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Water Scarcity and its Impact on the Agricultural Sector of Balochistan

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Abstract

The current research was conducted to identify water scarcity in Balochistan - a semi-arid landmass to analyze certain options that could be utilized to make water available for the agricultural and livestock sectors in the province. The current study employs a qualitative and quantitative research methodology to conduct an analysis of primary and secondary sources and information received from government departments, internet, and interviews related to this issue. A case study of a Pakistan Water and Power Authority (WAPDA) project of construction of small/ medium dam, illustrates the economic benefits of such dams for increasing crop intensity and cropped land. Therefore, increasing water storage capacity, recharging groundwater, better water management by shifting to high- efficiency irrigation systems, enhancing the capacity of canals to utilize full share of the Indus river, shifting to high-value crops, and standardizing livestock would boost agricultural sector to ensure food security for the present and future needs of a growing population. Continuous review of National Water Policy (NWP), while implementing salient features of the policy to control water scarcity in the province is essentially required.

Keywords: agricultural sector, livestock, national water policy (NWP), water scarcity, water management

Introduction

Pakistan's economy heavily relies on the agricultural sector. For this purpose, the agricultural sector is in dire need of water. Water is a basic human need and states are bound to provide it at an affordable price (Lahiri-Dutt & Wasson, 2009).

Pakistan comprises deserts or semi-desert areas with sandy soil and high temperatures with minimal humidity. The ground water is saline. Therefore, people have taken rainwater as a prime resource for harvesting. Moreover, saline farming techniques are used for fulfilling the domestic needs of

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agriculture and rear lives stock. Balochistan is a dry province, which comprises an arid zone; people use water for irrigation and other purposes through the khushkaba (dry farming with direct use of rainwater) and sailaba (flood irrigation from run-off) systems of water management.

The traditional water-usage systems like Karezes in Balochistan have adversely affected tube wells in the province. For centuries, Karezes were used for irrigation by tapping water into the groundwater and conveying the water under gravity but pumping through tube, wells have disrupted this system immensely (Lahiri-Dutt & Wasson, 2009).

Primarily, in South Asia, the water problem are caused by neglecting alternate options of the management of water resources with more focus on increasing the additional supply of water. South Asian countries have turned towards advanced technologies to overcome the growing scarcity of water by adopting improvised methods of mining fossil water from hard-rock aquifers as in Balochistan (Lahiri-Dutt & Wasson, 2009).

Balochistan is outside of the Indus Basin. Therefore, the province relies heavily on groundwater, which is fast depleting due to the over usage of water. The mountainous and coastal areas of Balochistan rely on rainwater for harvesting and other agricultural activities (Lahiri-Dutt & Wasson, 2009).

In agricultural sector, water is the major resource for agriculture after land. In Pakistan, 93 % of existing water is used for agriculture, 3% for industry, and 4% for household. Out of 18 m hectares, 6.81m hectares are irrigated by canals and 11.23 m hectares by tube wells for producing 90% of food and fiber. Ground water potential is 64 MAF out of which 42 MAF is used and rest 22 MAF is unusable (Chaudhry, 2006). A number of 180 MAF of rainwater is lost on runoff and water harvesting in arid and semi-arid areas, which is hardly 25 MAF of rainwater (Chaudhry, 2006). The gathered data of water resources available in Pakistan are as under (Chaudhry, 2006). Annual river inflow of water recorded at the rim station from 1922-2003 is 138.4 MAF (84% in Kharif and 16% in Rabi).

Table 1

Canal Water

Water available in canals	105 MAF
Water available in water courses	78 MAF

Lost through evaporation, seepage from canals	27 MAF (adds to ground water)
Water available at field level	40 MAF
Water lost in water courses	38 MAF

Table 2
Ground Water

Available	64 MAF
Currently used	42 MAF
Brackish water	22 MAF

Table 3
Rain Water

Rain water	180 MAF
50 % run off	90 MAF
Seepage and evaporative (Adds to ground water)	65 MAF
Collected by harvesting practices in arid and semi-arid areas	25 MAF

Table 4
Water Conservation

By lining rajbah and water courses.	38 MAF
Treating saline water	22 MAF
Rain Water	25 MAF

In Balochistan, the Karan closed Basin and Makran Coastal Basin cover about 15% of the surface water of Makran Coastal Basin, which has not been exploited as rivers are seasonal and remain dry during drought periods. The duration of drought ranges from 3-5 years.. Rivers of Karan are closed

in Basin discharge and evaporate in an island basin. Makran Rivers are flashy and flow directly to the Arabian Sea (Government of Pakistan, 1987).

Statement of the Problem

The current study aims to assess the scarcity of water resources in different parts of Balochistan; and its impact on the agricultural sector of the province.

Moreover, the research will identify available water resources in Balochistan, arable land, and pattern of agriculture prevalent in the province. This study would also focus on the use of available water resources in an efficient manner through conservation and better management, making cost analysis of the viability, and feasibility of the projects in terms of economic benefits accruing to the people of Balochistan and suggesting alternate crop pattern, suitable for the arid zone areas of the province.

Significance and Scope of the Study

The study would focus on the availability of water resources and their impact on the agricultural production that has been threatened by scarce water resources. Furthermore, depletion due to various factors like long periods of drought caused by climate change, pumping of ground water through tubewells, and crop pattern not based on scientific methods, this study aims to distinguish available water resources in Balochistan. The study would suggest possible ways and means for water conservation and resources for optimal utilization of the agricultural land to uplift economic conditions of the people in the province.

Review of Literature

Primary and secondary sources have been consulted for formulating an argument for exploring alternative methods of irrigation and conservation of scarce water resources in Balochistan for enhancing agricultural output in that province. Books on water management and agricultural sector in Pakistan were consulted to understand the problem of water scarcity and its impact on agriculture in Balochistan. Recourse to official publications and correspondence has been made for using authentic data. Information has been gleaned from official websites of international agencies and Government of Pakistan and Government of Balochistan. The information particularly data has been analyzed for formulating opinion and conclusion.

Methodology

The study was undertaken to highlight low agricultural output in Balochistan, due to water scarcity and suggest ways and means to harness scarce water resources in the province for increasing agricultural production. Data from original and secondary sources through interviews of experts in this field, official government records and websites, and Internet were analyzed by conducting a qualitative analysis. Primarily, the reliance of researcher was on historic data available water resources of Balochistan than latest figures, as they were not available when the study was initiated. However, the occasional abnormal weather patterns did not have much impact on the analysis and conclusions were drawn from the study.

Organization of the Paper

The current study is divided into four sections. The first section gives an overview of the landscape and water resources of Balochistan. This section is further sub -divided into five sub-sections. Sub-section (A) describes topography of Balochistan. Sub-section (B) provides the data about available surface and ground water resources in different parts of Balochistan. Sub-section (C) contains data of average rainfall in that province. Sub-section (D) provides data of water storage capacity in Balochistan. Sub-section (E) gives the share of the province under Water Apportionment Accord 1991 of Indus Water System.

Section 2 analyzes potential of agricultural activities in Balochistan, including current land utilization, such as, arable land, area under cultivation, present crop pattern, different sources of irrigation, crop production, and yield.

Section 3 evaluates a case study of Naulong Dam Project prepared by Pakistan Water and Power Development Authority (WAPDA) for efficient management and conservation of water resources, water availability for irrigation, and its impact on agricultural sector in the district of Jhal Magsi. Moreover, it suggests an alternate crop pattern, increase in crop production and yield, and determining viability of such dams in Balochistan through a private investment.

Lastly, section 4 analyzes challenges faced by the agricultural sector due to the scarcity of water resources by suggesting strategies to overcome them through proper conservation and better management of water resources in the province.

Landscape and Water Resources of Balochistan

Topography of Balochistan

Pakistan is divided into three major geographic areas. These are highlands in the north, the Indus River Basin, which divides the province into provinces of Punjab, Sind, and Balochistan Plateau. West of Balochistan Plateau is a desert with one dry lake stretching to 87 km. Therefore, the temperature in Balochistan is usually high because of the sea breeze that blows along the coastline making it moderate (Commonwealth Secretariat, 2001.). The map showing the aridity classes of Pakistan is shown in Annexure A.

Balochistan is divided into uplands in its northeast, while plains, deserts, and coastal line comprises the rest of the province, categorized as zone 1 and zone 2 as shown in Annexure B.

The diverse geography and extreme climate resulted in a sparse population in the province. It had a population of 12,335,129 according to the 2017 population census. Area of the province 347,190 sq. km forms 43.6% of the total area of Pakistan (Pakistan Bureau of Statistics, n.d.). The population density of 35.53 per square kilometer of the province is the lowest in Pakistan.

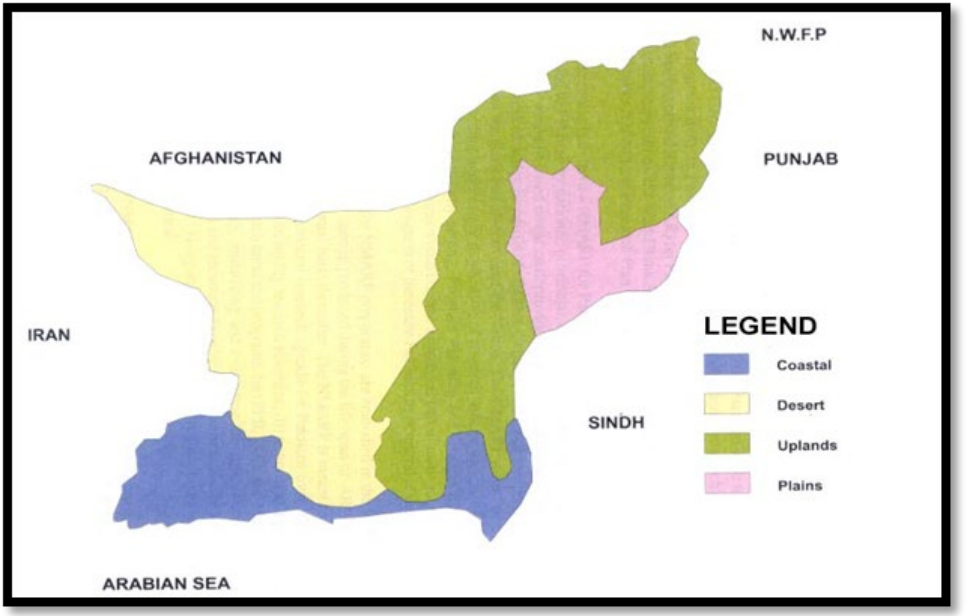
Upper highlands, known as Khorasan rise to 3,700 meters and valleys about 1,500 above sea level. They include districts of Zhob, Killa Saifullah, Pashin, Quetta, Ziarat, and Kalat. It comprises a number of ranges such as Suleiman, Tobak Kakari, Murdar, Zarghoon, Takatu, and Chiltan ranges. The highlands include Makran, Kharan, and Chaghi ranges in the west and Suleiman, Pab, and Khirther in the east. 760 km long, coastal line is not effectively connected to the hinterland. Steep hills beyond the coastal plain forms a barrier between Somiani, Pasni, and Gwadar seaports.

The lower highlands are in the south east of the province. The altitude ranges from 600 meters-1200 meters. They run into the boundaries of Gwadar, Turbat, Panjgoor, Kharan, and Chaghi districts. The plains cover only 15% of the total area of Balochistan. The plain comprises Kachhi plain, situated to the south of Sibi, which extends into Nasirabad division; southern part of Dera Bugti district, and narrow plain area along the Makran coast stretching from Kachhi to the Iranian border. The plains of Kachhi, Las Bela, and of river Dasht cover a sizable areas. Kharan and Chaghi

districts, in the west, consist of vast plains covered with black gravel surface and broad expanses of sand dunes.

