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HYDRO-CLIMATIC HAZARDS IN PISHIN LORA BASIN, BALOCHISTAN: ANALYSIS OF RISKS AND IMPACTS

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Abstract
Balochistan, Pakistan's largest province by area, faces acute water scarcity due to arid conditions, high evaporation rates, and recurrent drought spells. The Pishin Lora Basin (PLB), one of the most water-stressed regions, has experienced severe groundwater depletion—exceeding 18 feet annually—driven by climate variability, over-extraction via tubewells, and the drying of traditional karezes and springs. This study, based on content analysis and key informant interviews in Pishin and Mastung districts, examines the socio-economic and environmental impacts of hydro-climatic hazards. Findings reveal that groundwater tables have declined from an average of 36 feet to over 586 feet in three decades, with 91% of farmers now reliant solely on groundwater. Recurrent droughts and flash floods have destroyed fruit orchards, reduced livestock, and forced rural populations into poverty and migration. The basin's annual groundwater balance is negative (-0.396 billion m³), threatening agricultural livelihoods. The study highlights urgent need for integrated water management and climate adaptation strategies.

INTRODUCTION

1. Balochistan Province – A Glimpse on Water Scarcity and Hydro-climatic Hazard

Geographically, Balochistan is the largest province of Pakistan—located in the south-western region of the country. It has unique geo-political position having a total area of 347,200 square kilometers. Most of the parts of the province are comprised of mountain ranges (53%) while the rest of the area is alluvial fans (22%), piedmont plains (12%), and sandy deserts (7%) (Ashraf & Sheikh, 2017). In terms of area, the province is 44% of the total land area of the country, while in terms of population, the province is the smallest (only 6% of the total population of the country) (GoP, 2017). The population of the province is widely scattered. As per National Populations Report of 1998, the total population of the province was only 6.51 million, while in 2017 it increased to 12.34 million and according to 2024 Census Report, the population was 14.89 million. This reflects that the population of the province increased by 128.7% over a period of almost 25 years (i.e. 1998-2023). Consequently, the need for water and food has exponentially increased in the Balochistan. (Majeed & Qureshi, 2000).

Balochistan has arid climatic conditions (Jamro et al., 2019) and receives 50-400 mm of annual precipitation. The average annual precipitation is almost 200 mm with a very high evaporation rate ranging from 2,000 – 5,000mm annually (Ashraf & Majeed, 2006). Provincial natural resources including; water, rangelands, soil, forest, and biodiversity have been used very inefficiently. The province has severely suffered from recurrent and intensive drought spells that resulted in deteriorating socio-economic conditions of the populace; migration; and loss of cash crops, orchards, and livestock.

A high majority of the population lives in rural settings due to which the provincial economy largely depends on agriculture. Up to 62% of gross farm income is contributed by agriculture production. About 67% of total provincial human resource is employed by the agricultural sector while Ashraf et al. (2014) reports that a high majority of the population in Balochistan i.e. up to 85 percent rely on agriculture as a major source of living. The province is well-reputed for being the fruit basket of the country as it remained the largest contributor of apples (82%) to national production; grapes (97.6%); almonds (93.5%); pomegranates (82%); peaches (69%) and dates (64%) (ZTBL, Pakistan, 2016).

1.1 Water Trends in Balochistan

Balochistan has the largest geography of all provinces in the country, but the ratio of land being cultivated is very low. Only 2.07 million hectares out of 19.4 Mha (million hectares) are cultivated (Ashraf & Sheikh, 2017). The major reason for relatively very less cultivation of land is water scarcity because water resources are extremely limited in the province. The largest utilized source of water is underground water which fulfills the agricultural, domestic, and industrial needs of the people. Most of the surface-water resources are non-perennial. Rapid population growth, coupled with an influx of Afghan refugees, increased the need for food and water (Majeed & Qureshi, 2000). At the same time, regular and intense droughts and extreme temperatures have caused over-exploitation of groundwater resources, leading to a high depletion of water-table, the water-scarce *karezes* and springs, and the abandonment of fruit orchards (Ashraf & Sheikh, 2017). In addition to the arid climate and poor water management practices, climate change is also more of the major reason for water scarcity in the province (Jamro et al., 2019; Kakar & Ahmad, 2016). Though in terms of availability, groundwater is the smallest source of water (accounts for only 6% of total provincial water resources), it is the largest in terms of utilization (Kakar & Ahmad; 2016). IUCN (2000); ADB-PRM (2006); and IPD, (2006) report that almost 61% of ground water is exploited each year in the province.

