule set by the farmers, none of the group is allowed to build any kind of permanent structure across the river bed to tap the surface or subsurface flow. Moreover no evidence has been seen whether farmers are utilizing spate water in Panjgur City. However, spate irrigation has been observed upstream of the city along Rakshan River but at very minor scale. Similarly, no spate irrigation practices have seen beyond the city where a surplus run off in Rakhsahn River offers development of spate irrigation.

In 2002, Panjgure got electricity that resulted in installation of many deep tube wells for irrigation. This has affected the korjos. (Separate study is required to determine the effects). However the entire district has a potential to develop and build new spate irrigation systems on various torrents. Furthermore there is a scope for spate irrigation development in Guwarkoh Kaur area of Panjgure as well.

4.2 Kech (Turbat) District

The entire Kech district has a large spate irrigation potential along the Kech Kaur. Here spate runoff can be utilized from small tributary and creaks. Kech River also offers sub-surface shallow water availability in most of its reaches that can be supplemented with spate irrigation mainly up and down stream of the newly build (Mirani Dam). Spate irrigation is practiced currently all along the Balnigor-Suruk road that need investment in land leveling, water diversions, water distributions structures and land management. Similarly Bahri Kaur and Kil River in Hoshab area offers a wide scope for spate irrigation as well. Spate irrigation based livelihoods opportunities can further be explored in other parts of Kech District like Nihang and Nihang Kaur in Mand area, Shadi Kaur, Pidarak Kaur, Guruk Khaur, Dada Kaur that offers huge development scope and livelihoods enhancement through spate water management in valleys and lower semi arid pains annually. Tashil Buldea has also got a potential for development and utilization of spate water in different valleys.

Moreover along the Turbat – Panjgur road there is a high scope of spate irrigation in Balgatar area, Patandar Kaur and Sur Chap area. There is vast fine land available that can be irrigated by investing more in the development of new spate irrigation systems in the district.

In recent times Mirani dams have been constructed in the district but it is not cultivating lands according to plan. There are disputes on land and water distributions. There are certain protected areas for wild life which are known as Dasht Natinal Park and Wild Life Sanctuary and further down Hingol National Park.

4.3 Gwadar District

Gwader district is bound with the Baloch Gulf in the south. Its main settlements are Jiwani, Peshokan, Pasni, and Ormara which are basically fisherman towns. Fishing and sea food business is the main source of income for the

local population. Locally the fisherman man is called ***(Nahuda).*** They go offshore and fish during night times.They use sailing boats. In the morning, the fishermen rewind the nets and clean the fish they catched during the night. Normally, the fish is sold to big trawlers who sell the fish in international market. The daily average income per boat in 2002 was around Rs.1.500-2.500.

The entire land in Gwader district is lying barren. Fresh water is only available in the areas close to northern hills. The drinking water source in the district is Akra Kaur where a storage dam has been constructed by the provincial government.

Entire Mekran Division including Gwader is depending on the food and merchandise supply predominantly from Iran. Wheat flour, coca cola, eggs, sugar, audible oil, vehicles and their POLs are locally brought from Iran at cheaper rates than other parts of Pakistan and sold on local markets of Mekran, mainly (Gwader, Turbat, and Pangure). There is no irrigation taking place in the area. Approximately 75% percent of the local population in Mekran Division earns their imcome through daily wages in Karachi, Dubi, Musquat, Sultanat of Oman and Iran. Local sources at (Jiwani) mentioned that 5-10% local population is government employees in Iran. Large numbers of students from Pakistani Balochistan are studying in Iran. There is high level of unemployment As a result, the majority of the youth in Makran Division has fallen victim to drug use.

There is no credible scope of spate irrigation in Gwader district. However, areas along the Turbat – Gwader road also offer spate irrigation expansion.

8 Spate Irrigation in Sibi Division

Sibi Division comprises 6 districts: Sibi, Bolan, Kohlu, Dera Bugti, Harnai and Ziarat. The later 2 are small in size with comparison to other districts in the division. Harnai and Ziarat districts are inhabited by Pashtoon tribes while the other 4 districts are occupied by different Baloch tribes. The terrain of the division comprises plains and mountains. The road infrastructure is comparatively better in Bolan, Sibi and Ziarat and rest of the districts have low profile road network.

Dera Bugti and Kohlu agencies are entirely occupied by Bugti and Marri tribes. Due to recent insurgency in Balochistan, both districts are a no go area for development workers. The districts are economically poor and a large amount of the population has been migrated to Punjab and Sindh and other parts of the Balochistan Province. Sui gas is a natural resource which is coming from Sui-Dera Bugti Balochistan and is used for the national domestic and industrial purposes. Both districts have many clans and linage groups of the tribes. Tribal Sardar controls the socio-political culture of the districts. Literacy rate is low in both districts with comparison to other parts of Balochistan Province. There is no significant agriculture produces in the area other than millet and sorghum in Dera Bugti. In Kohlu district there are crop cultivated areas irrigated by tubewells and spate irrigation.

Harnai is a new established district. The district is geographically small but it is rich in water availability. Harnai has got moderate temperatures in the summer. Large amount of fresh vegetables are produced that are mostly sold in Quetta and Sibi. Harnai possesses large reserves of coals. The locals of Nasak, Zardalo and Sharag are engaged in mining, mining related labor, transport and hotels businesses. The major dominant tribe in the disctrict is the Tareen and the Kakar

The highland of Ziarat ranges 8.000-11.000ft above sea level. The winters in the mountains are harsh. Ziarat is famous for its horticulture especially fresh apples, peaches and cherry fruits. Due to harsh weather conditions large majority of the local population (60%) migrate to the Harnai plains where they spend the winter time. and return in Mid April to their native areas. Ziarat is a tourist area and approximately 0.2 million peoples from various parts of Balochistan, Sindh and Punjab are visiting Ziarat every year in summer months.

5.1 Sibi District

Three major hill torrents are flowing in Sibi District: Narri River, Chakar and Phujal River in Lehri tahsil.The provincial irrigation department built a weir in the perennial Narri River. Water from the river is diverted and used for irrigation and drinking purposes in Sibi and its surrounding villages.The estimated flow in the Narri is 120 cusecs after moonsoon. The water is owned by local tribes, mainly Khajjak, Luni, Dhapal and Pani that are living in various villages in the vicinity. The local government has also a share of water in the system and uses it for urban drinking purposes and irrigating the landscapes in government premises of the Sibi City. There is a network of tertiary canal for water distribution among the tribes mentioned.

Chakar River lays 15 kms in the east of Sibi City. The detail of the systems has been given in historical chapter measuring scope of irrigation in Balochistan. The Water is historically diverted by local farmers. There are numbers of off takes along the Chakar River. The first off take is (i) Talli (ii) Sultan Kot (iii) Raza Chandia (iii) Qaisar (iv) Chachar and partially Mal area. All the off takes are irrigating approximately 10,000 acres of land in a good year. The water is distributed on the principle of upstream first. The diversion systems are maintained jointly by the group of farmers at each off take. The contributions are made proportionate to the size of land owned by the individual farmers. The lands and water rights are registered in Revenue department SIbi.The entire water diversions structures are (earthen) except Chandia. The systems needs rehabilitation, strengthening of embankments to avoid overtopping of river at some locations, village protection walls and cleaning and extension of the centuries old systems are the main problems along Chakr River.

Similarly, Phjual River is emanating from the Marri hills in the east. The Rivers flow east – west and then south passing Lahri Village, Trehar Village and Bakhtiar Abad on main Jacobabad – Sibi highway. Final spate water enters in the Narri River and ultimately dispersesin Kenjhar Lake in Sindh. The flood water from the river is diverted to irrigation lands around Trehar and Lahri village at small scale. Further down, the spate water is utilized by several villages of Domki Tribes. Sibi District is not entitled to the flood water from Narri River except its perennial flow

which is utilized by the farmers in and around SIbi City.

Surplus water of Chakar River are further diverted towards Mal Goramzai, and Theiri Baramani area where large amounts of land lying barren. Similarly, surplus water from Phujal River is utilized on both sides of the 50 kms long access road from Bakhtiarabad – Lahri Village. Furthermore villages bordering Dera Bugti District like Sonwah, Maiwah and Mirwah areas are utilizing Phujal River water to irrigate their land every year. There is a need for land development, diversion structures and water reservoirs in lower Phujal spate irrigated areas. New canals and trenches may be developed to bring more land under vegetation cover, rehabilitate rangelandand recharge groundwater aquifers.

5.2 Dera Bugti District

Dera Bugti is bordering Punjab in the East Rajanpur and Kashmoor in southt-west Dera Murad Jamali and Sibi in its west. The district is predominantly occupied by the various lineage groups of Bugti tribe besides a high number of Local Hindus Since 1955; the famous Sui is situated in Dera Bugti district providing natural gas for domestic and industrial use at country level.

Major source of income for locals are livestock rearing, daily wage in Sindh and low profile jobs in (PPL) Pakistan Petroleum Limited main field at Sui. District Dera Bugti is devoid of surface water availability other than natural hill torrents. There are some areas having spring water availability and utilized by the local population. The entire population depends mainly on livestock rearing. Another source of income is daily wages from mainly Kashmore, Jacobabad and Nawab Shah in Sindh Province. A high number of people from Sui Tahsil seasonally migrate to Pat Feeder Canal area for fodder for their animals. Adult's male and female work as agricultural labor in the wheat harvesting season. Dera Bugti has a high potential for spate irrigation in the following localities.

Table 9: Spate Irrigation potential in Dera Bugti District

S/No	Name of Sub Basin /River	Potential for Spate Irrigation	Remarks
1	Belab River	Exact scale of spate irrigation is not available but there is ahigh potential for spate irrigation development	Dera Bugti Tehsil
2	Pesh Bogi Nullah	Exact scale of spate irrigation is not available but there is a high potential for spate irrigation development	Dera Bugti Tehsil

3	Nelagh	Exact scale of spate irrigation is not available but there is ahigh potential for spate irrigation development	Dera Bugti Tehsil
4	Gandoi Nullah	Exact scale of spate irrigation is not available but there is a high potential for spate irrigation development	Dera Bugti Tehsil
5	Washaf Nullah	Exact scale of spate irrigation is not available but there is a high potential for spate irrigation development	Dera Bugti Tehsi
6	Hado Nallah Tobba Nallah Gazi Nallah Dakin Nalla Jar Nallah Sehani Nallah Duzkustak Nallah Heran Nallah – Sui Kashmore Road Land along the Sui-Kashmor Road	Exact scale of spate irrigation is not available but there is a high potential for spate irrigation development	Tehsil Sui area

5.3 Kohlu District

Kohlu District is the area of the Marri tribe's who was founded by Chakar in 1550. Marri have been warriors in the Baloch History of Balochistan. The district is mainly occupied by the various sub-tribes of the Mari tribe. A small amount of Zarkoon belonging to the Pashton ethnic groups are also living in the vicinity of Kohlu City.