Figure 1

National Agricultural Research Plan



Source: National Master Agricultural Research Plan, Pakistan Agricultural Research Council

Available Surface and Ground Water Resources in Different Parts of Balochistan

Agriculture land in Balochistan is irrigated by various means. Out of which, the canals irrigate 563,628 hectors, wells 54,421 hectors, tube wells 426218 hectors, and Karezas/springs, and others irrigate 180396 hectares of the total land. Detailed data on areas irrigated by different sources of irrigation is given in Annexure C (Agriculture Statistics, 2010). 46% of the total area is irrigated by canals, followed by 39.24% through tube wells, and 18.75% by Karezes/ springs, and others.

Data on area irrigated by various methods in Balochistan from 1971-72 to 1996-97 is given in the table below:

Table 5

Data of Area Irrigated by Various Methods in Balochistan from 1971-72 to 1996-97

S. No	Irrigation Source	1971-72		1996-97		% Increase(+)/ % decrease (-)
		Area(ha)	%	Area(ha)	%	
1	Canals	250000	52	501386	61	101
2	Wells	4000	1	12938	2	223
3	Tube wells	19000	4	234834	28	1136
4	Karezes and Springs	208000	43	78550	9	-62
5	Tanks	2000	0		0	-100
	Total	483000	100	827708	100	

Note. Source: International Union for Conservation of Nature (IUCN, 2000).

Additionally, the farmers irrigate 700,000 acres of the total land is irrigated through the indigenous methods of diverting flood flows by constructing “kachha bunds”. Land irrigated by tube wells increased from 19,000 ha in 1971-72 to 234,834 in 1996-97. Increase of 1136% was phenomenal, which indicated that little effort were made to tap rainwater, however, more construction of canals to cater for the growing requirement of water for agricultural land is required to avoid water scarcity issues in the province. The decline in the traditional system of karezes showed depleting groundwater level due to excessive pumping by tube wells and scant attempts to replenish aquifers.

Land irrigated by Karezes – the traditional method of irrigation of groundwater decreased by 62% in the same period. The share of land irrigated by Karezes came to 9% in 1996-97 from 43% in 1971-72 of the total irrigated land. The share of land irrigated by tube wells increased from 4% in 1971-72 to 28% in 1996-97. The area irrigated by canals doubled in the same period with the share increasing from 52% in 1971-72 to 61% in 1996-97 of the total irrigated land.

Table 6

Water Utilization in the Province

S. No	Description	Quantity (MAF)		
		Available	Utilized	Balance
1.	Surplus Indus Water Perennial	3.87 3.87	3.049	0.821
	Flood	2.5	--	2.5
2	Surface Water (Flood runoff)	10	3	7
3	Groundwater	0.87	0.49	0.38
	Total	17.24	6.539	10.701

Note. Source: International Union for Conservation of Nature (IUCN, 2000).

There is need to tap run-off water for irrigation purposes to replenish ground water that has been reducing at an alarming rate. More than half of the groundwater has been utilized until now. The balance of 0.38 MAF would be further consumed if timely action were not taken to rectify this situation. Construction of dams to conserve run-off water, leaking dams to replenish groundwater, and digging out canals would help in providing water for irrigation purposes and save scarce resources.

Average Rain Fall

Balochistan - an arid region has been characterized by low, erratic, and uncertain rainfall with variations in the temporal and spatial distribution of rainfall (Shahid & Ahmed, 2008). The annual rainfall comes to 210 mm, 144 mm, and 94 mm computed at 25, 50, and 75% probability, respectively of different areas of the province given in the table below (Shahid & Ahmed, 2008)

Table 7
Annual Rainfall Probability in Different Areas

River Basins	Rainfall in mm at three Probability Levels (%)		
	25%	50%	75%
Dasht	117.97	70.27	38.10
Gwadar	152.40	93.98	45.72
Guj	220.98	146.05	71.12
Hamun-e-Lora	144.78	97.79	53.34
Hamun-e-Mashkhail	107.53	68.58	30.48
Hingol	205.74	144.78	101.60
Hub	209.55	121.92	58.42
Kachhi	143.71	93.22	55.37
Kadanai	251.46	187.96	133.35
Kalat	309.88	229.87	142.24

The study conducted by Shahid and Ahmed (2008) concluded that at 50% probability, the average rainfall comes to 57 billion m^3, which is almost five times the live storage capacity of the Tarbela dam. Similarly, the basin-wide availability of flood water at 50% probability is estimated to be around 10.8 billion m^3, which is equivalent to the live storage capacity of Tarbela dam, which increases to almost 2.5 times during the wet years at the probability of 25%.

The average rainfall in Balochistan for the years 2008, 2009, and 2010 provided by Climate Data Processing Centre, Pakistan Meteorological Department, Government of Pakistan, Karachi vide its letter no. CDP. 7(4)/1/2011/ dated 2 April 2011 is given in Annexure D.

The rainfall pattern is erratically laced with an interlude of drought-like conditions. Occasional cyclonic systems caused heavy rains in the coastal areas like Jiwani and Gwadar as in June 2010 with 386 mm of rain.

Rainwater in coastal areas cause flash floods as witnessed during summer of 2010 and falls into Arabian Sea.

Deluge of 2022

Large parts of Balochistan are relatively drier during the months of summer from May to August except in districts bordering Sindh that come under the influence of monsoon rains and coastal areas of Balochistan under cyclonic conditions. In 2022, weather pattern saw abnormal precipitation system that resulted in heavy downpours during July that caused flash floods. The July 2022 rainfall was excessively above average over Balochistan (+450%) and Sindh (+307%), both ranked as the wettest ever during the past 62 years (Pakistan Meteorological Department, 2022). The La Niña conditions have been persisting through almost 3rd year, one of the rare phenomena being described as Triple-dip La Niña and are likely to prevail through this summer. area-wise weighted rainfall in July 2022 as given in Table 8 below:

Table 8

Area-wise Weighted Rainfall in July 2022

	Normal (mm)	Average (mm)	Departure (mm)
Pakistan	63.1	177.5	180.4
AJK	173.9	161.9	-6.9
Balochistan	29.7	163.3	450.3
Gilgit Baltistan	13.3	17.6	31.9
Khyber Pakhtunkhwa	106.7	138.8	30.1
Punjab	104.1	224.3	115.5
Sindh	60.1	244.9	307.0

Balochistan and Sindh experienced unprecedented rains during these months.

The trend continued during August 2022 as well. National rainfall during the month was 243% above average. Surpassing the wettest August recorded in 1961. Rainfall was above average over Balochistan (+590%),

Sindh (+726%), and Gilgit-Baltistan (+233%) (Pakistan Meteorological Department, 2022). Weighted area wise rainfall during August 2022 is given in Table 9 below:

Table 9

Weighted Area-Wise Rainfall During August 2022

	Normal (mm)	Average (mm)	Departure (mm)
Pakistan	56.2	192.7	243
AJK	150.7	146.1	-3
Balochistan	22.4	154.9	590
Gilgit Baltistan	16.7	55.7	233
Khyber Pakhtunkhwa	103.6	163.9	58
Punjab	93.3	141.7	52
Sindh	53.6	442.8	726

The unprecedented heavy rainfall caused widespread devastating flooding across Sindh, South Punjab, and Eastern Balochistan, which resulted in the loss of human and livestock casualties besides damaging the private homes, agriculture, and public infrastructure, especially in Balochistan and Sindh provinces. The National Disaster Management Authority (NDMA) reported, "some 33 million people in Pakistan were affected, 1,191 people killed, and 3,641 injured from 14 June to 31 August. Over 372,823 houses have been destroyed and a further 733,536 damaged since 14 June, more than 731,818 livestock heavily influenced beside millions of acres of crops and orchards had also been impacted".

Water Storage Capacity

Dams are also constructed in Balochistan for the irrigation purposes. It includes Mirani Dam across Dasht River completed during 2007-08 and Sabakzai Dam completed during 2008-09 (Ministry of Water and Power). Mirani Dam irrigates 20,800 acres on the left bank of the canal and has capacity of 36 (sic) cusecs and on right bank it irrigates 12,400 acres and has a capacity of 141 cusecs. Total area irrigated by the dam is 33,200 acres

and has a capacity of 377 cusecs (Descon Engineering Limited, 2011). Sabakzai Dam has been constructed across Sawar Rud, a tributary of River Zhob some 65 km southwest of Zhob. The dam irrigates 6875 acres of land on right and left banks with a total capacity of 33 cusecs. The dam would increase cropping intensity to 123%, which was only 20.41% before its construction.

The government of Pakistan through Pakistan Water and Power Development Authority (WAPDA) has drawn up a plan bifurcated into two phases to build medium and small dams in Balochistan during 2001-2013. The salient features of phase I are as under:

Table 10
Salient Features of Phase 1

Sr. No.	Name of Dam	Location	Dam Height (Ft)	Gross Storage (AF)	Cropped Area (Acres)	Power (MW)	Project Cost (Rs in bn)	
							Approved	Revised
1.	Winder	Lasbela	102	36,484	20,000	0.3	1,696	12.412
2.	Naulong	Jhal Magsi	186	242,452	94,000	4.4	11,699	31,962

In Phase II WAPDA will undertake work on three following projects.

Table 11
Projects of Phase II

Sr. No.	Name of Dam	Location	Dam Height (Ft)	Gross Storage (AF)	Cropped Area (Acres)	Power (MW)	Project Cost (Rs in bn)	
							Approved	Revised
1.	Hingol	Lasbela	179	1,405,000	160,000	3.5	-	26,463
2.	Garuk	Kharan	184	50,695	26,000	0.3	1,790	-
3.	Pelar	Awaran	132	66,900	16,000	0.3	1,692	-

Groundbreaking ceremony of Winder Dam was held in April 2011. However, litigation by one of the bidder has delayed its execution. The government has undertaken certain steps to release 5% of the funds required for Naulong Dam and work is expected to start soon. WAPDA is making efforts to secure funding for Hingol Dam in the next financial year from

2011-12, which includes it in Phase I (S. Hameed, personal communication, May 21, 2011).

Additionally, WAPDA has prepared the feasibilities of three relatively small dams and the provincial government would be approached to carry out their construction because of devolution under the 18th Constitutional Amendment. These projects are:

Table 12
Projects Under 18th Amendment

Sr. No.	Name of Dam	Location	Dam Height (Ft)	Gross Storage (AF)	Cropped Area (Acres)	Power (MW)	Project Cost Rs in bn)
1.	Sukleji	Jhal Magsi	110	42,000	24,000	0.5	5,292
2.	Basol	Pasni	50	50,000	19,760	0.2	1,680
3.	Badinzai	Zhob	140	800,000	60,000	0.7	9,744

Phase I and II under the plan would yield storage capacity of 1.654 MAF. Another 0.892 MAF would be stored after construction of three dams by the provincial government. The cumulative storage capacity of these projects would be around 2.546 MAF that comes to 66% of Indus water share of the province.

Share of Balochistan of Indus River system under Water Accord of 1991

Balochistan is outside of the Indus River System. However, under the Water Accord of 1991 the province was apportioned 3.87 MAF of the Indus River System: 2.85 MAF for Kharif and 1.02 MAF for Rabi season (Ul Haq, 1998). The accord also accepted the right of Balochistan to develop water resources of tributaries on the right bank of the Indus flowing through its area (Ul Haq, 1998).

Irrigation by canal in the province is in Nasirabad and Jaferabad districts, which comprise only 10% of the total area of the Province (Functions of Department, 2011). The three canal systems in the province are:

Pat feeder Canal System

The canal was constructed in 1969 with a designed capacity of 3180 cusecs for irrigating 142510 hectares (352000 acres). It formed part of Guddu Barrage. Later, the canal remodeled for a designed capacity of 6700 cusecs increased irrigation intensity of the canal increasing it from 77%-96% and the crop area in Kharif and Rabi seasons increased from 142510 hectares-179000 hectares, respectively.