Tube wells are largely used for sucking groundwater in the province. The abstraction of groundwater primarily increased since the 1970s when farmers were offered incentives for the installation of tube wells (GOP, 2005). While the number of tube wells rapidly increased due to subsidies on electricity tariffs, especially in northern Balochistan where annual fruit farming is more common (Sekhsaria, 2001). The number of tube wells in Balochistan was almost 5,000 in 1980 which increased to more than 40,000 in 2015 (Figure 1) (Ashraf & Sheikh, 2017) excluding the unregistered tube wells. This rapid increase in tubewells installation is a huge threat to the sustainability of already scarce resources of water in the province.

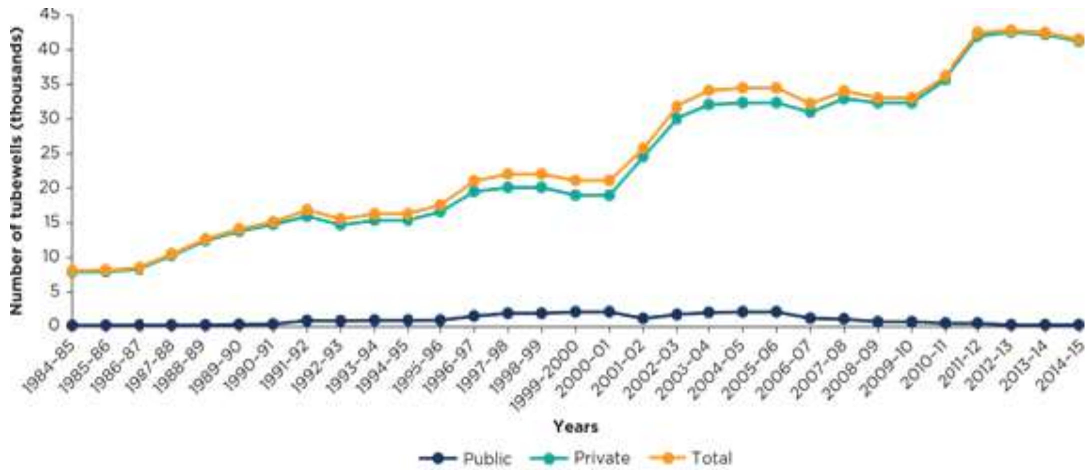

Figure 1
Increasing Trend of Tube-wells in Balochistan

Source: Government of Pakistan, 2016

This has resulted in the rapid depletion of groundwater tables up to 5 meters per year in some areas, resulting in the mining of groundwater especially in Pishin, Mastung, Quetta, and Kalat (Qureshi, 2020) threatening the viability of agriculture communities (Ashraf & Sheikh, 2017; Khair et al., 2010). The reduction in groundwater recharge as a result of decreased rainfall and over-pumping of water from the ground due to recurrent drought spells caused intensive groundwater depletion in the province in general and in Pishin Lora Basin in particular (Bhatti et al., 2008; ADB-PRM, 2006). According to Ashraf and Routray (2015), prolonged water scarcity lasting over two decades severely affected the entire province. It destroyed approximately 80% of fruit production and orchards, caused a general shrinkage in crop yields (especially for rain-fed crops), and led to the deaths of nearly two million animals (Jairath, 2008).