Kohlu has never been a good agricultural area. Agriculture is mostly rainfed and tubewells. Furthermore surface runoff is used to capture moisture for crop cultivation. Kohlu comprises of large valleys. The human settlements are based on clan and kinship basis of different sub tribes of Marri Tribe.

The entire population of the district is tribal; the clans are headed by their chief called *wadera*. The decisions are

made collectively not individually when the joint and common interests are involved. The Marri tribe remained hostile to the government from 1974 when the federal government undertook astrong military operation. Since then, the migration of the Marri tribe started and a high amount of Marri men left the area to settle in Sindh and other parts of Balochistan. Initially migration took place for safety reasons that further converted into permanent resident. In the mid nineties, electricity has increased the income from agriculture when a many people started to use tubewells for agriculture in the surroundings of Kohlu City and its suburbs.

The locals are depending on rainfed agriculture, livestock and labour in coal mines in Chamalang on the border of Loralai and Kohlu District.

Spate irrigation can be developed in many areas through Kohl district. The wider scope of such irrigation is possible to intensify through construction of spate controlling structures in the following valleys:

Narri River	-	Passing near Karahi Maidan in Kohlu
Mawand	-	The entire Mawand Tahsil and mainly alongside the Sibi-Kohlu Road

5.4 Harnai and Ziaarat Districts

Harnai is rich in surface water. The all region is relying for irrigation on small perennial flows and shallow wells in torrents passing through the district. The district is supplying fresh vegetables to the provincial market on large scale. There are giant coal mines in the area. This creates the second largest source of income for the local people who are engaged in transport and hotel business. There is no major potential for spate irrigation in this district and no elobarate information on the subject is made part of this handbook.

Secondly Harnai is adjacent district to Ziarat. This district is severely cold in the winter months. Therefore many people from Ziarat migrate to Harnai in December and stay until mid April. Almost 50% of the households' residents in Ziarat district possess agricultural lands in Harani district as well. So, the people of Ziarat have two dwellings: Ziarat itself in the summer and the Harnai plains in the winter season. Due to the steep slopes and volatile flood flows, Ziarat does not offer potential for spate irrigation expansion.

5.5 Ziarat District

Ziarat comprises of mountains mostly covered with Juniper forest. Ziarat is a good place for local tourism in the summer. It creates considerable income for the local people through renting guest houses and food based business. The major part of irrigable land in Ziarat district is occupied by apple and cherry orchards that are irrigated by the traditional karezes and deep tube wells and dug wells. The area receives heavy snow fall and precipitation in the winter months which is the major source of water in district and recharges subsurface shallow aquifers used for karezes and dug wells. Numbers of delay action dams are also build in the district to supplement irrigation water needs and ground water recharge.

Spate Irrigation is practiced on small scale in the south eastern part of Ziarat beyond Shrin Viala. There is no high potential for spate irrigation in this district apart from small scale water management through lined tanks. The district needs protection against soil erosion. This can be provided through the contruction of stone packed gabion structures along the rivers.

6 Spate Irrigation in Zhob Division

Zhob division comprises of 5 districts: Zhob, Killa Saifullah, Loralai, Musa Khel and Barkhan District. Most of the areas in Zhob Division is tropical and gets excessive monsoon rains with comparison to other parts of Balochistan. The entire region is moderate in the summer months and severely cold in the winters. Sherani and Killa Saifullah districts get snow fall in winter every year. The population through Zhob division is sedentary and does not move anywhere else with exception to several hundred households who have small ruminants flocks temporarily move within their local territory in search of green rangelands for their animals.

The Zhob Division exists of various tribes of Pashtoon with exception to Barkhan that mainly comprises of Khetran and Marri Tribes of Baloch. Major sources of income for the local population are irrigated agriculture followed by livestock rearing and government employment and coal, (inferior type of) Onex and granite mining in the Loralai and Killa Saif Ullah districts

The agriculture in Zhob division is depending on groundwater, natural springs, open surface shallow wells and Karezez. Historically, the Pashtoons are not inclined towards spate irrigation system and its techniques. In the division, no spate water rights or distributions practices are observed, neither registered in the land records. However, in the rainy season farmers at local level divert small streams flows to fill their embanked bunds. Rabi wheat, barley and mong beans are cultivated in Killa Saifullah district, Zhob District and part of Loralai district.

6.1 Zhob and Sherani Districts

Zhob is a district in a declared provincial tribal area which is borded by Afghanistan in the west, KPK in the north-east and Killa Saifullah in the south. Zhob is situated 350 kms in the north of the provincial capital. The entire district is mainly occupied by the Kakar, Mandokhel and Babar Tribes of Pashtoon.

Zhob has a tropical climate. It receives heavy rains during monsoon every year. Main sources of income are agriculture, livestock, trades and government employment. Zhob entirely consists of hilly mountains with plains and fertile valleys. The main water source for agriculture is predominantly perennial flows, springs and karezzes.The recently build Sabakzai dam has added a new command area under irrigation in Mina Bazar area. It irrigates approximately 7.000 acres of land on regular basis.

Zhob is rich in surface water Local communities settled along, Sawar River, Saliaza River, Zhob River. Irrigation water is mainly diverted by the schemes constructed by the provincial irrigation department. No Formal spate irrigation is

practiced in Zhob District. But there is still a high potential for expansion, especially by investing in infrastructure, land leveling and water distribution. The Following areas are suitable for spate irrigation in Zhob District:

Surab Manda and its both banks
Sra Khula Zhob
Tra Manda – Lakka Bund Area
Tirkha Manda – Margha Kibzai area
Both banks of Zhob River

In Laka band, shaghaloo and Tehsil Kamar Din Karez, the groundwater is shallow. Small scale pump sets can be installed for irrigation. Traditionally the local population is depending on their livestock for income. The local population is malnourished and economically poor and cannot make investment in the irrigation sector. A sort of joint venture with community on share crops and investment basis can be set up in cooperation with the provincial government.

6.2 Sherani District

Sherani has been a Tahsil of Zbob district and dissected to establish a new district in 2010. The entire Shirini district is occupied by Shirini tribe of Pashtoons. There have been many local feuds thatlead to blood shedding. Majority of local households in district earn their livelihoods from livestock rearing.The watersheds and mountains are naturally green and offer a healthy environment for livestock breeding. The majority of the Shirini tribe is working in the Arab Gulf States.

Irrigated agriculture is done on small scale for crops such as almond; wheat, barley, and maize. The agriculture produce are mainly consumed locally. Surplus is sold in the outer market. The local population is not much inclined to irrigation rather prefer to keep livestock. Agricultural employment is almost zero, due to non availability of good soil in most part of the district.

6.3 Killa Saif Ullah District

Killa Saif Ullah district is abode the of the Kakar's Nawab that belong to the Jogezai tribe and has authority over all Kakar tribe in Balochistan and Afghanistan. The area has been depending on spate irrigation until it was connected to the national electricity grid in 1977. Human settlements are found along the rivers and dry water creaks. After the rise of subsidized electricity, farmers switched 100% from spate irrigation to groundwater extraction for crop cultivation. Major cash crops are fresh vegetables and fruits. The area bordering Afghanistan in the west forms a large range land that offers livestock fodder for the seasonal nomads from Afghanistan and local livestock breeders.

Livelihood of local population is mainly depending on groundwater irrigation and livestock breeding. The villages

with electricity are now completely shifted to ground water for irrigation. Villages with no electyricity are depending for their income on livestock rearing, government employment and trade.

Spate irrigation is practiced along Killasaifullah – Zhob high way on small scale where flows from nearby creeks are diverted and utilized for irrigation. Temporary diversion structures build by the farmers are working well due to small volume run off from the hills. Wheat, barley and mong bean are cultivated. Farmers depending on spate irrigation are economically poor compared to farmers who cultivate cash crops with groundwater release from tube wells.

The wide barren lands alongside the Zhob River starting from Kan Mehterzai offer the potential for spate irrigation development. Balochistan government has recently prepared a pre-feasibility for the flood based farming by constructing diversion structures in Killa Saif Ullah district to irrigate these plains. The proposed project will irrigate 5.000 acres of new occupied land.

6.4 Loralai District

Loralai district is occupied by Pashtoon tribes. The Kakar, Tareen and Nasar are the major tribes settled in the various parts of the district. Irrigated agriculture in Loralai was affected by droughts in 1995-2001 when the major irrigation systems depending on Karez supply run driy. In many villages 100% depletion of the groundwater aquifers has forced local population to migrate elsewhere to earn any income.

Spate irrigation is largely practiced in Tehsil Mekhtar. Flood water is diverted from small and medium torrents. Loralai Tahsil also lay in the range of monsoon which receives rains heavily in the season making green range land and supply water for spate fed agriculture. Rains are erratic in this area and cause erosion.

The large majority of the people living in Tashil Duki are earning income from the local coal mines owned by the local elite which provide large scale employment. Onex mines in loralai are also a major source of income which is owned by the local communities. Coal mines of Chamalang are considered a large natural resource owned jointly by the Luni and Mari tribe that provides high income to the local tribe's owners of the resource. The mining in Chamalang has created new ways of income transport and trucking, hoteling and mining based employment in and around Mekhtar area.

Spate irrigation has a much potential in Tahsil Duki, Tahsil Mekhtar and lower adjoining parts of the Sehan River in Tehsil Bori where thousand acres of arid land are available. Ground water has been declined in Loralai district. There is a need to develop and expand spate irrigation systems to meet the future food security of the increasing population. The barren lands are owned by various local tribes and still lying under communal tenure. It can be redistributed with the joint consensus of the tribes.

6.5 Musa Khel District

Musa Khel is situated 450 kms in the north east of Quetta. Musa Khel has been part of district Loralai until mid eighties. Majority of local population belong to Musa Khel Tribe of Kakar Pashtoon with a couple of other small tribes such as Jaffar and Qaisrani living in the eastern edge of district bordering Dera Ghazi Khan in Punjab – Balochistan border. Local conflicts on land distribution, internal interest and tribal feud within the clans and tribes remain high. The Primary source income in the district is livestock rearing followed by agriculture and daily wage labor in Punjab. The entire district forms the catchment area for Snaghar River. Musa Khel is connected with Punjab at Taunsa Sharif by a feeder road. Products for daily domestic use are also coming from Punjab.

The district falls under the monsoon range. That makes the annual rain fall higher in this region in comparison with other districts of Balochistan. The north and north-eastern part of the range are naturally green which host the nomad livestock herders of Musa Khel and Afghanistan. Similarly, in the winter Afghan nomads with their flocks seasonally migrate through the district to the warmer Punjab plains.