Khirther Canal System

It is a subsidiary of N.W.Canal, some 36 miles downstream Sukkur Barrage. It was constructed in 1932 with a designed capacity of 1164 cusecs, irrigating an area of 74700 hectares in Balochistan and 55870 hectares in Sind. It has also been remodeled to accommodate the perennial supplies per Indus Water Accord of March 1991, after which its capacity increased to 2400 cusecs, irrigating an area of 77146 hectares.

Uch Canal and Manuthi Canal

These canals were constructed in 1901 before Guddu Barrage was built. These canals take off from Desert Canal at 44 and 52 miles and have a total length of 32 and 15 miles, respectively. The capacity of the canal is 732 cusec irrigating an area of 17570 hectares.

The under construction water, canals carried out by WAPDA in Balochistan are as under (Kacchi canal, 2011):

Kachhi Canal

The canal when completed would bring 0.7 million acres of barren land of Balochistan under cultivation. The province would get 2.02 MAF water from the Kacchi canal as per its share of Water Accord of 1991. Total length of the canal is 500 km of which 300 km passes through Punjab, while the remaining portion would go through Balochistan, which includes 76 km in Dera Bughti - the point at which it enters Balochistan. The portion of the canal passing through Punjab has been cemented, namely. Plain Cement Concrete (PCC) to avoid wastage of water. Initially, the portion in Balochistan was not to be lined or cemented to allow percolation of water to raise groundwater for drinking and irrigation purposes (Rs 22.86 billion released, 2010). The canal would irrigate lands in Districts Nasirabad, Bolan, and Jhal Magsi in Balochistan besides Dera Bughti (Karachi Canal, 2011).

Balochistan Effluent Disposal into RBOD – III Project

It has spread over 287,106 hectares in two districts of Balochistan, namely Nasirabad, Jaferabad, and districts Jacobabad and Kambar Shahdadkot of Sind. On completion the project would improve cropping intensity from 113%-125%, for the Rabi crop by removing surface water, reclamation waterlogged areas, reducing pollution in Hamal Lake, and improving quality of water.

Agricultural Potential of Balochistan

Cropping in Balochistan as in Pakistan in divided into Rabi and Kharif. Water shortage has been witnessed during Rabi crop. Agricultural sector dominates the economy of the province; including livestock and fisheries. It contributes to the overall provincial GDP, which is 52% and employs 65% of the labour force. Of the total agriculture GDP, livestock contributes 40 %, fruits 30 %, field crops 17%, vegetable 12%, and fisheries 1% (Forest, Wildlife and Fisheries Department, 2011). Map showing cropping pattern in Pakistan and Balochistan is at Annexure E.

Cropping Pattern in Baluchistan

The northern highlands have adequate Kharif but moderately adequate to deficit Rabi crop. The area in the east bordering Sind have excess Kharif and Rabi crop because of canal irrigation. The central Balochistan like the western tip has adequate Kharif but moderately adequate or deficit Rabi crops. The coastal plains have adequate Kharif but excess Rabi.

In early 1950's, Balochistan had lowest agricultural output per hectare among all other provinces of Pakistan. It also had the lowest regional per capita income. Multiple cropping was nonexistent. Vast areas of arable land were underutilized and un-irrigated (Aslam, 1989).

During the period of 1960s and 1970s per hectare, agricultural productivity in Balochistan has not only increased but the increase in the province was more than that of the other provinces (Aslam, 1989). In Balochistan during 1979/80, the weighted average per hectare production of crops, like jowar, edible oil seeds, and fruits, was also significantly greater than that of the other provinces. Per hectare, production of rice was highest in Balochistan. However, it lagged behind in the overall average production of all crops in other provinces in per-hectare production (Aslam, 1989).

Balochistan despite being a water deficient province is known as the 'fruit basket' of Pakistan because of high quality fruit production. Fruit crop and rearing livestock is the major source of income for people living in the province. The data about the area available for agriculture, cropped area, and uncultivable area is given in Annexure G (Agriculture Statistics, 2010). Area, which is sown more than once in a year is only 71158 hectares, which is only 6% of the cropped area. The current fallow of 921712 hectares indicated that nearly 46% of the land could not be cultivated in the reported year that had been under cultivation in the previous year. Culturable waste of 3833072 hectares lying idle is nearly two times (1.9 times) more than the cultivated land.

Land utilization in Balochistan according to the Agriculture Statistics of Balochistan (1996-97) is as follows:

Table 13
Land Utilization in Balochistan

Sr. No	Description	Area (M Ha)
1	Area not available for cultivation (58.6%)	20.346
2	Forest (5%)	1.875
3	Culturable Waste (25.1%)	8.715
4	Fallow (6.5%)	2.257
5	Net sown	1.528
	Total Geographical Area	34.720

Land Utilization in Balochistan

Nearly half of the cultivable land in Balochistan is lying idle mainly because of water scarcity. Availability of water would make water resources available for more land and cultivation of the agricultur and rearing livestock. The cultivable waste could also be brought under cultivation. A comparison of land utilization in ten years from 1998-99 to 2008-09 is given as below:

Table 14
BalochistanComparison of Land Utilization (000) Hectares

Items/Years	2008-09	1998-99	Percentage Increase/ Decrease
Total Cultivated Area	2055.8	2125.8	-3.3
Current Fallow	921.7	1261.1	-26.9
Net Sown	1134.1	864.7	31.2
Total Cropped Area	1205.3	869.2	38.7
Total Un-Cultivated Area	15131.1	17200.5	-12.0
Cultureable (sic) Waste	3933.7	4855.6	-19.0
Forest	1362.8	1049.1	29.9
Net available for cultivation	9834.6	11295.8	-12.9
Reported Area	17186.9	19326.3	

Total cultivated land has decreased by 3.3% with the biggest contributing factor being the fall of the current fallow area from 1.2611 m hectares to 0.9211 m hectares. The culturable waste decreased by 19% and total cropped area registered an increase of 38.7% from 0.8692 m hectares to 1.2053 m hectares. However, the total land available for cultivation decreased from 11.2958 m hectares to 9.8346 m hectares.

Crop pattern in Balochistan showed that wheat, gram, barley, rape seed/mustard, vegetables, and fodder are major Rabi crops, while rice, cotton, fruits, melons, onion, and sorghum (jawar) are major Kharif crops. The table below shows the data of crop patterns in Balochistan, which is shown in Annexure H.

Yield in kg per hectares in the non-irrigated areas is half than the production in the irrigated areas. Better management of water resources and conservation could increase the production in the non-irrigated areas.

Main fruit produced are apples, apricot, grapes, pomegranate, dates, coconut, and others. Detailed production of fruits in Balochistan is given in Annexure J.

The yield per hectares of hectares in Pakistan is far below than world average. The following Table 15 illustrates the world yield with that of Pakistan and Balochistan (Agriculture & Cooperative Department, 2011)

Table 15

World Yield with Reference of Pakistan and Balochistan (Deduced from Annexure J)

Fruits	Yield (Tonnes/Ha)			Best Yield	Best Country
	World	Pakistan	Balochistan		
Citrus	7.04	10.6	6.9	30.5	Syria
Mangoes & Guava	7.4	10.5	6.6	40	Cape Verde
Dates	5.7	7.3	6.3	15.2	Egypt
Apples	14.5	6.8	5.2	91.5	Australia
Peaches/Nectarines	11.3	6.03	7.6	44.2	Austria

Major reason of low yield is scarcity of water besides other factors. Table at Annexure J indicates that non-irrigated land produced nearly half of the production as compared to the production of irrigated land. Other factors like mechanization, use of fertilizers, and credit ability of farmers play a major role in the per hectare yield. A comparison of mechanization in Balochistan over a period of ten years from 1998-99 to 2008-09 is given in the table below (Agricultural and Cooperative Department, 2009)

Table 16

Balochistan Comparison of Mechanization

Items/Years	2008-09	1998-99	Percentage Increase/Decrease
Tube wells	33039	22456	47
Tractors	11743	7876	49

Items/Years	2008-09	1998-99	Percentage Increase/Decrease
Threshers	3238	1713	89
Reapers	46	48	-4
Harvesters	132	392	-68
Bulldozers	410	N.A	-

Mechanization in the ten-year period contributed to the overall increase in agricultural production in the province along with availability of water during that particular period.

Livestock Resource of the Province

Balochistan has 32.4 million hectares of rangelands, which is 93% of the province. 21 million hectares that is 65% is considered grazing land, producing varying degree of fodder. 9.8 million hectares that is 30% is unproductive and 1.6 million hectares, which comes to 5% is unreachable. The rangelands are divided into Northern Zone (38% of the province) and Southern Zone (62% of the province). The Northern Zone has higher rainfall and 76.5% of the total livestock is in this zone, while the Southern Zone has less rainfall and supports 23.5% of the livestock (Forest, Wildlife and Fisheries Department, 2011). As a result of low rainfall extensive crop culture operations are not possible in all the areas of the province. It is estimated that about 15% of the rangelands are located in areas having more than 250 mm of annual rainfall, which can support perennial grasses and shrubs. Therefore, except for some portions of the Loralai and Zhob districts, the rest of the land surface cannot support the rearing of livestock around the year, which requires seasonal migration of nomadic and transhumant grazers to find feed for their livestock. Migration takes place in summer and winter quarters adopting fixed migratory routes, in spring and autumn. Nomads and transhumant livestock owners follow precise itineraries to and from the highlands of Balochistan. Two such itineraries can be distinguished as under:

i. The north-south migratory routes are usually followed by Pushtun nomads and transhumant.

ii. The east-west migratory routes followed by Brahvi transhumant.

Rangeland Types (Forest, Wildlife and Fisheries Department, 2011)

Central ranges: It include ranges in Quetta, Kalat, Mastung, Pishin and parts of contiguous districts.

Western ranges: It covers ranges in Kharan, Chagai, Nushki, Kech and parts of adjacent districts.

Eastern ranges: Mainly include ranges of Zhob, Loralai, Musakhail, Barkhan, Kohlu, Sibi, Nasirabad, Khuzdar and parts of adjacent districts.

Suleiman Mountain ranges: Includes the north-eastern and western parts of Zhob and Sherani districts bordering with KP province.

Livestock & Dairy Development

Importance of livestock, in Balochistan, cannot be overlooked especially as rangelands cover 93% of the total landmass. The livelihood of about 80% rural population depends on rearing sheep, goats and camels. Despite being an arid and semi-arid province, livestock contributes more than 40% towards agriculture share and 52% share towards GDP. Livestock is the mainstay of more than 75% of the people living in rural areas of the province. Livestock is considered as financial security in the event of crop failure. Therefore, a family without any animal is considered the poorest.

Despite contributing more than 40% to the economy of the province this sector continues to be neglected by the policymakers and government. According to 1996 census, the number of small ruminants is around 20 million sheep and goats, which is 46% sheep and 23% goats of Pakistan's population of sheep and goats, respectively. The share of different sectors of livestock in Balochistan is as under:

Table 17

Share of Different Sectors of Livestock in Balochistan

Meat	40%
Milk	35%
Eggs	13%
Skin, Hides & Wool	10%
Others	2%

It is seen that the provincial heard has not grown as par with national heard.

Table 18
Live Stock in Pakistan and Balochistan

	Cattle	Buffaloes	Sheep	Goats	Camel	Horses	Mules	Asses	Poultry
Pakistan	29558812	27334985	26487741	53,786988	920868	344,253	155698	4268472	73647888
Balochistan	2253581	319854	12,804217	11,784711	379528	59,973	6,256	471942	5911304
Percentage	7.6%	1.2%	48.3%	21.9%	41.2%	17.4%	4.0%	11.1%	8.0%

Out of the total sheep production in the country, 48 % of it occurs in Balochistan, which has just increased by 12 % from 23 million in 1996 census to 26 Million in 2006 census. During the same period the cattle production increased by 44%, buffalo production increased by 34 %, and goat's production increased by 30 %.