1.2 Hydro-climatic Hazards in Balochistan

The location. geology and topography of Balochistan determine that the province is at severe risk of hazards due to climatic changes that has the potential to cause a variety of disaster emergencies and large migrations and displacement of people (LEAD-Pakistan, 2017). The climate-caused natural extreme events and risks are further intensified by deforestation, environmental degradation, and soil erosion. There has been a shape increase in disastrous flash floods due to variations in rainfall patterns, especially in the monsoon season. The August 2022 floods in the province and most of the other parts of the country are primarily due to climate change impacts (P-Lama & Tatu, 2022; Shahid et al. 2022).

The impacts of climate change are more obvious to the poor and marginalized people of the province. Different parts of the province are differently affected by climate change such as increase in temperature, seasonal shifts, unpredictable rainfall/snowfall, and sea level rise. Some regions of the province are suffering from the impacts of intensive drought spells due to insufficient and erratic rainfall while other regions are more often hit by flash floods due to varying climate patterns as a result of the increase in mean temperature. Climate change impacts on water-food-energy nexus have worsened the insecurity of the three sectors, resulting in high vulnerabilities in the life of people in Balochistan. Heat waves due to climate change result in deteriorating situations in this area and increases risks to livelihood of people (Zahid & Rasul, 2012). Climatic changes may have considerable effects on the hydrological cycle of Balochistan. As a result, winters are shorter and summers are getting more intense (IPCC, 2014).

2. Pishin-Lora Basin

Pishin-Lora is a major river of the basin (with 10 sub-basins) located at the border of the Balochistan province of Pakistan and the Kandahar province of Afghanistan. It rises in the northern highlands of the region, flows into Kandahar province of Afghanistan, and finally re-enters the Zangi Nawar Lake in the Nushki district of Pakistan. It covers five districts of Balochistan namely Quetta (provincial headquarter), Pishin, Mastung, and parts of Killa Abdullah and Kalat districts (Halcrow, 2008). The basin is located between longitudes 66o 12' E and 67o 43' E and latitudes 28o 43' N and 31o 00' N. The basin has a total area of 18,700 square kilometers (Bhatti et al., 2008). It consists of small valleys mostly within mountains. The land is normally characterized as mountainous separated into low and highlands. The precipitation rate varies across regions with a range of 150-250mm annually mostly in winter (GOB, 2005). The basin is heavily populated representing almost 5% area of the province (Bhatti et al., 2008). The majority of the population depends on agriculture for livelihood (Kakar & Ahmad, 2016). Dependency on the livestock sector has declined during the last two decades due to climatic events especially recurrent and intensive drought spells.