Regular irrigation depends on small scale springs and perennial flows in the catchment. However the major part of agriculture in Musa Khel district is rain fed. The local population is not used to irrigatetheir crops. Seasonal crops in the area are wheat barely and sorghum which is consumed locally.

Following valleys and area offer potential for expansion of spate irrigation along the hill torrent in the district:

Loay Lahar	-	On both banks got a high potential
Kingri Nallah	-	Got a potential in various places
Luni Lahar	-	Small potential
Tributary of Lori Tang-		Small Potential
Khajuri Nallah	-	Got a potential along its length
Sarin Lahar	-	Got a small potential

6.6 Barkhan District

Barkhan is bordering DG Khan Punjab in the east, Kohlu in the west, Dera Bugti in the south and Musa Khel in the north. Bakrhan is entirely occupied by the different linage groups of Khetran tribe settled throughout the district. The major source of income for the local population is agriculture, livestock, transport, and government employment. The area receives heavy and regular monsoon rains every year. Some valleys in Barkhan are rich in groundwater where farmers have installed tubewells to grow vegetables and other crops.

Temperatures in the summer are moderate. Farmers in Barkhan grow vegetables though March-June that they sell on markets in DG Khan and Multan. Punjab is the nearest and common market place. The serious medical cases are

taken to the civil hospitals at D.G. Khan and Multan. For higher education there are many educational institutions in Punjab.

The Khetran tribe has been in a historic conflict about land ownership with the Leghari Tribal Chief of DG Khan and Sardar of Barkhan. Leghari Chief Claims that land in entire Barkhan valley is owned by his family which was given to Khetran on tenancy and now the Khetran have occupied the land completely and not paying any share to the Leghari. When Farooq Leghari Chief of Leghari Tribe became the president of Pakistan he started a case in Supreme Court and won the ownership of land in Barkhan district. But he has not been able to secure land ownership. Written In cadastral records of many valleys land ownership of Legharis and Khetran are their hereditary tenants.

In spate irrigation and rainfed cultivated areas in Barkhan mong beans, sorghum and millet are cultivated. The spate irrigation practices in the district are different to other areas in Pakistan. Normally, the irrigated fields are in plain valleys and catch the run off of the small hills and local plains.It is not common to divert water by *ganda* system or diversion bunds except on a few typical locations on Rakhni manda. Farmers have built the dry stone intakes and outlet at the field level and during rain the structures works properly without managing the water on the spot. Due to heavy rainfall, the natural vegetative growth affects the crops seriously.

In Barkhan, many valleys lay under communal tenure that can be developed byrain water harvesting and spate irrigation systems. There is no high potential for spate irrigation development in the district. However, minor developments on water management, construction of inlet and outlet structures, land leveling would add to more agriculture returns and incomes.

Following hill torrents and the valleys have potential for spate irrigation in Barkhan District:

Daula Rud and Tributaries	-	Through its entire length
Suka Lahar	-	Some it's Bottom Valleys
Pir Wali Naddi	-	Some of its Bottom Valleys
Churi Naddi	-	Some it's parts
Chang Area	-	Large Valley with spate harvesting potential
Wandoi Lahar	-	Some of its parts
Malain Area	-	Some of its Parts
Karach Nala	-	Some of its Bottom Valleys
Han	-	Its Bottom end areas

7 Spate Irrigation in Naseerabad Division

Naseer Abad Division situated in the east of Quetta on Main Jacobabad-Sibi -Quetta Road. Two of the four districts, Naseerabad and jaffarabad, depend on the Indus River Canal systems for perennial irrigation. Patfeeder, the

recently built Rabbi Canal and the Kirthar Canal are serving the irrigation water needs of the districts. Dominant tribes in Naseerabad division are Rind, Raisani, Chalgri and Jamoot in Bolan, Umrani, Khosa and Jamali in Jaferabad and Naseerabad, Magsi, Lashari and Syed in Jhal Magsi district. The main spoken language of the area is Balochi and Saraiki where Sindhi is widely spoken through all the districts in Naseerabad division. A high amount of local Hindus live in all districts.

A Larger proportion of land in the districts Naseer Abad, Jafferabad, Bolan and Jhal Magsi is owned by the feudal Baloch tribe. There are other tribes who own high amounts of land in western Balochistan. Among them are Lehri, Zehri, Sasoli, Bugti and Mengal Baloch. The later have purchased the landin the past or acquired land rights during the Kalat sate times. Hindus do not possess agricultural land and earn income from local trade, selling and buying of surplus wheat, rice, sorghum and other local harvests.

Each tribal chief lives with his clan's men in their respective area. The tribal chiefs are traditionally making the decisions at the time of conflicts and armed feuds. Local governments in the area are constituted through the will and support of these localchiefs. In this case the government in this district is weak in power with comparison to other district governments in the country.

Bolan is a very dry region. Only land is irrigated from water that comes from the Bolan River. Irrigation from this river is taking place in Drabi, Rind Ali, and Kot Raisani area. However a large part of the Bolan district is depending on groundwater from tubewells and spate irrigation. Land in the District of Jhal Magsi is irrigated from the perennial flows of Mula River. The water is distributed among the different tribes. However the major amount of water is used by the Bhotani Clan of the Nawab Magsi. The Lashari's of Patch, Syed in Fatehpur. Furthermore the government farm Gandawa is also using water from the Mula River. There are few more springs in western Kirther Range that are owned and utilized by Dinari at Khari, Kasuk at Konara and Shoran River for irrigating land in Gajan in Jhal Magsi and Shuran in Bolan District.

The rest of the eastern lowlands are depending on seasonal spate irrigation, where majority of the population are living in poverty. Normally the local people from these local areas seasonally migrate every year to canal irrigated areas of Jafferabad and Naseerabad in search of livelihoods and green fodder for their animals.

Wheat, sorghum, mong, millet and mustered oil seed are the major spate irrigation crops in Bolan and part of Jhal Magsi districts. Several water basins end up in the Nasseerabad Division that is mainly Bolan River, Mula River, Kashuk River, Narri River, Chakar River and Phujjal Rivers. These rivers have the tendency for causing damages at the lower parts of Naseerabad Division along district Dera Mrad Jamali. The surplus water from the rivers finally dispersed in Manchar Lakre in Sindh.

7.1 Bolan District

Bolan district with it's headquarter at Dhadar is situated at the gate of Bolan Pass/River that enters in the Kachi Plains. The dominant tribes in the area are Rind and Raisani. There are a few other small Bloch groups living in the area such as the Khosa, Mugheri, Chalgri and Jamoot. District Bolan is a dry region. Only small permanent flow in the Bolan River is utilized for irrigation by the Syed Dopasi, Raisani, Rind and Khosa tribes settled in Rindali and Mushkaf village along the Sibi-Quetta National Highway. The major crops grown in this area are fresh vegetables, wheat, barley and green fodder. Green Fodder is sold to the large commercial dairy farms in Quetta.

The remaining areas in Bolan are depending on spate irrigation. Mainly Rind, Raisani, and Shahwani tribe along the Narri River are beneficiaries of spate irrigation. Spate Irrigation in Bolan district developed by the Kalat State was distributed to tribes that joined the major state based military expedition in the time of Khanat. In Balochistan, the Narri River spate irrigation system had been one of the well defined systems that is properly operated and maintained by the local farmers under the supervision of Kalat State. Government of Balochistan is currently building a modern spate irrigation system by placing mini barrages to replace the 6 traditional major off takes (gandas) along the Narri River. The barrages would be electronically operated through locally generated electric power and trained staff of Provincial Irrigation Department. With an estimate 150,000 acres of land will be irrigated after the completion of the construction.

In the past the Bolan Dam and Mahram Dam were build to supplement spate irrigation. Both structures were washed away during the 1985 floods and never re-build until now. In Balochistan, famous Mehrgrah Civilization traces are found in Bolan that refers to 7.000 BC. There are ancient signs of spate irrigation in Bolan. Up hill Gazg, Narmukh and Johan areas where large *gori* bund are still visible. District Bolan consists of hilly regions in the west and Kachi plains in the east. This offers large potential for spate irrigation development. The following hill torrents are potential area for spate irrigation expansion in Bolan district:

Bolan River	- After Pir Thango area, the banks along the river have high potential.
Sukleji Rver	- There is a high scope to irrigate the left bank lands
Narri River	- There is large scale irrigation and efforts are required in introduction - of agricultural extension and water management at canal level.
Mushkaf Nallah	- Spate Irrigation is practiced but there is a huge scope for expansion by digging new canals further downstream
Paro Nallah	- There is a high potential in the lower plain area through water managements and diversion structures.
Bibri/Sibri Nallah	- High potential is diverting spate water to irrigate the land on the right side of the river down the Sibi-Dhadar Road.
Dong Nallah	- Reasonable potential in plain area where nallah emerge
Dhong Jhal	- Reasonable potential in plain area. Needed land leveling and

water diversions

Kharo Nallah - Height potential for spate irrigation by managing water in lower plains through- building canal, land level and field embankments etc.

Phujjal - Tahsil Lehri area

7.2 Jhal Magsi District

Jhal Magsi has been part of Kachi district and got its district status in 2002. . The district lay in the foot hill of Kirthar Range in the west, District Shahdad Kot in the south, district Bolan in the north and the eastern frontiers are bounded to jafferabad and Naseerabad districts of Balochistan. The major ethnic groups are Magsi, Lashari, Dinari, Syed and Jamoot. The land resources are largely owned by Nawab Magsi family in the district. In Pach, Kotra and Kunara villages lands are owned by the Lashari's. Khari area is under the ownership of Dinari Baloch tribes. Size able parts of lower plain irrigated by floods are owned by Syed, and other Jamoot tribes settled in the Gandawa and its suburbs. There are 200 numbers of local Hindu families living in both tahsil Gandawa and Jhal who are mainly engaged in local trades and –lend money to the local farmers for their day to day needs.

Floods from the hill torrents of Western Kerther Range are used for spate irrigation mainly in the lowland areas of Tehsil Jhal and Gandawa. The rest of the water further drains to the east and then to the south and finally ends up in Manchar Lake in Jamshoro district of Sindh Province.

The lands are distributed among the tribes at household level. There are no communal lands other than the mountain range. The main source of income of the local population is agriculture and government employment. The Nawab Magsi overall dominates the district in managing tribal conflicts and local politics. An occasionally armed conflict erupts between the various tribes over the tribal matters. These conflicts were finally resolved in Balochi Jirga through tribal elders. The political situation in the district, being in the vicinity of Sindh Border's is however still unstable. It is unsafe to travel by road by night. Road robberies are often reported in local media.

Western line of Kirther range is rich in ground water. There are many springs and perennial flows that irrigate the small lands. Mula River is main source for spate and perennial irrigation. Perennial water in the river is utilized by the local farmers groups in Gandawa Tahsil. Water is distributed at the village level down to household level.