Effects of Drought and Flood

Severe drought in 1990s has adversely affected the livestock of Balochistan. Growth rate of livestock in Balochistan was quite slow as compared to the livestock activities countrywide. This led to disenchantment amongst farmers. The situation demanded immediate and focused attention of the authorities to restore confidence of the farmer in rearing livestock that not only contributed to the overall economy but also provided security to the rural population. Floods of 2010 caused heavy damage to the livestock in Balochistan apart from agriculture.

Forest Resources of the Province

Forest resources of Balochistan are distinguished based on the area according to the availability of water resources. The forests of the provinces are divided into following categories:

"Conifer forests: Juniper forests (Ziarat & Kalat)- Chilgoza & Blue Pine forests (Zhob)

Scrub forests: Olive, Pistachio & Acacia forests (Zhob, Musakhail, Loralai, Barkhan, Kohlu, Ziarat, Oila Saifullah, Qila Abdullah, Quetta, Kalat & Khuzdar)

Desert scrub: Tamarix & Haloxylon forests (Kharan & Chagai)

Thorn forests: Prosopis & Acacia forests (Sibi, Jhal Magsi, Bolan, Dera Bugti, Panjgur, Kech, Awaran & Lasbella)

Coastal forests: Mangrove forests (Sonmiani, Kalmat & Jewani)"

Evaluation of Case Study of Naulong Dam Project

Naulong Dam Project is located in District Jhal Magsi, across Mula River near Sunth about 24 km from Jhal Magsi Town. River Mula has a catchment area of about 7485 sq.km. Towns of Kalat, Khuzdar, and Surab area are on the periphery of catchment area (Pakistan Water and Power Development Authority [WAPDA], 2011). A case study for storage of irrigation water in Baluchistan has been evaluated to determine the cost and benefit of such projects in the province where there is no river basin and most of the rainfalls is wasted as run-off water. The case study evaluates economic benefits of such dams for making available water for irrigation in Baluchistan.

Objectives (WAPDA, 2011)

Development of Naulong Dam Project envisages the following objectives:

(a) Store flood and perennial flows of Mula River.

(b) Utilize 138,000 Acre ft. of water to irrigate 47,000 Acres of land.

(c) Hydropower generation of 4.4 MW annually.

(d) Flood control to save life and property of the people.

(e) Drinking water supply.

(f) Development of fisheries.

(g) Poverty reduction and improvement of living standards.

Project Description

As per project planning Report prepared by Naulong Dam Consultants, the Project envisages construction of following major components:

(a) Zoned earth filled dam with impervious core 186 ft. high

(b) Zoned earth filled auxiliary dam 179 ft high

(c) Spillway with Discharge capacity 432,000 Cusecs

(d) Fuse plug with discharge capacity of 40,000 Cusecs

(e) Dual stage intake.

(f) 10 ft. dia tunnel 5700 ft. long

(g) Power House No. 1 to generate 2.6 MW annually

(h) Power House No. 2 to generate 1.8 MW annually

(i) Irrigation system for cultivable command area of 47,000 acres (27,000 acres on right bank and 20,000 acres on left bank)

(j) Access Road and

(k) Project Colony.

Hydrology

The catchment area of Mula River at the proposed Naulong dam site is 7,485 sq. km. The estimated average annual water availability is 152,000 AF (acre-ft) (WAPDA, 2011).

The other hydrological features are as under:

Reservoir

Gross capacity	242,163	AF
Dead storage	42,207	AF
Live storage	199,956	AF
Life of dam	> 50	years

Irrigation System

A strategy has been formulated under the project to store the perennial and flood waters of Mula River for irrigation and other domestic purposes for irrigated area on the left side of the river and to the proposed new command area of 27,000 acres on the right bank of the river in Jhal Magsi area. The project aims at.

i. Upgrading of the existing irrigation system to an improvised perennial supply system, increasing the commanded area from 9000 acres to 20,000 acres, and achieving better efficiency with higher intensity by management of regulated demand-based supplies in the existing canal system.

ii. Taking up new area in the north of Jhal Magsi town for irrigation, by utilizing available stored supplies of Mula River.

iii. Power generation for the tube wells as well as for domestic use of the local area.

iv. Providing water supply facilities to command areas.

The existing canal system is historic in its value. These canals were dug out by landowners on self help basis. These canals are presently receiving perennial supplies from Mula River regulated through the Punj Munh distribution system near Kandori. More land can be brought under cultivation by installing high efficiency irrigation system i.e. drip irrigation system or sprinkler irrigation system, as compared to conventional irrigation system.

Water Rights

Traditionally upstream land owners have the first right to use flood water leaving downstream flood water to land owners. Water rights for the land owners on the left bank of Mula River in Tehsil Gandawa have been safeguarded in conformity with the existing traditions with the provision of 90 Cusecs of water as per tribal agreement. There are no water right issues on the right bank of the river in Jhal Magsi Tehsil of 27,000 acres, which can be established with community participation through representatives of Union Councils (WAPDA, 2011).

Agriculture Development

The project envisions following benefits accruing to the agriculture in the area: Irrigation Modes Considered for Agriculture Development.

Different modes of irrigation considered for cultivable command area include

(a) Surface irrigation

(b) Sprinkler irrigation

(c) Drip irrigation

Water use field efficiencies and major recommended crops for these irrigation modes are given below:

Table 19

Water Use Field Efficiencies and Major Recommended Crops

Irrigation Modes	Surface	Sprinkler	Drip
Water Use Field Efficiency	70-75%	92-95%	95-98%
Major Crops	Cotton Wheat Oilseeds Vegetables Orchards	Orchards Vegetables Wheat Cotton Fodders	Wheat Orchards Vegetables Cotton Fodders

The project recommends sprinkler and drip irrigation mode for added benefits in the as compared to surface irrigation, despite high initial costs involved in the former two systems. The crops proposed are best suited to the soil and climatic condition prevailing in the area.

Agriculture Development Parameters

Agriculture development parameters adopted for various irrigation modes are given below:

Table 20

Agriculture Development Parameters

Sr.No	Agriculture Development Parameters	Irrigation Modes (in a Acres)		
		1	2	3
		Surface	Sprinkler	Drip
1	%page of CCA	100%	100%	100%
2	Cropped Area (Acre)	47,000	79,900	82,250
3	Cropping Intensity (%)	100	170	175

The drip and sprinkle irrigation enhances crop intensity and cropped area as compared to flood irrigation. The cropped area in case of sprinkle and drip irrigation increases 32900 acres, and 35250 acres, and cropping intensity by 70% and 75%, respectively.

Crop Yields

The current crop yields in the area have been estimated based on current individual farming practices in the country. The project envisages improvement in the yield through corporate farming and using better seeds, balance fertilizers and plant protection measures (WAPDA, 2011).

Table 21
Yield of Rabi and Kharif Crops

Kharif	Yield (Kg./Acre)	Rabi	Yield (Kg./Acre)
Sorghum	310	Wheat	822
Kharif fodder	10,396	Rabi Oil Seed	401
Kharif Pulses	207	Rabi fodder	7,989
Kharif oil Seed	104		
Guar	225		

Project Cost

The estimated cost of the project showing comparison amongst surface irrigation, sprinkle irrigation system and drip irrigation system is shown in table below, that impact total cost of the project. Detailed costing of the project is in table at Annexure K (WAPDA, 2011).

Table 22
Detailed Costing of the Project

Description	Surface Irrigation System (Million Rs.)	Sprinkle Irrigation System (Million Rs.)	Drip Irrigation System (Million Rs.)
Irrigation and On Farm Management System	678.349	3,498.349	3,028.000

Flood irrigation is the most inexpensive method of irrigation but as has been explained hitherto it causes 50% loss of water through evaporation and seepages. The sprinkle and drip irrigation systems not only conserve 50% of water but also give high economic rate of return with less payback period.

Annual Operational and Maintenance Cost (WAPDA, 2011)

The recurring costs, including routine operational and maintenance costs, annual leasing costs, and abiana are estimated as below:

Table 23
The Recurring Costs

Sr. No.	Annual Cost Components	Irrigation Modes		
		Surface Irrigation	Sprinkler Irrigation	Drip Irrigation
1	O&M of Engineering Works	117	117	117
2	O&M of On Farm Water Management	-	-	-
	(i) Surface Irrigation 1% of the cost at Table 20	6.780	-	-
	(ii) Sprinkler 3% of the cost at Table 20	-	105.000	-
	(iii) Drip 5% of the cost at Table 20	-	-	151.000
	Total Annual Cost	123.780	222.000	268.000

The recurring and maintenance cost for high efficiency irrigation systems is higher than the flood irrigation but the amount of water that is saved in the former method is utilized for increasing output either through better yield per acre and increasing crop intensity or by increasing area of production.

Table 24
Annual Land Leasing Cost

Sr.No.	Description	Annual Cost (Million Rs.)
1.	Total Annual Lease Amount During Construction Period	242.000
2.	Total Annual Lease Amount During Commissioning of the Project (First year)	266.200

Annual Abiana

Sponsor would pay abiana @ Rs.150/- and 200/- per acre for food crops and non-food respectively, subject to the approval of Provincial Government (WAPDA, 2011).

Annual Project benefits

It is envisaged that the project would be completed in four-year time. Summary of annual benefits accruing on its completion is given in the table below (WAPDA, 2011).

Table 25

Summary of Annual Benefits Accruing on its Completion

Sr. No.	Benefit Type	Annual Economic Benefits (Million Rs.)		
		Surface Irrigation	Sprinkler Irrigation	Drip Irrigation
1	Agricultural Benefits	1,337.410	2,674.000	2,942.303
2.	Power Benefits	516.146	516.146	516.146
3.	Drinking Water	61.971	61.971	61.971
4.	Fisheries Benefits	91.564	91.564	91.564
5.	Flood Alleviation Benefits	611.700	611.700	611.971
2	Total Annual Cost	123.780	222.000	268.000
	Total	2,619.613	3,956.203	4,223.685

Economic and Financial Analyses

Net Present Value (NPV), benefit Cost Ratio (B/C Ratio) and Economic Internal Rate of Return (EIRR) calculated for each irrigation mode are given below (WAPDA, 2011):-

Table 26

Net Present Value (NPV), Benefit Cost Ratio (B/C Ratio) and Economic Internal Rate of Return (EIRR) Calculated for Irrigation Mode

Description	Conventional Irrigation	Mechanized Irrigation System (Sprinkler)	Drip Irrigation
Project Cost (Million Rs.)	12,180	15,726	15,135
Economic Internal Rate of Return (EIRR)	15.3%	16.2%	17.3%
Benefit/Cost Ratio	1.33	1.420	1.54
Net present worth (in Million Rs.)	2,857.010	4,799.870	5,940.030
Payback period (in years)	13	12	12

Payback Period

The sponsors are estimated to earn a return of Rs. 18,000, Rs. 47,000, and Rs. 53,000 per acre per year through surface irrigation, sprinklers, and drip irrigation systems, respectively (WAPDA, 2011).

Table 27

Irrigation Mode with Cost Estimation

Irrigation mode	Present Worth of Cost (Million Rs.)	Benefits (Million Rs.)	BC ratio	EIRR (%)	Payback Periods (years)
Surface	8,573.330	11,430.340	1.330	15.3	13
Sprinkler	11,298.120	16,097.990	1.420	16.2	12
Drip	11,091.290	17,031.520	1.540	17.3	12

Some of the important conclusions are summarized under:

- The Project is technically feasible and economically viable.