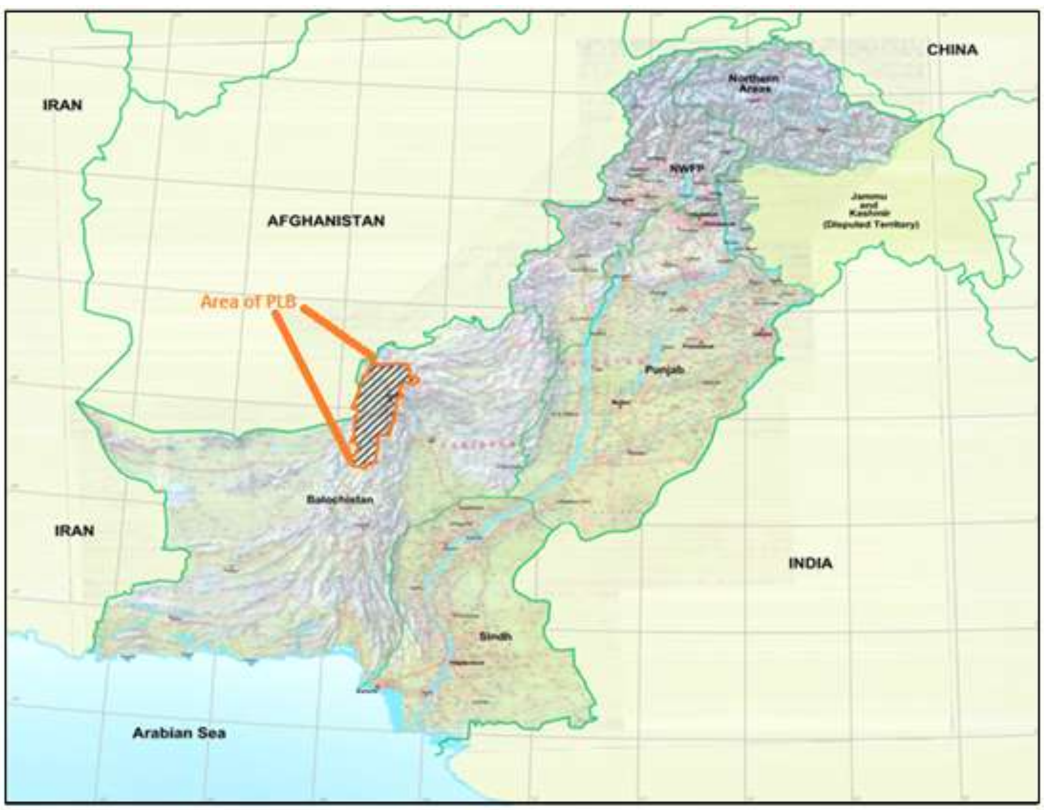

Figure 2
Location of PLB in Pakistan

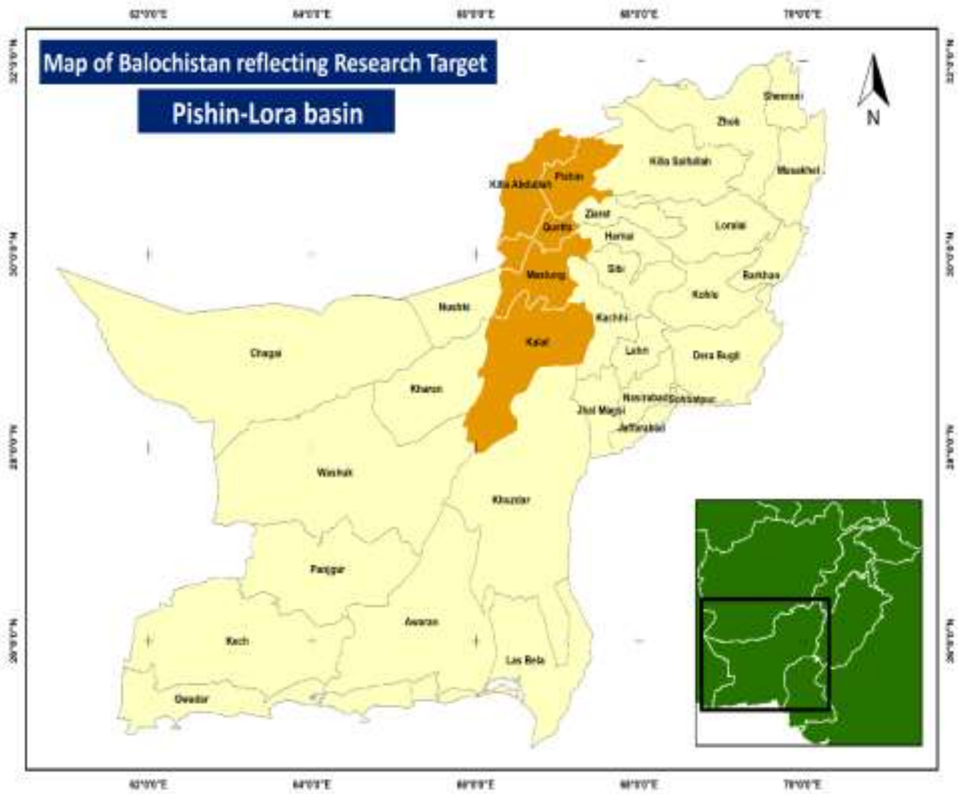

Figure 3
Map of Balochistan Reflecting Study Area (Pishin Lora Basin) and Selected Districts