Large proportions of spate irrigated land are owned by the Nawab Magsi family in Tahsil Jhal with small entitlements to the rest of the Magsi Tribe. The spate irrigated lands elsewhere in the district are tenant operated. At the time of harvest the authorized Naib of the Nawab are informed for *Batai* distributions of shares. This is done individually with each tenant. The share of Nawab is collected and sold by the Naibs.

Local markets are Gandawa and Jhal and are mainly owned by Hindu traders. Cash payments are not common. Especially the small land owners and tenant families are borrowing daily needs from Hindu and the loans are re-paid at the harvest. In some cases tenants hardly have any harvest left after *Batai* and the major left overs are spent to settle the debts he has on monthly basis.

7.3 Nasirabad and Jafarabad District

District Naseerabad and Jaffarabad are bordering Sindh in the South. Both districts are connected with the Indus connected Pat Feeder and Kirther canals. The dominant tribes in the districts are Jamali, Umrani, Khosa and Bugti, Kharani, Nandwani and Jamoot. The tribal feudal possess large size of irrigable land in the district. The lands are mainly operated by tenants. The major languages of the area are Sairaki and Sindhi. Major crops grown are paddy and wheat. Winter vegetables are also cultivated in the districts and sold in Quetta.

Pat Feeder canal is passing through district Naseerabad. The torrential floods from Narri, Phujal, Bolan, Mula, Kashuk are finally joining in the north of Dera Murad Jamali and flow along the right bank *(Beroon)* of the canal. High floods inundate pat feeder in the tail close to Tahsil Chattar and flows towards south to finally disperse in Manchar Lake,Sindh.

There is no scope of spate irrigation in the district at all. However, both districts have been affected by Indus floods in 2010 and there is a need to construct flood protection dikes in various villages to cope with future floods. There is a further need to train and sensitize the local population how to build houses particularly on artificially elevated dikes.Howver the positive side is that due to flood water accumulation, there are small wet lands in the district that host migratory birds in winters.

Chapter -II

8. Spate Irrigation in Punjab, History Current Status and Practices

8.1 History of Spate Irrigation in Dera Jaat

Spate irrigation in district DI Khan and DG Khan called Dera Jaat in British colonial records is not older than 500 years when Baloch tribes migrated with Chakar Rind to Punjab plains. Koh-e-Suleman or Suleman ranges were occupied by various migrant Baloch tribes. Tribes that settled down in the province from north to south area: Kaisrani, Buzdar, Khosa, Lund, Leghari, Mazari and Dreshak and Gorchani. The entire lands in piedmont area of suliman range and inside the mountain are occupied by these tribes within their own tribal boundary. All the tribes have their known boundaries. The lands are distributed on the linage basis.In the past, the province have been under the rule of various tribes. Under the Kalat State, the province was under the rule of the Baloch tribe. Then it was occupied by the Nawab of Bahawalpur which later on was taken by Sikh density of Ranjeet Singh. Ranjeet Singh was expelled by the English Colonials.

English colonials introduced land rights through recording the land title under Management System of Land Revenue Department. Though there have been quarrels between the English colonial and local tribe men on the inheritance rights to be given to the females which were denied by some tribes in Dera Ghazi Khan.

Spate irrigation systems were developed by setting the scale of operation and maintenance depending on the the size of cultivated land. The same rules were used during land settlement from 1860-1901 in Dera Jat District. Separate Rodh Kohi staff was appointed to settle and record the water rights. Water thefts, intentional breaches of ganda and land right conflicts were put under the government rule. The department and staff still exist but their support to the farmers is now diminished by taking care of the old records.

9 Current Status and Practices of Spate Irrigation in Punjab

Punjab province is depending on Indus River and Jehlum River to supply watet to t world largest canal irrigation systems. There are three broader types of irrigation systems prevailing in the province: Perennially fed Punjab land, tropical range fed regions and dry hill torrents.

Panjab's major piece of land is irrigated from the Indus and Jehlum River. The Potohar region comprises, Jehlam, Chakwal and part of Mianwali, surrounding of Islamabad Capital, Haripur and Manshera districts. These districts are tropical rain fed regions and are depending on seasonal rains for crop cultivation. Estimatedly, 50% land in western hilly regions of Dera Ghazi Khan Rajanpur in south Punjab is irrigated though spate irrigation. This guide book does not include any recommendations of the rest of Punjab irrigation sector and will stick only to the spate Irrigation area with defined water distribution systems in Dera Ghazi Khan and Rajanpur. This Guideline does not discuss khushkaba rain fed regions including Jehlam, Chakwal, Mianwali, Islamabad Federal Capital Territory and Mansehra.

9.1 Spate Irrigation in Dera Ghazi Khan Rajanpur Districts

Dera Ghazi Khan and Rajanpur are situated on the west bank of the mighty Indus. After the construction of Taunsa barrage in 1970, the DG Khan Canal was excavated to irrigate land on the west bank of Indus. It is called Dajal Canal when it enters the Rajanpur district. Chashma Right Bank Canal (CRBC) has been completed in 2006 and is irrigating lands in Taunsa Sharif, a tehsil in the north of Dera Ghazi city bordering north with KPK Province. CRBC ends after entering DG Khan Canal near Mana Ahmadani village on the Indus High way 18kms south of Taunsa Sharif City.

Both canals have brought those lands under canal command that once were spate irrigated areas. Now, off course famers have shifted their interest into newly build canal systems which are more secure and easy in operation and maintenance. The famers whose lands became a part of canal system have stopped their contributions towards the spate irrigation system maintenance since they are not using spate water any more. As a result the spate irrigation system is only left to the farmers outside the canal command west bank (locally known *Pachad*) of CRBC, DG Khan or Dajal Canal. So there are two kind of farming communities: Those that are depending on conventional canal irrigation and those on spate irrigation. Both farming groups have distinct problems in their areas. Communities depending on canal system are facing flooding problem of the Suleiman range which inundate their lands and local settlements. Recent floods in 2010 have entered in Dera Ghazi Khan City and its surroundings. Similarly Rajanpur district and its western parts were badly affected by the 2010-12 floods coming from the western mountain range. In Tahsil Taunsa farmers in CRBC commanding area are facing water logging problems in the command area after it enters in the Punjab jurisdiction of Dera Ghazi Khan. The large parcels of land are completely destroyed by water logging starting at Kath Gargh- Tibi Kaisarani until Narri village along the Indus highway.


Erosion-Flood Water Distribution Kaha Sultan Rajanpur

Reportedly there are 200 small to medium and major hill torrents in Dera Ghazi Khan and Rajanpur districts originating from the western Suleiman range that flow towards Indus river in the east. Out of those, 13 are major hill torrents which end up by joining Indus River every year. The internal distance from the Suleman range to the Indus River varies from place to place. In Taunsa Sharif, the closest distance is 12kms. Here spate water flows with high velocity enabling the spate farmers to manage it for irrigation purposes. The largest distance from Suleiman range to Indus River is about 50kms from Kaha or Chachar hill torrent in Rajanpur district. These hill torrents bring flash flood of short duration but with high magnitude and are highly unpredictable and erratic in nature which causes flooding to lower areas. It effects rangelands, housing structures and inundates roads, and canal network of DG Khan and Dajal Canal fed irrigated area. Contrary to large hill torrent, the small are manageable. Here farmers are diverting water for irrigation through build structures locally called (*ganda, wakera, wah, bund, chur and LahRi*) etc.

During the last decade, Punjab Irrigation Department Circle Dera Ghazi Khan built such structures in Mithawan, Kaha, Kaura, Vehoa, Taunsa and Wadoor Hill Torrents. The main structures built are bed stabilizers, wire crated diversion bund and intakes, Guide bunds, Erosion control walls, RCC intakes and flow division structures. Construction work in some areas is still in progress. The main construction focus remained on the diversion structures and no attention is given to the spate feeding canals which are either silting up or causing serious erosion due to secured and augmented water supply from constructed diversions. It is imperative that the spate irrigation should be seenas a whole. All three components must be included in the project plan (i) the diversion structures, (ii) the main feeding canals and (iii) the command area development works. For example in the project channel bed erosion in the feeding channels of Bigwari wah on Sanghar spate irrigation and Haji wah on Mithawan hill torrent is not addressed. The channels beds are badly eroded and farmers are not able to divert water to their fields. As a result, water in the channels is flushed away to the Indus or disperses in lower command depressions which cannot be used for cultivation. It deprives the upstream farmers. Similarly in Kaura, the construction of proper headwork is now causing flooding in the lower command area and local villages. These constructed structures at the river level are free intakes which cannot stop the undesired flood flows.

Line department elsewhere are more focused on the construction of head works and guide bunds or to safely pass the hill torrents floods to Indus River without causing damages to the public and private owned constructed structures.

Additionally, there are drainage problems in major hill torrents in the district. After the excavation of DG Khan or Dajal Canal in 1970, proper cross drainage structures are either not builds to pass the peak floods or they have been silted up with the passage of time. Encroachment of the natural drainage routes are further narrowed down by the local farmers. Another factor of flooding in Rajanpur district is the construction of Kachhi Canal which has blocked the water in the 2010 and caused flood damages in the surrounding villages in Rajanpur district mainly in the west of Kachi canal.

There are 2 major types of spate irrigation systems in Dera Ghazi Khan (i) in the mountains (ii) in the piedmont areas. The farmers living in the mountains have small- pieces of land. Those are irrigated by water runoff from creaks that is managed and drained during rain. Hence major problems of this category of spate system are frequent soil erosion around flush structures. Intensive repairs needed are sometimes beyond the farmer's capacity. It is relevant to mention that in the mountains spate irrigation is still done with bullocks due to none availability or in some cases none accessibility of tractors and agricultural machinery. Protection of land is more important to save the small land holdings from frequent erosion. Due to remoteness of catchment ranges, accessibility problems, the availability of machinery spate irrigation practiced in the mountains are in bad shape. None of the governmental/NGOs have focused on improvement of these irrigation systems.

Spate Irrigation in piedmont areas can be classified into sub-types. The first type is hill torrents where floods are passing through the small and medium catchments yielding manageable flows. Small hill torrents used for the spate

irrigation have their distinct problems. In many cases there are disputes among the farmers over the distribution of water. The farmers of such systems are economically poor and their efforts to system maintenance to rehabilitate the inundation, and frequent breaches of diversion structures and soil erosion is weak. The second type of spate irrigation in piedmont areas is where water that flows from small hilly routes called *(chur or lahRi)* and irrigates 50-100 acres of land in a good year. Such systems are manageable and local farmers are successfully practicing the spate irrigation through this category of irrigation system. Problem in this category are smaller with comparison to farmers on medium-major hill torrents.