- The Project will have major positive impact on the area and its development.
- The Project can be implemented through private investment. The proposed scheme includes leasing land from the local and handing these back to them after 25 years of start of the project.
- Special measures have been envisaged for emancipation of women and poor of the area, who would be allotted land and trained to maximize their potential.

Current Status of the Project (S. Hameed, personal communication, May 21, 2011)

- Feasibility study and detailed engineering design of the Project completed in 2009.
- PC-1 amounting to Rs.11.699 bn approved by ECNEC on September 3, 2009.
- Tenders for construction opened on April 17, 2010.
- The contract of Naulong Dam Project is under award to the lowest bidder M/s. Descon-Zargoon JV (Bid Price = 15.600 Billion). Funds awaited for award.
- Govt. of Balochistan assured full security to the Contractor including M/s. Sinohydro.
- Response of Sinohydro is awaited for joint venture with the lowest bidder for construction of Naulong Dam Project.
- Revised PC-1 amounting to Rs.31.962 Billion cleared by CDWP on its meeting held on June 29, 2010 for approval of ECNEC.

Conservation and Management of Water Resources in Balochistan for Increasing Agricultural Output

Vision for Water Conservation

There is no water policy adopted by the government. A draft Water Policy is under consideration since 2003 but no headway could be made due to conflicting perceptions and opinions of the provincial governments (Muhammad Ali Shah, personal communication, May 25, 2011). India foreseeing the depleting water resource came up with the concept of

National Water Council that formulated Water Policy (Lahiri-Dutt & Wasson, 2009)., which states, "Water is a scarce national resource to be planned, developed, conceived and managed as such, and on an integrated and environmental sound basis, keeping in view the socio-economic aspects and needs of the states". Indian policy makers have held water as a national asset and not a private property or tradable commodity.

Principles of Integrated Water Resource Management (IWRM) espoused in 2002 at World Summit on sustainable Development in Johannesburg and reiterated at 3rd & 4th World Water Forums at Kyoto 2003 and Mexico City 2006 are (Ahmed, 2008):-

a) Water is to be treated as an economic, social and environmental good-meaning that while water can no longer be seen as a free resource and states cannot overlook their responsibilities to the poor and vulnerable those have disparity in access to water.

b) Governments should facilitate and enable the sustainable development of water resources through integrated policies and regulatory frameworks, which address water in its totality and not in terms of supply-demand management.

c) Water resources should be managed at the lowest appropriate level-decentralization and stakeholder participations are important.

d) Women should be given vital role in the provision, management and protection of water resources and services (Lahiri-Dutt & Wasson, 2009).

Development of water resources in Pakistan has to take into account the conservation of water; accessibility of the poor and disadvantaged people to water; gender equality to encourage women to take active part in water development programs.

One such program is Balochistan Community Irrigation and Agriculture Project launched by World Bank (2011). The project aims at to help 7,000 poor farming families with 4,800 acres of land. The program focused on ensuring women participation in "water user associations, setting targets for the inclusion of women in water user associations, associating NGOs to mobilize and train women to participate" (World Bank, 2011).

Water Management

Water management is required to meet current demands of different sectors in general and agriculture in particular. In this regard focus is on three major areas:-

a) Surface water management

- Conventional farming practices result in low crop yield, conveyance and water use efficiencies. Modified bed and furrow technique developed by Pakistan Council of Research in Water Resources (PCRWR) could save 30% of water whereas sprinkler system can save up to 40% of water.
- To identify low cost materials used for lining water courses for maximum seepages from the side banks and not from the bed.

b) Groundwater management

- Groundwater is depleting rapidly in Balochistan for which the provincial government has constructed over 165 delay action dams. However, effectiveness of these dams has been low because of various technical and management issues. To resolve these problems, low-cost recharging structures like leaky dams that are beneficial for groundwater recharge besides reducing the flood effects. The concept of leaky dams is being implemented in parts of Balochistan (Pakistan Water Gateway, 2011).

c) Indigenous development of water management instruments

- Changing crop pattern by developing hybrids requiring less irrigation and shifting to crops that need less water. For example, a new variety of maize requires only one pre-sowing irrigation that can save 20% of water. Shallow groundwater (0.4-0.5 m) contributes to crop water requirements of various crops (Pakistan Water Gateway, 2011).

d) Rainwater harvesting

- Rainwater harvesting is essential in areas like Balochistan where drinking water is scarce particularly in the desert areas and vast cultivable land where live stock can be reared. The project launched by Pakistan Council of Research in Water Resources (PCRWR) in Cholistan desert constructed 92 reservoirs within 15 km distances from each other with water storage capacity of 15000 cubic meter making total of 1.35

million cubic meters storage annually. With the availability of drinking water throughout the year, migration of human and livestock has halted water saving Rs. 6 billion annually that was lost because of loss of livestock production in the form of mortality, diseases, fall in meat and milk as well as damage to crops in canal irrigated areas. The micro-climate around these reservoirs has led to eco-friendly environment. Birds and other wildlife started frequenting the reservoirs with more and new vegetation species observed having positive impact on biodiversity of desert (Pakistan Water Gateway, 2011). The model can be replicated in Balochistan for the improvement of livestock.

e) Improving quality of water

- Brackish water can be used either mixing with canal water or by sulfurous acid generators technology on gypsiferous soil and use of gypsum on non gypsiferous soil. Sandy desert (10.6 m hectare) can produce salt tolerant plants by application of brackish water because salts do not deposit on partides (sic) of sandy soils and are percolated to deeper layers (Chaudhry, 2006).

Policy Interventions

According to Asian Development Bank (2011)

a) Restructure agricultural tube well subsidy

Tube well subsidy for tube well installed after cut- off date should be disallowed to preserve ground water that have been depleting at an alarming rate.

b) Introduce schemes for efficient water usage

Study to design and introduce a scheme for water conservation technologies and savings from tube well subsidy to be used for efficient water usage.

c) Introduce measures to enhance the revenue yield from Abiana

Increase in the rate of Abiana and its full cost recovery to cover operational & maintenance (O&M) costs to maintain and update the canal system to reduce wastage of water.

d) Implement IWRM policy

Government of Balochistan to form a working group to formulate Integrated Water Resource Management Policy

e) Develop master plans for implementing IWRM for three selected basins Pishin-Lora, Nari River and Zhob, where over exploitation of ground water has lowered water table and resulted in drying of Karezes and shallow wells (Shahid, 2008).

Diversification of Crop Pattern and Corporate Farming

Diversification of agriculture towards high-value commodities is being witnessed because of increasing per capita income, change in food consumption, urbanization, and development of infrastructure (Joshi et al., 2007). However, diversification to high-value commodities runs the risk in production and marketing because of small land holdings and perishable nature of goods (Joshi et al., 2007). Nevertheless, diversification can act as an engine to alleviate poverty (Shawki et al., 2007). Moving to fruits vegetables would enormously benefit farmers in Balochistan but it should be done by securing food security requirements of the province in staple food like wheat, maize, barley, and fodder for the livestock.

Vegetable area of Balochistan is 11% of the total vegetable area of Pakistan. Balochistan form 23 % of fruit area in Pakistan. The fruit area is increasing constantly but the yield levels have remained stagnant. Post-harvest lose about 25% of the total harvested product due to inadequate marketing. Diversification in the livestock sector is bright for Pakistan. Growth rate during ten-year period between 1980-90 and 1990-2000 for milk was 5.39 and 7.06, for meat 6.79 and 1.81, and for eggs 7.49 and 4.12, respectively (Qureshi, 2007). The grazing lands of Balochistan can be developed by diversification of its livestock.

Corporate forming will expand investment opportunities.

- Land development.
- Reclamation of barren, desert, and hilly lands.
- Reclamation of water logged and saline areas.
- Increase production of crops, fruits, vegetables, flowers, and their value addition.

- Implore modernization and development of irrigation system and water management, plantation for flood control resources.
- Encourage forestry and horticulture, dairy farming, and livestock forming, production of quality seeds, processing and packaging of fruit, vegetables, and flowers.

Corporate farming has been declared as an industry with the following main features:

- 100% foreign equity for foreign investors
- No limit on foreign investment
- Full remittance of capital, profits
- Credit and other facilities
- Private or public limited companies, local or foreign, allowed investing without upper ceiling on landholding.
- State land to be sold or leased out for 50 years extendable to another 49 years
- Banks to create separate portfolios for financing corporate projects
- Zero percent custom duty on import of agricultural machinery. Dividends of corporate agricultural not subject to provincial agriculture income tax.

Corporate farming entails certain inherent pitfalls that must be taken into account. Multinationals are driven by profit and they would use the land to export cash crop, thereby endangering food security of province like Balochistan (Qureshi, 2007). It would have a negative impact on the small farmers and may lead to poverty in rural areas. Control of food commodities would concentrate in the hands of few. Large firms would control major crops, natural resources, and bio-diversity. Mechanization by big corporations would lead to unemployment in rural areas. Therefore, the government should provide incentive and legal framework for co-operative forming in high value goods (Qureshi, 2007). While corporate agriculture may be initiated on barren state land for developing under privileged areas. Later, it could be extended to other areas when the corporate sector would come of age and find some mutual understanding with the farmers particularly of marginal and small farm holdings through building trust and

overcoming socio-economic obstacles that hinder its implementation in the current scenario.

Disagreements over Indus Water Apportionment

Balochistan has been deprived of its water share from the Indus River System. While negotiating the Indus Water Treaty, 1960 with India, inter-provincial rivalries were ignored (Hill, 2008). The Water Apportionment Accord of 1991 recognized canals and apportion future supplies based on previous 7-years supply (Hill, 2008). Dispute on water apportionment is not only between Punjab and other three provinces but Balochistan has been complaining that Sind was not releasing adequate water (Hill, 2008). Tension over water distribution is heightened during Rabi season when shortage of water is acute. However, resolution of largely technical issues has been eluded because in Pakistan it is taken as a political issue (Hill, 2008).

Water Policy 2018

Much-awaited National Water Policy unveiled in 2018 recognized Pakistan as water stressed country (Federal Flood Commission, 2018). It also took into account unpredictability of weather patterns under the impact of climate change having "serious consequences" to the availability of water. The policy sets thirty-three (33) point policy objectives. It devised strategies to harness water resources and improve water management. The policy established National Water Council (NWC) chaired by the Prime Minister. A Steering Committee headed by Minister for Water Resources to assist the Council. NWC is to meet at least once in a year with to perform following functions (Federal Flood Commission, 2018):

(a) Review and coordinate implementation of the National Water Policy and National Water Sector Strategy in the country and periodic updating of the same

(b) Recommend legislation, policies and strategies for water resources development and management in the country

(c) National planning and coordination for water resources development and management activities among concerned organizations at federal as well as provincial government level to achieve objectives of NWP

(d) Review all major interprovincial water-related projects and activities in the fields of irrigation, drainage, flood control and hydropower where

federal funding is involved to ensure optimal and economical use of water resources

(e) Create an enabling environment that shall promote broader multi-stakeholders' participation and integrated water resources management with due consideration for environment and ecology

f) Review in consultation with concerned organizations the progress in controlling pollution of water bodies including rivers, streams, lakes and groundwater

(g) Coordinating water resources database service at different level

(h) Any other functions, which the CCI may assign to the Council.

Conclusion

Water sacristy has adversely contributed to the poverty and affected the socio-economic activities and conditions of the people of Balochistan. The major reason for under development of agriculture in Balochistan is scarcity of water-. Depletion of ground water at an alarming rate is causing worry as it could lead to displacement of people on a large scale.