2.1 Socio-economics of PLB

2.1.1 Demography and Settlements

According to the national level census report of 2017, the total population of the Pishin Lora Basin area is 4.5 million with an average growth rate of 3.87 percent. 7.6 persons per family is the average family size (GoP, 2017). The average population concentration per kilometer square in Pishin Lora Basin is much higher than the average provincial population density – showing intensive pressure on natural resources. While within the basin, there is variation in population density across the five districts. Quetta is the largest urban city and the provincial capital. Except for Quetta, the highest population density is in Pishin District. Table 1 shows a demographic analysis of the five districts of PLB. People have mostly settled in valleys surrounded by rough mountain ranges. Since most of the water sources are small; therefore, human settlements are also small and widely scattered.

Table 1
Demographic Statistics of Districts in PLB

Districts	*Total District Population (2017)*	*Area in Km ^{2}*	*Average Annual Growth Rate (1998-2017)*	*Population Density per Km^2 (2017)*
Pishin	763,903	6,218	3.59	118.51
Killa Abdullah	785,354	4,849	3.98	154.96
Quetta	2,269,473	3,447	5.81	685.39
Mastung	265,676	3,308	3.05	80.31
Kalat	412,058	8,416	2.93	48.96
Total	**4,496,464**	**26,238**	**3.87**	

Source: Provincial Census Report Balochistan 2017; Pakistan Bureau of Statistics, Govt. of Pakistan, 2017

2.1.2 Economic Conditions and Vulnerability

The catchment area of the Pishin Lora Basin (PLB) river is one of the poorest and most deprived regions in the country. According to the UNDP (2020) Human Development Indicators, poverty in the area—as in other parts of the province—has been rising over time. All social development indicators, including child mortality, literacy, and life expectancy, are worse in the PLB compared to other regions of Pakistan. The persistent poverty and deprivation stem from multiple factors: unemployment, landlessness, lack of access to services, high mortality rates, and weak institutional performance. For most residents, agriculture and livestock are the primary sources of income. However, recurrent drought spells have severely affected both sectors, further deepening deprivation and poverty. As a result, many people—especially the poor—have been forced to abandon agriculture and turn to other income sources, most commonly daily wage labor. The vulnerability to poverty is disproportionately high among smallholder and landless households

2.1.3 Gender Issues

Women make up nearly 50% of the population in the Pishin Lora Basin (PLB), as in other parts of the province. However, due to a dominant tribal system and slow social change, they face severe cultural limitations. In these Pashtun-dominated areas, patriarchal and social norms restrict women's mobility, isolating them from the outside world and limiting their access to social services, education, and income-generating opportunities compared to men. Women are also largely unable to own resources such as land, houses, or businesses.

Most women are engaged in housekeeping, child-rearing, and other household activities. They generally lack the skills needed for formal employment, aside from traditional crafts. In rural areas, women also face significant barriers to accessing basic health services. The majority suffer from malnutrition, iodine deficiency, and anemia, leading to high maternal mortality. Each year, many mothers—including young girls aged 15 to 19—die from pregnancy-related complications. This already deteriorating situation of women in PLB is further worsened by climatic events.

2.1.4 Education

The situation of education is quite dismal in remote areas – away from the headquarters. Besides access to education, a large number of schools are not fully functional. Lack of resources, teachers' paucity, absenteeism, and capacity issues make the quality of education very poor in areas where access is available to students.

Post-primary education is not accessible to a large number of people in rural communities, especially girls. The literacy rate in Quetta district is the highest for being the provincial capital, followed by Pishin and Mastung, however, the literacy ratio in Kalat and Killa Abdullah is the lowest in the region. There is a huge variation between the literacy ratio of males and female in all districts of PLB especially Mastung, Kalat, and Killa Abdullah.