Similarly the 3rd type of irrigation consists on medium to large hill torrents where water is distributed and diverted from rivers. Along such rivers, there are always series of off takes *(ganda)* that divert water to individual canals which is owned by the certain amount of famers. The maintenance of the diversion bund *(ganda)* is the collective responsibility of the farmers taking water from that particular channel/wah. The maintenance of the wah is the responsibility of the farmers. Similarly after the floods, the channel beds are cultivated and owned by the neighboring farmers where it passes.

There are rules and regulation for maintenance and breaching of *ganda* and water distribution which are respected and adhered in all parts of DG Khan, DI Khan, Rajanpur, Bolan, and Sibi districts.

The following main River in DG Khan and Rajanpur district is where spate irrigation is practiced. All systems are in bad condition. Due to none availability of earth moving machinery and change in land rights and further land distribution in the linage groups has reduced the land holdings. Most systems have become none productive. The following systems can be improved through more investments in diversion structures:

Vehoa Roud	- More New canals and Disaster Risk Management
Kaura Road	- More new canals and Disaster Risk Management
Litra Hill Torrent	- Water distributor, canal improvement and diversion structures
Bhatti Hil Torrent	- Water deflector, guide bunds and land improvement
Kawhan hill Torrent	- Diversion of water from Sanghar in the catchment, new canal for reserve land, flood protection, intake structures (mohan).
Snghar Hill Torrent	- More water management in Sokar village and Magrotha village
Mohi Hill Torrent	- Water deflector, intake structures and outlet structures
Suri Lund	- Diversion structure on both side of river in line with traditional water distribution
Mithawan Roud	- Improvement of diversion structures, flood protection structures, - improvement of feeding canal, resolve the command problems.
Wadoor Roud	- Water Diversion, flood protection around Wadoor village, and along - the edges passing in the west of DG Khan City
Kaha Hill Torrents	- Improvement in feeding canals, and at field water management
Chachar Hill Torrent	- New diversion structures and proper drainage of access water.

10. SPATE IRRIGATION IN KHYBER PASHTOONKHAWA PROVINCE

Chapter III

Current Spate Irrigation Status and Practices in KPK

In KPK, well know nspate irrigation systems exist in Dera Ismail Khan. However, small scale spate irrigation is practiced in Luki Marwat and Kohat Districts of the province. There is large potential for spate or conventional irrigation on the hill torrent passing in the south of Bannu where large tracts of lands are lying barren on the both sides of the river. Evidently, the width of the river is large here and it could be a problem for the local farmers to build diversion structures. It appears that in past, local farmers have never tried to divert and utilize water from the River.

Dera Ismail Khan is the most southern district in KPK province. The district is bounded in the east by Bhakar and Mianwali in Punjab, in the southwest by South Wazirstan Agency and Zhob in Balochistan and in the northwest by Laki Marwat and Tank District. DI Khan livelihoods depend on agriculture that can be further divided into 2 major categories (i) the canal fed agriculture and (ii) Spate irrigation based agriculture. In this guidebook the focus is on spate irrigation.

There are 25 sizeable hill torrents in the district: Pezu Nallah, Paniallah Nallah, Tank Zam, kiriana Nallah, Takawara Nallah, Hauz Khad, Soheli Nallah, Gomal River, Gomal Nallah, Luni North Nallah, Mochiwala Nallah, Bhuar Nallah, Khad Haranwali, Luni South Nallah,Sheikh Hyder Zam Toya Nallah, Draban Zam, Khad Warukay, Chudwan Zam, Kaura Khad, Gudh Nallah, Gajistan Nallah, Valhari Nallah, Sherana Nallah and Ramak Nallah. Along these hill torrents, spate irrigation is practiced. Rivers carrying the name with Zam mean that they have perennial flow availability throughout the year that is utilized by the locals. As per distribution, the upstream users have the first right to utilize the perennial flows as well as the floods flows. 0.63 Million acres of land is irrigated through spate irrigation every year.

Water distribution rules are well defined among the farmers and registered with the Revenue Department at Dera Ismail Khan. Each of the rivers is feeding certain numbers of *gandi* along its length in series. Each *gandi* is entitled to divert water as long as it survives the flood or its entitled command area is fully irrigated. Once the command area is full irrigated, farmers are not allowed to re-build their *gandi* and traditionally *(as per riwaj)* are bound to let the water flow to the downstream *gandi* to irrigate the land of those groups of farmers. S*aropa-paina* (head to tail water distribution is practiced at River level, *gandi* level and channel level). The maintenance of the certain *gand*i, its *(saad the guide bund)* is the responsibility of the group of farmers who belong to the gandi. There could be several groups of farmers with the water rights on relevant *gandi*. There are also farmers owning land in more than one *gandi.* The maintenance cost is collected jointly depending on the size of land owned under the *Haqooq, literally recognized rights of land and water.* There is land further downstream that are declared *non-haqooq* having no water rights in the hill torrents. So owners of such lands are not entitled to perennial or spate water, though the

lands are *bunded* and developed. Some of these lands get surplus water from breeches of fields in the vicinity.

Spate irrigation in DI Khan and elsewhere is in dismay due to shifting of interests of farmers in other sources ofincome. DI Khan lower plains are now irrigated by the recently build Chashma Right Bank Canal (CRBC). For the spate irrigation system that is left to the tenants it is unclear who is responsible for the maintenance and operation of the systems. Due to none availability of earth moving machines the rehabilitation of canals and *gandi* on regular seasonal basis is a difficult job and as a result many systems are damaged so badly that it beyond repairs.

Revenue department of District DI Khan is receiving marginal financial support in terms of bulldozers hours from the provincial government for the 25 spate irrigation systems every year which is not sufficient to meet the needs. There is no mechanism for the management of the meager resources provided for spate irrigation. In many cases local MPA influence the process which erodes the equality based resource distribution among farmers.

There is large scope to bring more lands under spate irrigation command if the services are extended to the entire spate irrigation systems in DI Khan. Huge investments are required in the construction of diversion structures, improvement of feeding canals and land development.

KPK government has recently completed Gomal Zam Dam with the financial support of US aid. The scheme has yet to be opertionalized since the district administrations together with the line department is working on the water distributions among farmers and constructing tertiary canals network in the command area. The irrigation water within the system of Gomal Zam was distributed according to *Riawaj and Kuliat* defined water distribution rights. Now the situation has changed and new rules for water distribution would need to be defined and redefined. It is estimated that 150,000 acres will be irrigated from the recently build structures. There is a potential risk for conflict on water distribution among the farmers entitled for perennial water flow and the farmers entitled for spate water irrigation under the old system.

11. SPATE IRRIGATION IN SINDH PROVINCE

Chapter IV

Spate Irrigation in Sindh Province

Sind province is entirely irrigated by the large canal networks dissecting from Gudu, Kotri and Sukkhar and Ghulam Mohammed Barrage. However, spate irrigation is practiced in Kohistan area of Sindh province mainly in the north-western Kerther range along Dadu, Jamshoro and part of Karachi district. There are dozens of other small to medium hill torrents flow every season to the Indus River without being used for spate irrigation.

Similarly the entire western side of the Indus, from Jamshoro – Dadu, is entirely depending on spate irrigation. However in this area spate irrigation systems are not yet developed. The development of the small scale spate irrigation systems in the Kirther range is neglected by the Sindh government that has no development program running in this area. For instance, farmers who live in the mountains and are now depending on livestock as the first mean of income could use the small scale perennial flows in the area for irrigation. Similarly, people who live in the piedmont area along the Jamshoro – Dadu- till the Balochistan frontiers are entirely depending on seasonal rainfall for irrigation, livestock water and domestic wateruse. In many areas if it doesn't rain for a year, the groundwater level drops down significantly and open surface wells are becoming dry.

11.1 Spate Irrigation in Jamshoro District

Jamshoro District in Sindh province is famous due its Agricultural University and Jamshoro Power Project. Jamshoro is situated on the right bank of the Indus A log bridge connecting it with Hyderabad. One can say these are twin cities. But the geographical area of Jamshoro is stretched to the north until district Dadu. Small scale Indus water based irrigation is practiced along the right side of Jamshoro-Sewan Road mainly south of Sun Tahsil.

Jamshoro comprises plain lands and hilly terrains in the east and Kirther hill range in the west. A large part of Jamshoro is dry . Many hill torrents flowing from Kirther are disappearing in the Indus. The larger majority of the District population belongs to various Baloch tribes mainly Chandio, Khakheli and Syed. A small amount of farmers living in Sun Tahsil, are pumping from a long distance water the Indus for irrigating winter wheat.

Spate irrigation systems that are well organized by Farmers in Sun Tahsil District Jamshoro are situated along the Ocha River where from Khaskheli Goth, Joda Khosa Goth, kachi Goth, Abra Goth. Sher Khan Goth, master nazar Mohammad Khakheli Goth and Mirwani goth are diverting the spate water for irrigation. Abra Goth is the largest beneficiary and is large in population size. There is formal distribution of the water between the various villages. Nothing is registered in cadastral records. Ocha River inundates the soil bunds and earthen structures when the excessive flood comes. Sindh Irrigation department is considering building large storage dams in the catchment area as irrigation reservoirs.

Ranni Kot River is another large spate water river. Most of its flood water flows into the Indus River in the east. Recently the local irrigation department has built a new spate irrigation system close to the Rani Kot-Sun road. No water distribution is introduced by the department until the completion of the scheme. As a result influential farmers are the major beneficiaries of the project. The project hassignificant impact in the surrounding of the Railway line in the east where groundwater has been recharged and farmers have started to pump water from dugwells to irrigate small patches of lands along the Rani Kot Road.

Spate irrigation can further be developed in the following areas of district Jamshoro by building diversion structures, feeding canals, , and water ponds. Furthermore there are large plain lands available in District Jamshoro's North that can be converted into spate irrigation:

Table: 10 Spate Irrigation Potential in Jamshoro District

S/No	Hill Torrent/River	Potential for spate irrigation development
1	Ocha River	Diversion structures at many locations, with improvement of feeding canals and converting plains into new land through embankments. Land distribution will be essential before intervention
	Rani Kot Nadi	There is a need to construct new diversions downstream of the existing spate irrigation scheme. Land leveling and landscape development need to be done for better water distribution.
2	Manjheri Nallah	The upstream area has potential for spate water management, by
		building diversions, field inlet/out structures
3	Jhungri Dhora	Along Jamshoro- Karachi Road – there is potential for Spate irrigation
4	Anero Nallah	Along Jamshoro- Karachi Road – there is potential for Spate irrigation
5	Kanwaro	Along Jamshoro-Karachi Road – there is potential for Spate Irrigation
6	Road nalla	Along Jamshoro Karach Road – there is potential for Spate Irrigation
7	Mucha nalahh	Along Jamshoro- Karachi Road – there is potential for Spate Irrigation
8	Mera Nadi	Along Jamshoro – Karachi Road – there is potential for Spate Irrigation
9	Lung nadi	Along Jam Shoro Karachi- Road – there is potential for Spate Irrigation
10	Patwaro	Along Jamshoro Karachi Road – there is potential for Spate Irrigation
11	Sarin Wari Nadi	Along Jamshoro-Karachi Road – there is potential for Spate Irrigation

11.2 Spate Irrigation Malir Karachi District

Karachi is a cosmopolitan city with a population of 120 million. Karachi is the provincial capital of Sindh and belongs to the National Hub of top largest cities generating revenues. There is significant scope of spate irrigation in the east then along Karachi – Hyderabad Highway that consists on hilly and dry. The major population living in the area is rural and belonging to various Baloch and Jamoot tribes. People in Noor Mohammed Goth and Khatore area are depending on employment in Karachi as their main source of income. Being a least devalued area and small scale irrigation; no significant investment has been made on the development of local irrigation systems mainly depends on torrential rains run off.