Emphasis of the policy is on the storage, conservation, and management of water resources. Though it acknowledges the transient nature of weather patterns attributed to climate change but does not encompasses the fact in the policy and strategies. Policymakers had before them the erratic rain patterns in 2010. It stated that he geographic location of Pakistan places the country in the heat surplus zone on earth, putting it high on the vulnerability scale of climate change with considerable increase in the frequency and intensity of extreme weather events and erratic monsoon rains, as demonstrated by the unprecedented floods of 2010.

Limited storage capacity to tap run off water resulted in the wastage of precious resource in a water scare province where rainfall is very limited. There are potential chances of additional water availability by constructing small and medium dams that has been identified in various studies and feasibilities conducted by WAPDA.

Mining of water in Balochistan has depleted the ground water to an alarming level. Ground water exploitation should be made in a planned manner in conjunction with other sources of water. Indiscriminate pumping of ground water has played havoc with the resources. It could not be left to

the discretion of private owners to use ground water without replenishing the aquifer through recharging dams.

Over 50% of canal irrigation water is lost due to the evaporation and seepage. While some of seepage is necessary for recharging ground under, there is a need to conserve most of it for irrigation purposes. Maintenance and updating of canals is of prime importance to manage distribution of water efficiently and equitably.

Yield per acre of crops in Balochistan is far below than the national average produced per acre, which is largely due to scarcity of water though there are other contributing factors like low mechanization, less use of quality seed and low fertilizer use. Balochistan has an edge over other provinces in the per acre yield of fruits. Nevertheless, average yield for Balochistan or Pakistan is far below than the international output per acre of fruits.

Economic conditions of the farmers can be improved by changing crop patterns to high-value crop, such as, vegetables and fruits. A change in the crop pattern to high-value crop in Balochistan must be coupled with better and improved storage facilities, marketing, and transportation to enhance shelf life of perishable crop. Increase in income would encourage the farmers to switch over to high efficiency irrigation system from flood irrigation.

The province has potential of rearing livestock for national consumption as well as for global markets. The resource is not harnessed because of various reasons but scarcity of water has caused less than potential production. Water scarcity also necessitates seasonal migration of the nomads to head towards areas where water is adequately present. The problem of low yield of milk is attributed to insufficient availability of balanced feed and fodder is a direct consequence of water scarcity. There is little effort to improve quality of wool. Because of the fact that sheep are reared primarily for meat purposes, loss due to faulty shearing is estimated to be 20%. Whereas, 25% of wool is lost as it is left on body of sheep.

Population density per hectare of arable land is relatively lower in Balochistan than other provinces. Vast areas of land can still be transformed into arable land through irrigation. Therefore, factors indicated that there is a possibility that migration and population increase in Balochistan, which may lead to further development of its agricultural sector. However,

nationalists of Balochistan are opposing against the settlement of outsiders in the province particularly Baloch dominated areas for fear of converting locals into minorities. Militants are also targeting development projects, which they see as a prelude of influx of non-Balochis into the province. The militant Baloch nationalists have waged insurgency creating serious law and order situations hampering the development projects.

Recommendations

Availability of water resources are required to improve water management of Balochistan under Water Accord of 1991 of Indus River System. Differences between Balochistan and Sind over the share of the Indus water should be resolved through Indus River System Authority (IRSA) that provides proper forum to deal with the disputes between the provinces. Therefore, this matter could be placed before Council of Common Interest (CCI) if IRSA fails to address the complaint of Balochistan.

Construction of dams to store run-off water is need of the hour to manage water resources efficiently. Construction of leaking dams would help to restore groundwater through percolation. Regulatory framework is required to be devised for corporate farming in Balochistan that has been viewed as a way forward to finance dam projects through a private-public partnership. The regulatory law should protect food security of the province. Corporate farming may tend to go for high-value crops like fruits and vegetables at the expense of staple crop.

The irrigation system must be updated and developed to reduce wastage of water. O&M costs for maintaining the canal system in the province should be covered through water charges (abiana) gradually as a five-year program. Poor maintenance of canals in provinces like other parts of the country is contributing to the wastage of water resource.

Sprinkle and drip irrigation needs to be promoted, as flood irrigation that is prevalent in the province is the prime cause of water scarcity. Easy loans to the farmers to shift from flood irrigation to sprinkle and drip irrigation would encourage introduction of latest technology for conservation and better management of available water resources. These loans could be guaranteed by irrigation department in the canal-irrigated areas of the province. It has the mechanism to recover the loan by linking it

with payment of abiana and in case of default, the water rights may be abridged.

Alternatively, policy interventions like making pumping of ground water a high cost venture by withdrawing subsidy and increasing the rates of electricity, at least in Balochistan. Thus, the saved amounts should be diverted to subsidize drip irrigation for orchards utilization of groundwater, which should be regulated to check its unplanned exploitation.

Low cost technology could be used for determining the necessary irrigation by employing EnvironScan that determines water requirement of different crops and soils to minimize excess irrigation. A single unit costing unit costs Rs. 400,000 for same soil and crop can be used for any size/area of land. However, for varying soil and crops, one unit each could be employed (Ihsan Bajwa, personal communication, May 21, 2011). Agriculture Department should take initiative to install EnvironScans in different areas to update farmers to meet their requirement and volume of irrigation for their crop. The information should be disseminated by voice/text messaging, electronic and print media, and mobile teams which would guide the farmers regarding irrigation .

Better crop varieties should be developed that are drought resistant by establishing linkages between line departments with research and educational institutions. Development of livestock that is mainstay of agricultural sector of Balochistan would provide economic stability to the people. NGOs should be involved to form farmers association for community participation in resolving their problems and discuss relevant issues. Veterinary hospitals and clinics should be geared up to coordinate with the farmers. As a policy intervention, price control mechanism to control milk prices should be done away with to encourage this sector for enhanced production of livestock resulting in lowering of prices through competition. Private sector could play a major role for the development of dairy sector. Incentives should be given for processing dairy products for value addition for export to Oman and Gulf countries through Gwadar port for reducing transportation costs and making them competitive.

The quality and quantity of wool obtained from animals can be improved through:

- Shearing with modern electric machines

- Keeping quality wool separate from lower parts wool
- Storing and protecting wool from parasites

Veterinary hospitals and clinics in the province should impart modern techniques of shearing through mobile units.

Periodic review of NWP requires comprehensive studies to determine whether changes in weather would be more frequent or just once in every ten years phenomenon as in situation arising out of deluge in 2022.

A strategy to overcome the problem could only be found in the optimum utilization of available water resources. Easy long term loans for orchid owners to introduce drip irrigation to conserve water would increase yield per acre and increase cultivated land.

In short-term emphasis should be on the increasing yield per acre and crop intensity. Increase in cropped land should be undertaken in long term by enhancing storage capacity after meeting the requirement of current cultivable land.

In order to secure and maintain peace in the province, apprehensions of the Baloch nationalists could be allayed by negotiations, to ensure that local populace would be entitled to the first right of economic benefits of any development in the province. Trepidation of domination of outsiders could be removed by introducing constitutional safeguards like restriction on internal migration.

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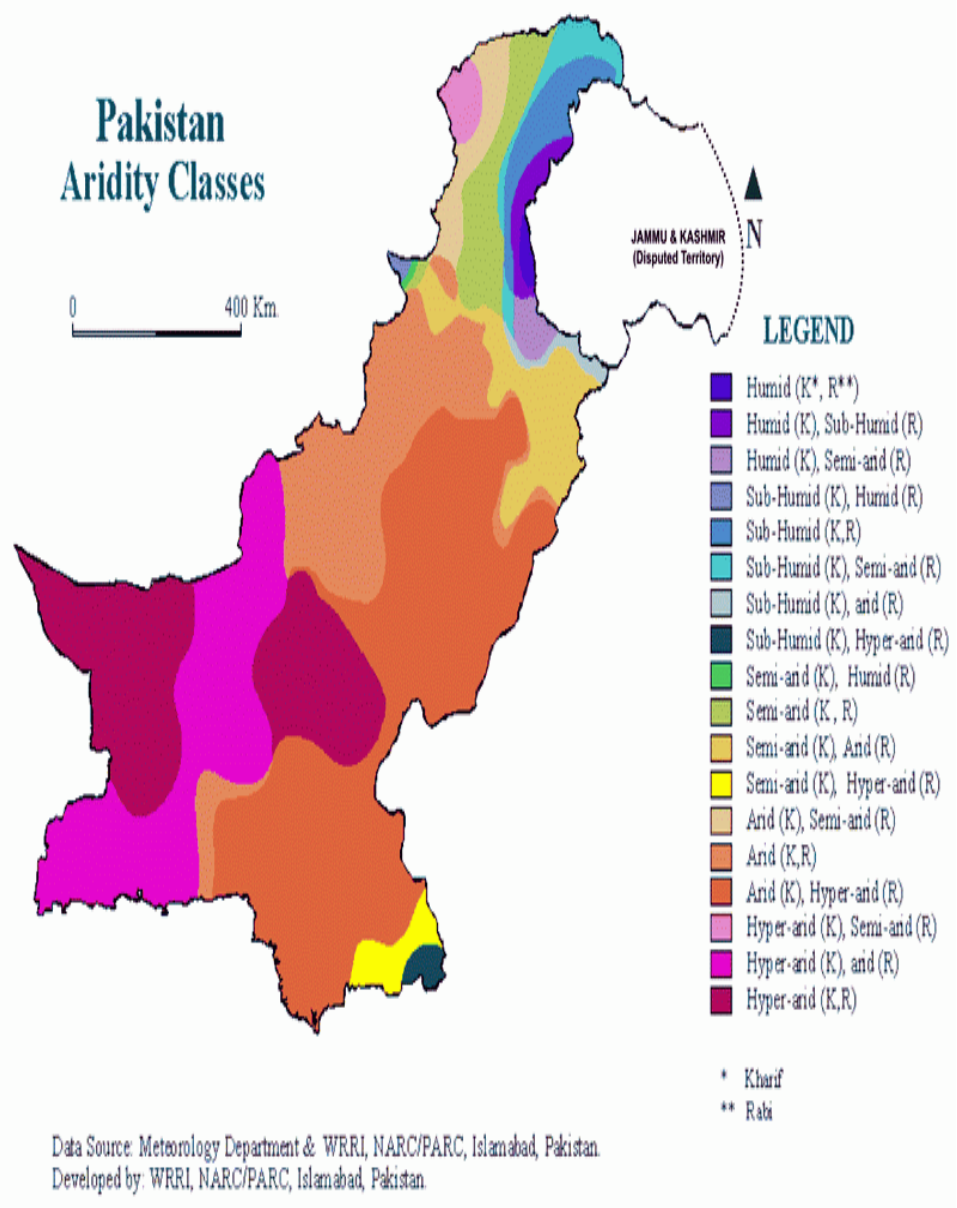
Annexure A


Pakistan
Aridity Classes
0
400 Km.
JAMMU & KASHMIR
(Disputed Territory)
N
LEGEND
Humid (K*, R**)
Humid (K), Sub-Humid (R)
Humid (K), Semi-arid (R)
Sub-Humid (K), Humid (R)
Sub-Humid (K,R)
Sub-Humid (K), Semi-arid (R)
Sub-Humid (K), and (R)
Sub-Humid (K), Hyper-arid (R)
Semi-arid (K), Humid (R)
Semi-arid (K , R)
Semi-arid (K), And (R)
Semi-arid (K), Hyper-arid (R)
Arid (K), Semi-arid (R)
Arid (K,R)
Arid (K), Hyper-arid (R)
Hyper-arid (K), Semi-arid (R)
Hyper-arid (K), and (R)
Hyper-arid (K,R)
* Kharif
** Rabi
Data Source: Meteorology Department & WRRI, NARC/PARC, Islamabad, Pakistan.
Developed by: WRRI, NARC/PARC, Islamabad, Pakistan.