2.1.5 Health and Sanitation

Health services in many remote rural areas of PLB are either not accessible or of poor quality. A large number of basic health units in remote areas are not fully functional. Major reasons for ineffective health services in PLB are a lack of skillful human resources, a paucity of funds and physical resources, and poor infrastructure. Remote rural areas are mostly deprived of health services due to a lack of infrastructure and the absenteeism of medical staff. Most of the staff of remote medical centers are not willing to perform duty in the field as they normally reside in urban settings. Immunization of children is a big issue in areas of Killa Abdullah, Kalat, and some areas of Pishin and Mastung. It has been reported that epidemic, respiratory, and stomach-related diseases are common among the masses. Quetta district for being the provincial capital and Mastung district has better health services as compared to other districts of PLB. The most deprived district in terms of health services and infrastructure is Killa Abdullah.

2.2 Water Resources and Irrigation Systems in PLB

PLB falls in the arid to the hyper-arid climatic zone of the region. It is located in the arid zones of the country with mild summers and cold winters. In most of the area of PLB, the winters are extremely cold with occasional snowfall each year. Water for drinking and agricultural purpose has always been a big problem for the people. The rate of precipitation is low while evaporation is high. The area has been facing recurrent drought spells resulting in low rainfall. Community water needs are fulfilled from ground and surface water resources, though limited. Rainfall and precipitation are the major sources of ground and surface water recharge. Since the precipitation rate is very low and water resources are scarce in PLB, therefore, people have developed to utilize every possible source of water. Based on available water resources, three types of irrigation systems are practiced: i) perennial irrigation; ii) rain-water harvesting; and iii) flood irrigation. The perennial irrigation methods are further divided into tube wells, springs/karezes, and river intakes. Rainwater harvesting (also called Khushkaba) is a system in which rainwater is utilized for harvesting more often channeling water from surrounding areas. While in flood irrigation (also known as Sailaba) water needs for agriculture are fulfilled by torrential water flow from hillsides.

2.3 Climatic Events in PLB

The geographical location, climate, and socio-economic conditions of people in the Pishin Lora Basin make it highly vulnerable to various climatic hazards causing serious damage to humans, species, and the environment. Several extreme weather events (EWEs) have occurred in PLB during the last three decades including recurrent and intensive drought spells, flush floods, high-temperature waves, storm surges, and high-velocity winds. PLB falls in the arid zones of the country with mild summers and cold winters. In most of the area of PLB, the winters are extremely cold with occasional snowfall each year. The variability in climate, increasing water requirements for agriculture, irrational water pumping, and intense drought spells, the water table in Pishin Lora Basin is depleting at the rate of over 3 meters per year in the alluvia aquifer. while in the drawdown in the hard rock aquifer, the depletion rate is up to 20 meters per year (IDP, 2007), whereas in 1991 (before the initial drought spell) the estimated groundwater depletion rate was 1.52 meters per year (World Bank, 1991). PLB is the most withdrawn, exhausted, and worst affected river basin of the province in terms of water scarcity and extreme weather events during the last three decades (Ashraf et al., 2016; Kakar & Ahmad, 2016;

Bhati et al., 2008; Halcrow, 2007; IPD, 2007). In 2005, the total number of registered tube wells in the basin was 11,918 that are 44% of all tube wells in the province (IPD, 2007). Since there is no perennial surface irrigation system in the geographical area of Pishin Lora Basin, therefore, all sectors including agriculture, domestic, commercial, ecosystem, mining, etc. are solely dependent either on groundwater or flood water irrigation system. Climate change, variability, extreme weather events, water scarcity, and increasing temperatures have made life very miserable for people in general and the farming community in particular. Except for district Quetta—the capital and urban hub, the other district such as Pishin, Mastung, Kalat, and Kila Abdullah, a good majority of the rural population (31- 49%) get their livelihood from farming (Halcrow Pakistan & Cameos, 2008). The Halcrow (2007) analysis of the annual water balance for all basins and sub-basins of Balochistan finds out that the PLB is the most exhausted and water scarced in all basins of the province. The ground water balance sheet shows a result of -0.396 billion m3 each year which is the lowest of all basins in Balochistan.