The following areas are identified as potential spate irrigation sites.

Table: 11 Spate Irrigation Potential in Karachi (Malir district)

S/No	River/Nullah/Area	Potential for spate irrigation
1	Konkar Nadi	Spate irrigation is practiced
2	Thaddo Naddi	Spate irrigation is Practiced
3	Mendiaro nadi	Spate irrigation Practiced
4	Turi Naddi	Spate irrigation is practiced
5	Kathore/Noor Mohmmed Goth	All land around Noor Mohammed Goth and Kathore area can be irrigated through proper construction of small scale water
		reservoirs, diversion bunds and field inlet/out structure through improved water management practices
6	Kirther National Park	Part of Karachi area coming in the National Kirther park

11.3 Spate Irrigation in Dadu District

In Kohistan area there are hundreds of small to medium sized Nai or hill torrents . Nihang Nai, Angai Nai, Taki Nai, Nali Nai, Shori Nai and gar Nai enter in Kacha area and finally flow into Manchar Lake. The major spate irrigation system in Dadu district was constructed in 1934 called *(Teer Bhit).* This system was washed away in the 1995 flood and rehabilitated in 1996 by Sindh Irrigation and Power Department.

Spate irrigation systems in this district are well defined in term of water and land distribution which is locally called *warabandi.* In Kerther National Park area in the vicinity of Thana Bola Khan Farmers are also utilizing ground water to supplement the spate irrigation and grow vegetable and onion on small scale level. The reported ground ater depth in the national park area is 6-17m deep where farmers have developed hundreds of dug wells to grow cash crops. Crop production through spate irrigation and the use of groundwater is the main source of income for the local people in the area. Livestock is considered the second source of incomes. Gaj Nai is the largest spate irrigation system in the upper Kirther hills which is feeding 9 separate off takes.

5 taluka in Jamshoro and Dadu district are entirely depending on spate irrigation that mainly include Dadu, Johi, Sewen, Kotri and Thana Bola Khan. Moreover people in Bhan, Haji Khan Village and Hairo Khan – Johi are 100% depending on spate irrigation farming. Reportedly 15.000 acres land was irrigated in district Dadu in 2001. This is before far below the available arable lands that can be irrigated in District Dadu . Large amount of the population migrate to the lowland in district Thatha to work as agricultural labor during the harvesting season every year.

12. ENGENEERING DYNAMIC IN SPATE IRRIGATION

Little investment has been made throughout Pakistan to develop and maintain this indigenous form of irrigation. Pakistan is the largest country in world practicing spate irrigation. Throughout the 4 provinces, similar types of crops and are cultivated in spate irrigated areas in similar types of environment. Furthermore the languages spoken in the spate irrigation through all 4 provinces are of the same of dialect mainly, Saraiki, Sindhi and Balochi. A large majority of the spate irrigation lands are from the Baloch tribe where Pashtoons own a large amount of spate irrigation areas in Pakistan, predominantly in Balochistan.

Not many researches have been done in Pakistan in the selection of improved crop varities for arid agriculture. Farmers are still using local seed varieties that have lost their production capacity. For instance the sorghum yield in spate irrigation areas in Pakistan is far below t the sorghum yield that is produced in spate irrigation areas in Africa. No research in Pakistan is focusing on crop-water management in spate irrigation areas. This is important because, spate irrigation as a traditional form of irrigation where water flows are unpredictable need a different kind of management comparing to conventional irrigation where the quanity of water flows are known and measured. While designing spate irrigations structures, traditional ways of engineering, local norms of system maintenance and water distribution have to be taken into account.

Engineering in spate irrigation is entirely different from that in perennial systems. Someof the spectacular failures in improving spate irrigation in the recent past resulted from a lack of appreciation of the special characteristics of pate irrigation systems. An evaluation of 47 relatively minor spate systems built in Balochistan between 1960 and 1990 for instance established that only 16 were still operational in 1990 (Groundwater Consult 1991). The main reasons were that the diversion structures has either been severely damaged by the floods or had been by passed after construction. In some cases disputes between water users had made the system inoperational. Another well-known failure is the Mithawan Dam in DG Khan that filled up withsediment within one year of completion.

Fortunately in recent years the understanding on what works engineering-wise and what doesnot work in spate irrigation has improved. For spate irrigation in most situations there is an appropriate improvement - be it in improving traditional diversions or in constructing new diversions or in engaging earth moving equipment on (reinforced) soil bunds. Special engineering challenges in spate irrigation are:

the challenge of capturing as much as possible of the usable floods in terms of volume, duration and timing
the need to deal with high floods - these may play havoc with the command area and are usually kept out
the need to deal with high sediment loads - in spate flows these can run up to 10% of volume. The sediment loads can help built up soils and brings fertility but they can also carry coarse material, clog canals and cause command areas to rise and go out ofCommand.
the need to operate in widely shifting river beds or in very soft alluvial material with the low flow channel moving in different directions and being hard to capture

the need to be economical - with very costly investment usually not justified in the low or medium value agriculture, that is supported by spate irrigation systems

the need to respect existing water rights and rules - these are often different in spate irrigation systems. Rules often accommodate a large number of situations - the sequence of water turns between separate command areas, the division of floods between both river banks, the designation of areas that are entitled to spate irrigation and areas that are not, the practices with changes in the river bed. In many spate irrigation systems

there are a series of separate intakes along the ephemeral river rather than one single diversion and water rights systems are based on these.
There is always need to consider improvement of feeding canals alongside the main diversion structures at spate irrigation systems. In many cases the feeding canals canal cause flooding to the villages, so the disaster risk reduction structure be considered in the design.
Include spate irrigation in the higher education learning at University Level leading to solution oriented modern research.
Availability of earth moving machines for the famers at district and provincial level
Spate irrigation produce organic crops and there is need to develop the value chains of different local crops for example chickpeas, mustered, truffle mushrooms and other organic food legumes and other medicinal plants.

Options for Engineering Structures in Spate Irrigation

Category	Structure	Notes
Diversion	Weirs	Create additional head, stabilize the river bed or bed fixers, But siltation in front of weir is inevitable, so small earthen, gravel, gabion structures are required to protect the diversion structure from erosion at bottom-end

	Flow dividers	It is useful to manage the flow in manageable proportions – need enough protection to avoid erosion near ashlars.
	Deflection spur	Common higher up the river/gravel fan Catches part of the flood – in high flood can be over top – exclude the low flood
	Gravel dike/bund	Suitable to divert the flow towards intake and can be alternative for weir (need rebuilding quite often)
	Soil dikes/bund	Suitable in lowland Alluvial spate systems Low cost: Location and choice of material is important (silty-loams non-saline) Reinforced by gabions, plastic sheet, brush woods or pegs. Often built at angle.
	Conical Abutment	Can protect intake or heads of spurs and stabilize soil bund
	Breaching bunds	Will act fuse plug and break and allow large flood to pass and save main infrastructure and command area. Allow having breaching bund high up the gravel fan as they may break too fast -proper location is in plain areas
Intakes	Multiple intakes and short canal	Preferred as to minimize conflicts and management problem
	Open intakes	Large dimensions- so as to pass large column of flood water in short time.
	Orifice intakes	To make it possible to exclude un-wanted large flood.
	Gated Intakes	Can allow closure of area if it is already irrigated. Mechanical operation may be difficult and it could be expensive option too.

	Rejection Spell way	Allow rejection of destructive floods
	Scour slice preferably with curved skimming weir	Can work but often closed by farmers as they do not want to lose water.
	Sedimentation ponds	In most these do not work – as their cleaning and flushing is cumbersome and farmers do not want to spend water on it.
	Trash racks	Put at angle as trash is guided to main river
River Bed Stabilization	Bed Stabilizer Or River Bed Fixer	Make sure that weep hole are provided to allow subsurface flow to pass Masonry: steep river slope Gabion : Flat river slopes
	Gabion spurs	Location and slope is important to avoid loss of area or undercutting over river Stepped nose to avoid scour around nose
	Vegetation bank protection	Can be natural – or planted need protection against cutting
Canal and command area structures	Steep channel	Preferred in upstream area with heavy sediment all the way to field (for look at natural drain)
	Shallow wide channels	Preferred in downstream area with soft alluvial soil to prevent uncontrolled scour.
	Stepped drop structure	Effective in dissipating energy In general try to provide drop structures – can some time be avoided by using a different route
	Gabion flow division/diversion structures	Ensure that downstream apron structure is long enough to avoid back cutting. Can stabilize and fix the flood channel bed

Improved field intakes	Allow closure of gate when the field is filled
Field inlet/outlet structures	Fields in catchments area are filled with small creaks flow. So needed to build rock filled inlets/outlet to take and flush water when field is filled accordingly
Over flow structure	Useful if there is level difference between to avoid gulling in downstream fields
Low recharge weir	Will reduce velocity of flows and induced recharge.

SOCIO-ECONOMIC CONDITIONS OF SPATE IRRIGATION AREAS IN PAKISTAN

12.1 Land and Water Distribution Pattern and Current Practices

Since spate irrigation is practiced in Pakistan for many centuries. Spate irrigation was the prime source of irrigation, before the modern irrigation systems were constructed in ninetienth century by the British colonials.

Maintenance of spate irrigation systems have to be done throughout the year because of frequent erosion and breaches, deterioriation of the system due to rodents and invasive plant species . Farmers have to stay ready to manage floods in the moments of the years those occurs.

The torrential floods have not been used effectively due to the absence of strong diversion structures. For instance when upstream a diversion structure will collapse, the upstream farmers are not able to irrigate their land from wah, or divert water from the river towards their canals during a particular flood event.

Therefore to secure water intake, more diversion structures (head to tail sarupa paina) are build along the river, traditionally made with stones, brushwood and soil. This pattern is more common in medium to larger hill torrents that flows several times in an average year.