Annexure – B


Zone 11 & 12
Uplands and Foot hills of AJ&K
Uplands of NWFP
Zone 10
Foot Hills of NWFP
Zone 9
Zone 7
Northern Punjab
Southern Plains of NWFP
Zone 8
Zone 6
Central Punjab
Uplands of Balochistan
Zone 1
Zone 5
Southern Punjab
Plains and Foot Hills of Balochistan
Zone 4
Northern Region of Sindh
Zone 2
Zone 3
Southern Region of Sindh

Annexure C

Table

Balochistan Area Irrigated by Different Source of Irrigation2008-9

Province/District	Total	Canal			Wells	Tube Wells	Karezes Springs & Others	Total Number Of	
		Govt:	Private	Total				Wells	Tube Wells
BALOCHISTAN	1224663	482623	81005	563628	54421	426218	180396	8717	33039
Quetta	9814	0	0	0	0	6972	2842	0	751
Pashin	26478	0	0	0	465	25346	667	14	2366
K.Abdullah	10778	0	0	0	17	9979	782	11	1134
Chaghi	23634	0	0	0	6240	16648	746	672	1427
Loralai	32550	0	0	0	1116	30624	810	77	1316
Musa Khail	2793	828	0	828	670	1080	215	134	120
Barkhan	42537	0	0	0	1494	40894	149	249	2921
Zhob	26213	4000	13000	17000	0	8300	913	0	415
K.Saifullah	218578	0	0	0	0	70000	148578	0	2500
Sibi	14608	5329	0	5329	101	9178	0	5	162
Ziarat	7204	0	0	0	0	1120	6084	0	80
Kohlu	4534	0	0	0	1392	2880	262	232	240
Dera Bughti	8987	406	0	406	2125	5625	831	370	495
Nasirabad	210054	210054	0	210054	0	0	0	0	0
Jaffabad	232470	231915	0	231915	0	555	0	0	37
Bolan	33495	26670	0	26670	0	6825	0	0	117
Jhalmagsi	68425	0	38000	38000	0	25000	5425	0	391
Kalat	23168	0	0	0	0	22760	408	0	2529

Province/District	Total	Canal			Wells	Tube Wells	Karezes Springs & Others	Total Number Of	
		Govt:	Private	Total				Wells	Tube Wells
Mastung	35652	0	0	0	0	35644	8	0	2546
Khuzdar	89575	0	6000	6000	23010	46610	255	3835	4031
Awaran	19386	0	0	0	1580	17490	315	316	2915
Kharan	24168	0	0	0	9723	13836	609	539	805
Lasbella	21332	3421	0	3421	4408	13593	0	230	2101
Turbat	29005	0	24005	24005	0	0	5000	1470	134
Panjgoor	26625	0	0	0	2080	21649	2896	415	1461
Gwadar	2600	0	0	0	0	0	2600	30	135

Annexure – D

Table

Month wise Annual Rainfall in Balochistan from 2008 to 2010

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Monthly Amount 0f Precipitation In mm													
Barkhan													
2008	14.0	9.0	18.0	41.0	63.0	99.0	47.0	57.0	13.0	0.0	0.0	36.0	397.0
2009	23.0	14.0	40.0	12.0	21.0	31.0	146.0	5.0	0.0	0.0	0.0	2.0	294.0
2010	2.0	3.0	48.0	4.0	22.0	60.0	114.0	142.0	81.0	11.0	0.0	0.0	487.0
Dalbandin													
2008	70.0	2.0	0.0	0.0	0.0	Trace	0.0	1.7	0.0	0.0	0.0	9.0	82.7
2009	6.9	18.0	1.0	8.5	Trace	0.0	4.0	0.0	0.0	0.0	0.0	24.0	62.4
2010	4.0	9.0	0.0	Trace	4.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	20.0
Gwadar													
2008	19.5	3.7	0.0	0.0	0.0	1.0	0.0	20.0	0.0	0.0	0.0	27.0	71.2
2009	15.6	0.0	Trace	8.9	0.0	0.0	4.0	0.0	0.0	0.0	0.0	14.1	38.6

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2010	19.3	27.1	0.0	0.0	0.0	386.0	0.0	0.0	0.0	0.0	0.0	13.4	445.8
Jiwani													
2008	16.0	0.0	0.0	0.0	0.0	1.0	0.0	9.0	0.0	0.0	0.0	28.0	54.0
2009	113.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	134.0
2010	19.3	27.1	0.0	0.0	0.0	386.0	0.0	0.0	0.0	3.0	0.0	13.4	448.8
Kalat													
2008	133.4	13.0	0.0	3.0	2.0	2.0	4.5	33.5	0.0	0.0	0.0	29.0	220.4
2009	71.9	13.0	30.7	10.1	2.0	0.0	9.0	3.0	0.0	0.0	0.0	37.0	176.7
2010	2.0	28.0	7.0	4.0	3.0	0.0	2.0	1.0	0.0	0.0	0.0	0.0	47.0
Khuzdar													
2008	14.4	10.0	22.7	6.6	18.7	43.9	67.8	8.4	0.0	0.0	0.0	109.7	302.2
2009	50.8	7.3	21.2	1.8	0.0	0.0	29.0	59.3	6.7	0.0	0.0	41.0	217.1
2010	4.8	8.8	0.0	7.7	19.5	3.5	25.7	89.0	0.2	0.0	0.0	0.0	159.2
Lasbella													
2008	7.3	0.0	Trace	Trace	9.7	12.3	10.0	67.6	2.5	0.0	0.0	124.5	253.9

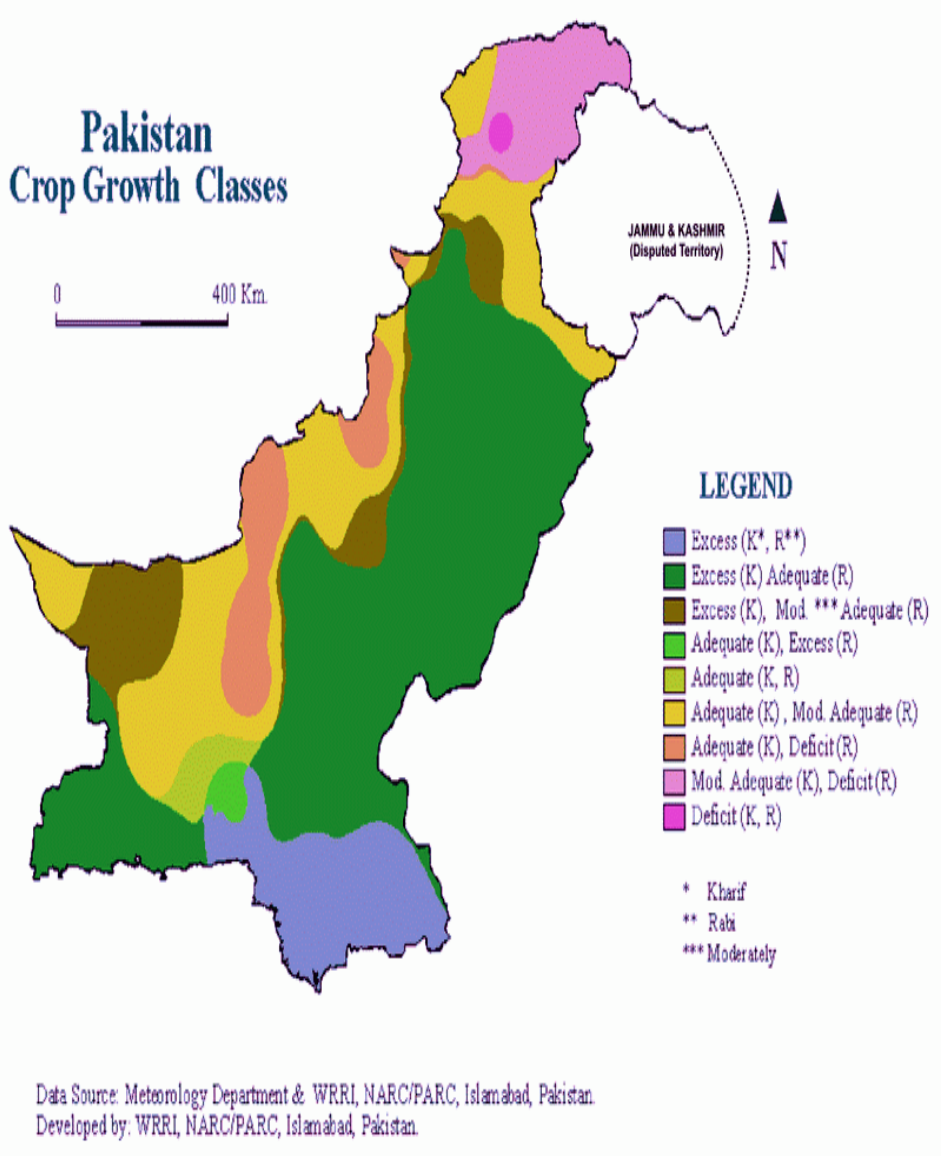
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2009	13.6	7.8	30.7	5.7	0.0	9.8	13.1	3.1	0.0	0.0	0.0	19.8	103.6
2010	1.5	6.9	0.0	7.7	Trace	13.0	59.0	36.7	0.0	0.0	0.0	0.0	117.1
Nokundi													
2008	75.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	77.3
2009	33.4	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	1.0	0.0	6.0	47.3
2010	2.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	10.7
Ormara													
2008	10.0	6.0	0.0	0.0	0.0	4.0	0.0	5.0	0.0	0.0	0.0	55.0	80.0
2009	9.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	0.0	0.0	0.0	12.0	25.0
2010	31.0	18.0	0.0	0.0	0.0	60.0	84.0	0.0	0.0	0.7	0.0	18.0	211.7
Panjgur													
2008	17.5	1.0	0.0	3.0	0.0	26.0	0.0	21.0	0.0	0.0	0.0	7.0	75.5
2009	38.0	0.0	8.5	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	59.5
2010	8.0	43.5	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.5
Pasni													

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2008	87.2	26.9	0.0	0.0	0.0	Trace	1.2	12.0	0.0	1.8	0.0	43.0	172.3
2009	35.2	0.0	1.5	0.0	0.0	2.0	2.0	0.0	1.0	0.0	1.2	7.0	49.9
2010	21.0	62.0	0.0	0.0	0.0	139.0	13.0	0.0	0.0	0.0	0.0	12.8	247.8
Quetta													
2008	97.0	15.0	Trace	6.0	1.0	2.5	Trace	2.0	0.0	0.0	0.0	11.0	134.5
2009	67.0	78.0	13.0	38.0	7.0	0.0	1.0	0.0	0.0	0.0	1.0	84.0	289.0
2010	45.0	51.0	6.0	16.0	7.0	5.0	0.0	1.0	0.0	2.0	0.0	0.0	133.0
Sibbi													
2008	6.6	9.8	1.3	2.5	2.0	75.2	65.3	6.7	14.4	0.0	0.0	22.7	206.5
2009	53.0	3.9	3.3	0.0	0.0	1.0	28.5	32.4	0.0	0.0	0.0	4.0	126.1
2010	1.2	1.9	0.3	0.5	Trace	Trace	107.6	93.2	43.0	0.0	0.0	0.0	247.8
Turbat													
2008	23.0	12.0	0.0	0.0	0.0	3.0	0.0	17.0	0.0	0.0	0.0	32.0	87.0
2009	27.0	0.0	0.6	10.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	24.0	67.6
2010	19.0	103.0	0.0	0.0	0.0	43.3	0.0	0.0	0.0	0.0	0.0	0.0	165.3