Intakes are owned by a group of farmer who jointly build and maintain the system. Construction and maintenance is managed by the water bailiff, in Balochistan, Rais, in DG Khan *Mimhar* who set the time and date for maintenance work. This practice is normally recorded. The *mimhar* or water bailiff has to be present at the time of flood so that downstream farmers do not breach their diversion structure *(ganda).* In DG Khan the *mimhar* or water bailiff were entitled to receive part of the harvest. With the introduction of tractors in mid 1970 bullocks were replaced as draught power. The *mimhar* system became something from the past. The majority of the poor and landless families also kept bullocks to rent them out for maintenance work and ploughing the land. large part of the spate irrigation areas is owned by the tribal rich class. The introduction of machinery Caused that those families of tenants had to found new means of income.

Interestingly, the rich farmers are unable to supervise and operate their lands because of their social status. Sothe tenants are still required to keep the spate system running. However, tenants cannot afford the operation cost of tractors. The change in tenancy arrangements and decreasing use of bullocks for draught power has resulted in the decay of spate systems. Another factor that has damaged the system is the continued land distribution among the heirs of land owner leading to smaller land titles. This has caused that land owners are not capable anymore to make a living from their land. Those conditions have led that spate irrigation areas are not abandoned completely but have reduced in size to 50% with comparison to 30 years ago. The new type of tenancy has replaced the traditional norms. Now the tenants are serving many land owners at a time and owners are satisfied whatever they get as a return without investing much in maintenance. In such a tenancy pattern, the tenants are entitled to 50% of harvest after deduction of expenditures on system maintenance, seeds, ploughing and threshing.

Potters, cobblers, barbers, blacksmiths jointly called *(LoRis*) and carpenters are seriously affected by the impact of this change. Usually they provided their services on free basis to the families of tenants and land owners and were entitled to receive a certain portion of the harvest in both the grains and fodder. The change in system has badly affected potter and cobblers t. The other groups shifted to cash business. The blacksmiths have found the way by establishing sanitary wares, steel molding in the housing industry.

Especially Potters and cobblers were seriously affected. The piped drinking water from tube wells has led to the construction of small tanks at household level and dropped the demand of pots to zero. Similarly, the modern shoes industry has reduced the village cobbler just stick to repair of shoes. During the hay days of spate irrigation such artisans were living a comfortable life

Small irrigation systems mainly exist inside the catchments areas or just in the foot hills. Such systems are still fully functional but their size with comparison to large irrigation systems is very small in terms of land versus production.

In Pakistan most of the irrigable lands are distributed among the local people and recorded in the cadastral records on the names of individual households. The non irrigated arid areas surrounding the spate irrigation systems are kept under ***shamlat, that*** literally means lands under communal ownership. Each of the households who possess a certain amount of land in the irrigated command area is entitled to a piece of ***shamlat.***The remaining lands are mainly arid rangelands ***(Rakh)*** and haveno potential to be irrigated through spate or surface irrigation. Such rangelands are also registered in the cadastral records under the ownership of provincial government and forest department. Similarly, the catchments areas are also owned by the tribes

Land ownership is divided in different groups or tribes in areas along major rivers. For other rivers that have small perennial flows or seasonal flows, upstream farmers are the first ones who are allowed to use the water.

Most of the spate irrigation systems in KPK, Punjab and Sindh Pakistan are lying on the western edge of the Indus along the Suleman Range of Punjab and KPK and Kirther Range of Sindh. For Balochistan, this is different a case, because the Indus is not flowing through this province. with exception of canal irrigation from the Indus in Dera Mrad Jalami, Dera Allah Yar and Jhal Magsi District. The rest of Balochistan can be considered as water scarce and is

depending on small scale river flows, springs, shallow aquifers, karezez and groundwater. All spate irrigation farmers in Pakistan are economically poor compared to the rest of the population and depending for their income on agriculture, government employment, and daily wage labour. Public amenities like drinking water, education and health, road infrastructure are poor in most spate irrigation areas in Pakistan.

Leasing and renting land in spate irrigation areas is not common. It is common that after harvest of certain seasonal crops or in case of no irrigation, lands remains fallow and all local people are allowed to graze on such lands for free. Cutting and pruning of wild trees is prohibited for non land owners. Green branches are sold to pastoralists with the small ruminants such as goats. The green leaves of tree branches are also sold as fodder. The rate depends on the type of tree species and the size of the tree. Buyers are only allowed to cut the branches and twigs.

Due to poverty, farmers in spate irrigation sell the tree bracnhes to traders who further sell them as firewood in colder areas. For example Sindh, Balochistan and upper regions of Dera Ghazi Khan and Dera Ismail Khan are selling tree branches to the nomad Pashtoon migrants. These migrants and convert some parts of the wood into charcoal and sell them on local markets in Balochistan in winters.

12.2 Cropping Pattern in Spate Irrigation

The unique reality is that crops cultivated in spate irrigation areas are the same throughout Pakistan. Mainly Sorghum, millet and guar beans are grown in Kharif where mustered, and chickpea are the major Rabbi Season crops. In both seasons small crops are also grown like mung and moth beans and late Rabbi Sorghum is also cultivated on availability of moisture for the animal fodder.

Centuries old traditional seeds are utilized in spate irrigation areas for crop production. No new notable crops in the spate irrigation are introduced in the last 100 years. One time irrigation in a season is considered enough for the crop to grow in spate irrigation fields. No pesticides are utilized for any reason. Hence, all crops cultivated in spate irrigation are organic in nature. There is no defined marketing systems mechanism. Farmers sell the harvest to local traders. Farmers keep seeds from the previous season harvest and there are no inputs shops throughout the spate irrigation areas that can provide or sell seeds on time.

Looking at the moisture conditions farmers make the decision which crop to cultivate. Sorghum being major crops is cultivated with mix cropping. However, some farmer mix mung and millet for an extra harvest and for animal fodder. Sometimes if moisture conditions are good, sorghum is cultivated by applying extra amount of seeds than normal. At the time when plants are mature , farmer through thinning gets the off season green fodder for the animals. Similarly guar is cultivated with sorghum and mung not to get only the harvest for home consumption but to get green fodder for the animals as well.

Rampant surge of technological options in the irrigation sector and the upcoming of electricity in the rural areas,

made it possible for rich farmers to install tube wells for irrigation. Now, in spate irrigated areas tube wells are installed. However this is done on small scale. Accordingly, spate irrigation areas are are in shortage of electricity. This makes pumping from the tube wells not effectively functioning. In Balochchistan, tube wells are not subsidized. Therefore farmers in spate irrigated area cannot compete with the farmers of canal irrigated areas. Due to heavy electricity charges and input cost this practice of pumping groundwater has not get further expansion and installed tube wells are gradually in decay in spate irrigated areas of Dera Ghazi Khan.

In some of the spate irrigation areas groundwater is scarce or brackish. The only water source remains spate for crop cultivation and drinking water such as in Sibi, Jhal Magsi, Musa Khel and Dera Ismail in Balochistan and KPK province respectively.

13 Drinking Water in Spate Irrigation

Spate irrigated areas in Pakistan mainly depend on the floods for domestic use as well as animal drinking. After the rains, the gushing spate is diverted to irrigate the fields. For a month these temporary natural depressions are utilized for animal watering.

Diging River Bed in Search of Sweet Water-Chandia Balochistan

In many areas, construction work only starts when spate water is available for building and repair of mud houses, walls and animal shelters. In other areas like Kachi, Sibi, Bolan, Jhal Magsi, the seasonal spate recharge the groundwater temporarily Local people use it for drinking and animal watering. When the surface water dries up, local people excavate the shallow depressions. The water level in such depressions is gradually becoming deeper during time. They ultimately dry up in 2 -3 months period if there are no subsequent rains. All villages in lower Sibi have constructed earthen reservoirs to store rainwater to meet the animal and human needs. These reservoirs are properly maintained and cleaned.

In other areas like Dera Ismai Khan and part of Dera Ghazi Khan, many farmers have constructed earthen storage reservoirs which are filled with spate water in the season. In such areas if there no sufficient rains, the local population have to migrate with their animals to water rich areas.

It is often that the same pond is utilized for domestic use and animal drinking as well. At night the wild animals drink from the. In this case that these reservoirs are not properly protected and there is free access for animals to drink water. In some parts of Balochistan, local NGOs have constructed sand stone filters and installed hand pumps in

order to get relatively clean water. In some villages of Jhal Magsi it is also observed that villager have jointly constructed a cemented reservoir and fill it with water imported by the tractors.

14 GROUND WATER AVAILABILITY IN SPATE IRRIGATION AREAS

Ground water availability and quality varies from place to place. Pakistan is irrigating (XXX???) percent of irrigated agriculture through groundwater extraction. Groundwater is the second largest source of irrigation in Pakistan. Groundwater is not the main topic of this document but being a vital source of life it has to be linked to spate irrigation in Pakistan.

All spate irrigation areas are devoid of groundwater availability. However, its extraction, utilization for crop production is not economical in comparison to canal water irrigation which is supplied to the farmers generally for free. The second important factor is groundwater in spate irrigation areas is often brackish or totally unavailable.

In Balochistan province the major part of land is irrigated through groundwater. Reportedly 17.568 tub wells are installed in Northern Balochistan for irrigation purposes. Electricity is provided to farmers on subsidized rates in Balochistan charging fix amount of Rsn: 7.000 per month. These tube wells are operating 24 hours on availability of electricity mainly in Kharif season when water is highly required by the crops specially orchards and green vegetables. In winters the majority of the famers grow wheat and barley on small scale due to non availability of fellow lands. Moreover the winters are harsh in most part of Balochistan that do not offer scope for Rabbi Crops.

The amount of tubewells in Balochistan expanded in early eighties. This has lead to high scale groundwater extraction that has further deteriorated the groundwater level in many valleys. Among them Kuchlak, Loralai, Mangocher some parts of district Pishin reached the bottom. Agriculture in Kuchlak has reduced significantly. Similarly, in other valleys the groundwater level reached to 500-1000ft below the surface level and the situation is alarming.

In southern Balochistan SIbi, Bolan, Jhal Magsi, Khudar, Kalat, Nushki the expansion in tubewells havebeen rampant in the past 2 decades. It has converted the partially spate irrigated lands into tube well irrigation and has increased the farmers' income many fold. However on the other hand groundwater reserve is depleting swiftly. Balochistan is a water scarce province and management of spate water would increase and sustain the groundwater level.
In Sindh the ground water situation is the same in spate irrigated areas of Dadu, Johi, Jamshoro and Malir districts; with minor difference that groundwater utilized for irrigation is charged every year through rains. If there are no rains, the surface and groundwater will dryp up and lead to zero crop production.. Life in the in the spate irrigation areas of Kohistan is totally depending on the seasonal rains and livestock rearing. The government in Sindh does not provide subsidy for electricity to farmers like in Balochistan. So deep water aquifers are protected in Sindh Kohistan area. In this case, farmers pump groundwater from shallow aquifers through diesel engines on seasonal arrangements. Kohistan area is devoid of public facilities. There are hardly anyroads to the area and public transport

is limited.

Accordingly, in spate irrigation areas of Dera Ghazi khan, the groundwater is hardly available or brackish. The spate irrigation areas are situated in the foothills of Kohi-Sulaiman Range and there is hardly any electricity available.. Similarly the government of Punjab does not provide subsidy for the electricity so it is not possible for the poor farmers to install tube well. Poverty is rampant in the mountain areas as well as piedmont areas of Sulaiman Range. Very few farmers have installed tube wells in Taunsa Sharif of district Dera Ghai Khan and Rajan Pur district. Shortage of electricity and high electricity costs have pushed the farmers either to abandon the tubewell irrigation or just opt for the Rabbi wheat. These farmers cannot compete with the farmers who use canal irrigation and get a relatively good price due to minor input expenditures.

15. GENDER ISSUES IN SPATE IRRIGATION

Women, men and children work in the fields collectively. Agriculture related activities start with the filling of embanked bunds. Farmer are checking them for couple of days to make sure that no breaches occur due to wind velocity creating currents in the filled bund until water properly seeps down into the soil. When the soil is drying up mulching is done. Mulching is mainly done during the early rabbi season when the season for sorghum, mung beans and millet has passed. And time is required to protect the soil for the next Rabi Crops. For Kharif season, if there are early flood in mid of March – April, crops are directly cultivated due to surging hot conditions that causes fast evaporation of the soil moisture. In this season, mainly fodder crops are cultivated especially sorghum and millet. Many farmers grow musk melon on small scale as well.

Women are responsible for cleaning seeds for cultivation. Women are also responsible to bring fuel woods and collect wild green fodder for the animals. When crops are mature, part of is weeded by the women and primarily used for animal fodder. After the monsoon rains many wild plants and tree species produce flowers and seeds. Mushrooms are collected by the women for home consumption. In all known spate irrigated areas, truffles grow naturally in sorghum and millet fields. The Truffle season is one month sand they do not grow in such high amounts that it can be sold at commercial scale. Most of the truflles collected by the farmers is consumed at home. Surplus is sold at village level. A few farmers or tenant families do truffle picking as a source of income earn Rs.500-1.000 on daily basis in 30 days season.

Spate irrigation lands in Pakistan are owned by the tribes with a major portion owned by tribal chieftain. . In many spate irrigation areas women do not inherit land. Recently government has evolved a law avoiding such suppression and depriving off women from the inheritance rights. As a result, females are now getting their share of inheritance in agricultural lands. In most of the cases the share of land she gets through inheritance right, is transferred to paternal families. They are still being deprived off from her share in the family owned house and other immoveable properties. Educational facilities are very poor in the spate irrigation areas. As a result, female education in many spate irrigation areas is hardly taking place. Many girls do not attend schools where other leave study after passing the primary, middle and metric level exams. University education of the females is almost

nonexistent due to absence of facilities.

During harvesting season tenant's and small farmers work as agriculture labor and harvest the panicles They are entitled to 20th share of daily pick. They are further allowed to take the sorghum and millet harvested plants for their animals to the weight they can carry. For other crops such as guar and wheat, they are not entitled for the fodder or any other byproduct. Now instead of crop share, agricultural labor is paid in cash. Women are also responsible to clean and store grains and collect water for domestic use.

Free movement of the women is also restricted in spate irrigation areas. They are not allowed to go alone to the markets and shops. They financially depend on the head of the household for their daily needs. In many cases their clothes and other daily needs are arranged by the older women at home. Polygamy and early childhood age marriages are common in spate irrigation areas. Marriage proposal of the girls are accepted or rejected by their parents. Treatment and regular check up of the pregnant women is not common unless complications and 65% deliveries cases are attended by the untrained mid wives or older women at home. Marriage customs and traditions are different in different spate irrigated areas for example in Balochistan the lab in Balochi and *Walver* in Pashto is demanded by the parents that are usually paid in cash, kind or animal. *Bijjar* is one way of cash contributions to the groom to meet the expenditures. Contrary to it, in Dera Ghazi Khan and Rajanpur spate irrigation, area the *lab or walver* is not common; however in hilly parts of the districts this is still common to receive the *Lab* on women though small with comparison to Pashtoons *walvers*.

Women are also responsible for feeding, milking, and cleaning the sheds of animal too. They process the milk for yogurt and butter oil. Some of the households sell milk and butter oil to meet their cash needs. Further taking care of kids, daily household chores women contributes more than men in rural spate irrigation areas. Women have no direct access to cash except to those who keeps pet chickens and cell eggs others are engaged in embroidery, stitching work at local level for women and kids suiting. In such cases the incomes are owned and possessed by the respective working women. Female education is not common in spate irrigation areas due to cultural barriers and none existence of educational facilities. However, DG Khan District is moderate and education of girls is comparatively better than Balochistan and elsewhere in Pakistan.

16. RISK COOPING MECHANISM IN SPATE IRRIGATION AREA

The population in spate irrigation areas is depending on rains and floods. The rains are not stable throughout the year. This makes the annual farmers' income fragile. The possibility of a bad agricultural season is in the minds of local farmers. So, immediate risk cooping is managed through livestock rearing. This is common in spate irrigation areas. The local population is depending on livestock and small ruminants as an alternate source of income for the daily life as well as for emergency purposes. A large amount of farmers keep camels for to transport fire wood transportation and sell it on the market as another source ofincome. A large amount of farmers is still depending on the sale of milk and milk related by products.

Another major risk coping mechanism is the mass migration from the spate irrigation areas to canal fed irrigated areas. In Kachi, Khuzdar, Jhal Magsi Balochistan almost the entire population migrate on seasonal basis to Pat feeder and Kirthar canal irrigated areas in Kobo Saeed Khan, Larkana and Shahdad Kot in Sindh Province. A large amount of local men with their agricultural equipment also move to Khuzdar every year to work as agricultural labour during the wheat harvesting and threshing season.

Accordingly, a large amount of farmers from Tahsil Taunsa of District Dera Ghazi Khan are seasonally migrating with their families and livestock to the Indus River Delta area locally called (Sidh or Pbeet) to work as agricultural labor and to search for rangelands for their livestock. Large amount of local men from the Kohi-Suleman area of Dera Ghazi Khan make a living mainly in Frontier Constabulary in Balochistan, because mountainous areas do not offer significant income opportunities. Small lands are always eroded during torrential rains due to flash run-off within the catchments of the hilly terrain. There are hardly any roads and local transportation is highly expensive. In other words, the spate irrigation areas throughout Pakistan are neglected from the mainstream development.

17. SOLIDARITY MECHANISM IN SPATE IRRIGATION AREAS

Spate irrigation areas in Pakistan are occupied by the various tribes belonging to Baloch and Pashtoon. Tribal settlement pattern is different to the urban population settlements. The urban population settlement is heterogeneous in nature where tribal human settlement is homogenous belonging to same race ethnicity. In most of the case certain tribe has their defined boundaries and occupied areas including mountain and hilly terrain.

Local customs and traditions are different in different areas, but in spate irrigation local communities are cohesive in their local relations. Landless families in the area are allowed to graze their animals and pick seasonal vegetables. The farmers and land owners in spate irrigation are strict to pay Zakat (Islamic duty to pay 2.5% share of annual savings to the deserving needy). There is belief among the people that Allah brings the rains. It is imperative to abide by the Allah's Rule. Normally Zakat is paid both in cash and kind. Part of their harvest (equal to the amount of 2.5% of the return) is paid to widows and orphans. They also get a share of the harvested fodder, the remains of the sorghum plants.

18. CONCLUSION AND RECOMMENDATION

No research or educational institutes are focusing on subjects related to spate irrigation. Managing floods for spate irrigation involve complex engineering. In this case, spate Irrigation systems in Pakistan do not work effectively. Major parts of water flow from floods dissipate in the Indus or in the Sea. However there are large areas where medium to small rivers flows are comparatively easy to manage. But the problem is that heavy rains inundates the farmers' build structures which take huge effort to rehabilitate within a short time in order to get the next consecutive spate for irrigation in that particularly year. Balochistan is a good example for this type of spate irrigation systems management where large investments can be done in small structures in the river bed, at channel

and field level. For example Mashkay River is the largest sources of irrigation in Awaran district where dozens of small intakes are annually build by the farmers to divert perennial and flood water for irrigation. No attention is paid to the improving the design of those intakes or better water management. A Similar example can be a given for spate water managements in Mashkay village and Kolwah area where huge lands are available that can be irrigated by the divertion of floods from the dozens of medium creeks and rivers passing through in the area. The major problem is poverty and non availability of agricultural machinery. Irrigation departments in the provinces of Pakistan in general and in Balochistan particular are focusing on conventional irrigation and invest in agricultural development in areas with perennial flows.

Balochistan is the largest province where spate irrigation systems can be improved, due to the abundant land availability and mountain catchments with seasonal flows.

Similarly, small (LahRi) creeks or streams are easy manageable with properly build spate structures. Such systems exist in Dera Ghazi Khan Rajanpur district. Although it does not mean that farmers have no difficulties in managing floods but local governments hardly heed any attention to such areas mainly due to unawareness of officials. Farmers and owner in such area are poorest of the poor and have no contact with government organizations.

Conjunctive use of ground water together with spate irrigation offers higher opportunities in Dadu, Jamshoro district in Sindh province. Farmers in this area are using open surface wells to supplement spate irrigation. Hardly any attention has been paid to the improvement in lining of wells and wells are collapsing frequently. Valley development projects can be introduced with a full package on catchment land development, rangeland developments, construction of check dams and animal drinking ponds.The upper plains of the sun village in Jamshoro offer a large potential for spate irrigation development. In this area hill torrents flow directly into in the Indus River. Land leveling in the plains and construction of headworks and canal can augment the food security and alleviate poverty in the area.

More research has to done on subjects regarding to spate irrigation in district Tank, Dera Ismail Khan in KPK, and DG Khan Rajanpur in Punjab. Further more it is recommended that separate divisions within the Irrigation Department need to look at the improvement of spate irrigation adding in annual PSDPs.

Accordingly, no significant statistics on spate irrigated area are available. Spate irrigated lands are not considered as a part of cultivated lands and instead considred fellow or barren lands. Similarly, no national data base is available on the net crop production from such systems. The spate irrigation system is overall neglected in the mainstream of

9*www.sbp.org.pk/departments/**stats**/onedayseminar/7*
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