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Zhob (Pbo)													
2008	21.0	8.0	6.0	21.6	5.3	74.8	122.0	19.0	15.0	0.0	0.0	12.0	304.7
2009	23.0	33.4	34.0	47.6	0.0	9.9	99.4	9.1	5.5	0.0	0.0	7.6	269.5
2010	11.2	3.0	22.5	7.0	15.0	7.0	117.7	116.4	0.0	0.0	0.0	0.0	299.8

Annexure E

Functions and Services, 2011



Annexure G

Table

Balochistan Land Utilization Statistics 2008-09 Area in Hectares

Province/ District	Geographical Area	Reported Area	Cultivated Area			Cropped Area		Un-Cultivated Area			
			Total	Current Fallow	Net Sown	Total	Area Sown More Than Once	Total	Culturalable Waste	Forest	Not Available For Cultivation
1	2	3	4	5	6	7	8	9	10	11	12
Balochistan	34719000	17186885	2055825	921712	1134113	1205269	71158	15131060	3833072	1362789	9834599
Quetta	168800	147803	13184	3530	9654	9964	310	834619	32184	80582	21853
Pashin	787400	293868	152434	120767	31667	32167	500	141434	32846	26436	82160
K.Abdullah	323000	14181	14181	0	14181	14371	190	0	0	0	0
Chaghi	5054500	3261148	65286	39080	26206	28546	2340	3795882	381392	382040	2432520
Loralai	801800	318523	125469	89770	35699	37369	1670	193054	64585	60396	68072
Musa Khail	572800	48316	11553	4331	7222	7256	34	36763	12737	4176	19880
Barkhan	351400	122650	41914	11938	29976	29967	11	80736	41521	0	39210
Zhob	2029700	227341	51272	34950	16322	16377	65	176069	75447	13010	8760

Province/ District	Geographical Area	Reported Area	Cultivated Area			Cropped Area		Un-Cultivated Area			
			Total	Current Fallow	Net Sown	Total	Area Sown More Than Once	Total	Culturalable Waste	Forest	Not Available For Cultivation
K.Saifullah	683100	416780	147872	15817	132055	132166	111	268908	107312	20287	141300
Sibi	961000	393847	38553	7079	31474	31674	150	355294	47936	270374	36950
Ziarat	330100	85832	6508	3428	3080	3120	40	79324	1507	69357	8460
Kohlu	361000	53577	31140	25236	5904	6936	39	22437	0	0	22437
Dera Bughti	1016000	81014	20658	5125	15533	16788	225	40356	356	0	40000
Nasirabad	338700	230393	213191	0	213191	217934	4743	17202	2537	0	14655
Jaffabad	244500	241981	214300	36630	117670	232320	54650	27681	5721	0	21960
Bolan	568200	324767	75273	44453	30820	31500	680	249434	97437	0	15195
Jhalmagsi	361500	333251	95166	13400	81766	81830	64	238085	101717	32374	103990
Kalat	662200	831452	109346	84590	21756	22957	1201	522105	29736	64772	427594
Mastung	685100	324075	204798	181664	23134	24777	1643	119277	50410	21356	47510
Khuzdar	3538000	3304749	132049	56838	76201	76289	78	3172700	1063445	17353	259190
Awaran	2951000	26213	26213	0	26213	26668	465	0	0	0	0

Province/ District	Geographical Area	Reported Area	Cultivated Area			Cropped Area		Un-Cultivated Area			
			Total	Current Fallow	Net Sown	Total	Area Sown More Than Once	Total	Culturalable Waste	Forest	Not Available For Cultivation
Kharan	4805100	3593379	69141	41804	27337	29181	1844	3524238	758965	127368	263790
Lasbella	1515300	1255390	83356	50203	35153	33188	35	1172034	893190	156275	12256
Turbat	2253900	554336	61132	26438	32694	32708	14	493204	56948	104	43705
Panjgoor	1689100	673228	33893	6578	28305	28390	75	639335	44458	0	59487
Gwadar	1263700	248851	17942	15062	2880	2883	3	2309096	32277	16527	18210

Annexure H

Table

Balochistan Area, Production And Yield Of All Crops[1] 2008-09

Province/District	Area in Hectares			Production in Tonnes			Yield in Kgs /Has			
	Irrig	Un-Irrig	Total	Irrig	Un-Irrig	Total	Irrig	Unirrig		Average
					Rabi Crops					
Wheat	354,887	54,049	408,936	806,634	61,577	868,211	2,273	1,139		2,123
Barley	13,707	2,280	15,987	18,093	1,876	19,969	1,230	823		1,249
Rape Seed/Mustard	25,068	8,725	33,793	15,459	2,509	17,968	617	288		532
Cumin	7,617	1,831	9,448	3,559	694	4,253	467	379		450
Gram	37,063	-	37,063	30,719	-	30,719	829	-		829
Mutter Pulse	13,231	37	13,268	7,312	17	7,329	553	459		552
Masoor	3,024	27	3,051	1,918	10	1,928	634	370		632
Vegetables	24,580	-	24,580	381,259	-	381,259	15,511	-		15,511
Fodder	18,805	-	18,805	595,371	-	595,371	31,660	-		31,660

[1] Government of Balochistan , Agriculture & Cooperative Department, "Balochistan area, Production and yield of all Crops 2008-09", under "Downloads", http://www.balochistan.gov.pk/images/agriculturepdf/Allcrops130/Allcrops.pdf (accessed 07 May 2011

Province/District	Area in Hectares			Production in Tonnes			Yield in Kgs /Has			
	Irrig	Un-Irrig	Total	Irrig	Un-Irrig	Total	Irrig	Unirrig		Average
Canola	2,980	-	2,980	1,974	-	1,974	662	-		662
Sunflower	690	-	690	772	-	772	1,119	-		1,119
Sunflower	0	-	-	-	-	-				
Total Rabi Crops	501,652	66,949	568,601	1,863,070	66,683	1,929,753				
				Kharif Crop						
Rice	190,149	-	190,149	643,731		643,731	3385			3,385
Sorgum (Jowar)	16,598	13,119	29,717	15,765	9319	25,084	950	710		844
Millet (Bajra)	1,307	2,092	3,399	1,017	1058	2,075	778	506		610
Maize	4,843	701	5,544	5,660	561	6,221	1169	800		1,122
Sesamum	6,017	942	6,959	3,945	450	4,395	656	478		632
Castor seed	-	6,030	6,030	-	2412	2,412	0	400		1,400
Moong	2,358	9,048	11,406	2,150	4795	6,945	912	530		609
Mash	2,435	1,498	3,933	2,732	769	3,501	1122	513		890
Moth	1,493	1,204	2,697	2,129	732	2,861	1426	608		1,061
Fruits	242,435	-	242,435	1,033,665		1,033,665	4264			4,264

Province/District	Area in Hectares			Production in Tonnes			Yield in Kgs /Has			
	Irrig	Un-Irrig	Total	Irrig	Un-Irrig	Total	Irrig	Unirrig		Average
Onion	32,533	-	32,533	607,015			607,015	18658		18,658
Potato	2,302	-	2,302	34,608	-		34,608	15,034	-	15,034
Vegetables	15,344	-	15,344	113,773	-		113,773	7,415	-	7,415
Melons	11,310.00	950.00	12,260	133,731	8,341		142,072	11,824	8,780	11,588
Chillies	4,230.00	-	4,230	6,179	-		6,179	1,461	-	1,461
Fodder	16,842.00	1,781.00	18,623	557,509	29,125		586,634	33,102	16,353	31,501
Conader	2,630.00	-	2,630	1,423	-		1,423	541	-	541
Garlic	686.00	-	686	5,995	-		5,995	541	-	541
Guar Seed	7,209.00	1,385.00	8,594	4,851	372		5,223	673	269	608
Tobacco	1,883.00	-	1,883	2,717	-		2,717	1,443	-	1,443
Sugarcane	768.00	-	768	37,865	-		37,865	49,303	-	49,303
Cotton	34,546.00	-	34,546	45,526	-		45,526	1,318	-	1,318
Total Kharif Crops	597918.00	38,750.00	636,668.00	3,261,986.00	57,934.00		3,319,920.00			
Grand Total	1,099,570	106,699	1,206269	5,125,056	124,617		5,249,673			

Annexure J

Table

Balochistanb Area, Production and Yield of All Fruits 2008-09

Province/District	Area In Hectares			Production In Tonnes	Yield In Kgs/Hectare
	Bearing	Non-Bearing	Total		
Almond	8726	1933	10659	25588	2932
Apple	58330	44,621	102951	306,534	5255
Apricot	19359	9,351	28710	218,601	11292
Grapes	10574	4,544	15118	74,758	7070
Peach	8113	1,387	9500	25,362	3126
Plum	3301	538	3839	35,128	10642
Pear	98	51	149	673	6867
Pomegranate	9876	1146	11022	43,604	4415
Cherry	689	306	995	2,314	3358
Pistachio	85	105	190	773	9094
Dates	46976	3886	50862	248594	6292
Mango	1331	204	1535	8541	6417
Citrus	1209	209	1418	8407	6954
Banana	311	214	525	5726	18412
Guava	545	30	575	3718	6822
Loquat	51	0	51	279	5471
Papaya	604	245	849	5166	8553
Chikoo	502	108	610	3131	6237
Coconut	1115	9	1124	10286	9225

Province/District	Area In Hectares			Production In Tonnes	Yield In Kgs/Hectare
	Bearing	Non-Bearing	Total		
Fig	55	30	85	217	3945
Other Fruits	970	698	1668	6265	6459
TOTAL	172820	69615	242435	1033665	

Annexure K

Table

Description	Surface Irrigation System (Million Rs.)	Sprinkle Irrigation System (Million Rs.)	Drip Irrigation System (Million Rs.)
Preliminary Works i.e. access road residential colony, offices, hostels etc.	183.639	183.639	183.639
Main Dam including Diversion Works	2,298.479	2,298.479	2,298.479
Auxiliary Dam	879.874	879.874	879.874
Spillway, Stilling Basin and Tail Races	3,436.810	3,436.810	3,436.810
Fuse Plug	441.050	441.050	441.050
Intakes for diversion and power tunnel.	50.570	50.570	50.570
Power tunnel – Stilling Basin & Main regulators	698.297	698.297	698.297
Civil works of Power House 1 & 2 control building, Forebay PH 2	122.229	122.229	122.229
Irrigation and On Farm Management System	678.349	3,498.349	3,028.000
11 KV. Transmission System.	32.355	32.355	32.355
Cost of land and environment & resettlement cost.	226.346	226.346	226.346
E&M Equipment Power house 1 & 2	696.373	696.373	696.373
Sub-Total (A)	9,744.371	12,564.371	12,094.022

Description	Surface Irrigation System (Million Rs.)	Sprinkle Irrigation System (Million Rs.)	Drip Irrigation System (Million Rs.)
Miscellaneous (Insurances, Performance Bond, Workman, Compensation. General Items of work i.e. contractors comp, recreation facilities dispensary, Purchase of T&P, Vehicles, Furniture instruments etc 1.75% of A	170.526	219.876	211.645
Administration, Accounts & Audit 1.25% of (A)	121.805	157.055	151.175
Over heads 2.25% of (A)	219.248	282.698	272.115
Total B =(13+14+15+16)	10.255.950	13,224.000	12,728.958
Contingencies 5% of (B)	512.798	661.200	636.448
Engineering Services (Construction Supervision and Design Reviews) 3.5% of (B)	358.958	462.840	445.514
Total C =(17 + 18 + 19)	11,127.706	14,348.041	13,810.920
Escalation (Local 6.5% & Foreign 2%)	1,052.344	1,278.758	1,324.317
Project Cost (20 + 21)	12,180.050	15,726.798	15,135.237
IDC (Interest During Construction) (9.96%)	2546.648	3,286.550	3,163.142
Financial Cost (22 + 23)	14,726.698	19,013.348	18,298.379