Climate change-induced heavy floods are not common in the basin area, while incidents of mild to moderate flash floods occur occasionally. However, in 2002 (June-August) severe floods hit not only PLB but all over Pakistan. These run-offs and flash floods caused intensive damage to life of people, livestock deaths, heavy losses to the agriculture sector, damage to infrastructure, and environmental degradation which adversely affected the overall socio-economic condition of the region (Baloch et al., 2022; Mazari et al., 2022; Shahid et al,. 2022)

2.3.1 Impacts of Climatic Events in PLB

The geographical location, climate and socio-economic conditions of people in the Pishin Lora Basin make it highly vulnerable to various climatic hazards causing serious damage to humans, species and the environment. Several extreme weather events (EWEs) have occurred in PLB during the last three decades including recurrent and intensive drought spells, flush floods, high-temperature waves, storm surges and high-velocity winds.

The variability in climate, increasing water requirements for agriculture, irrational water pumping and intense drought spells, water-table in Pishin Lora Basin is depleting at the rate of over 3 meters per year in the alluvia aquifer. while in the drawdown in the hard rock aquifer, the depletion rate is up to 20 meters per year (IDP, 2007), whereas in 1991 (before the initial drought spell) the estimated groundwater depletion rate was 1.52 meters per year (World Bank, 1991). PLB is the most withdrawn, exhausted and worst affected river basin of the province in terms of water scarcity and extreme weather events during the last three decades (Ashraf et al., 2016; Kakar & Ahmad, 2016; Bhati et al., 2008; Halcrow, 2007; IPD, 2007). In 2005, the total number of registered tube wells in the basin was 11,918 that are 44% of all tube wells in the province (IPD, 2007). Since there is no perennial surface irrigation system in the geographical area of Pishin Lora Basin, therefore, all sectors including agriculture, domestic, commercial, ecosystem and mining, etc. are solely dependent either on groundwater or flood water irrigation system. Climate change, variability, extreme weather events, water scarcity and increasing temperatures have made life very miserable for people in general and the farming community in particular. Except for district Quetta which is an urban city and capital of the province, the other district such as Pishin, Mastung, Kalat and Kila Abdullah, a good majority of the rural population (31- 49%) get their livelihood from farming (Halcrow Pakistan & Cameos, 2008).

The analysis of the annual water balance for all basins and sub-basins of Balochistan finds out that PLB is the most exhausted and water stressed in all basins of the province. The groundwater balance sheet shows a result of -0.396 billion m3 each year which is the lowest of all basins in Balochistan (Halcrow, 2007). Climate change-induced heavy floods are not common in the basin area, while incidents of mild to moderate flash floods occur occasionally. However, in 2002 (June-August) severe floods hit not only PLB but all over Pakistan. These run-offs and flash floods caused intensive damage to the life of people, livestock deaths, heavy losses to agricultural sector, damage to infrastructure and environmental degradation which adversely affected the overall socio-economic condition of the region (Baloch et al., 2022; Mazari et al., 2022; Shahid et al., 2022)

2.4 Profile of Selected Districts of PLB (Pishin and Mastung)

This research study was carried out in the catchment area of the Pishin Lora Basin-river of Balochistan Province in Pakistan. Pishin Lora Basin-river is spread over five districts in Pakistan and a border district in Kandahar of Afghanistan. While Mastung and Pishin districts were selected for the study. Both selected districts have agriculture as a major source of livelihood. The climate is arid and there is a huge variation in climate and rainfall. Recurrent and intensive spells of drought are common for more than two decades.

2.4.1 District Pishin

Pishin district is located in the neighborhood of Quetta—the provincial capital and its border are with the Kandahar Province of Afghanistan. Its total area is 6,218 square kilometers and is located between 66°46'01" to 67°49'19" degrees East Longitude and 30°44'02" to 31°14'02" degrees North Latitude. Administratively, the district is divided into four tehsils and 52 Union Councils.

According to the Census Report of 2017. Pishin has population of 736,903 (3.59% growth rate). 80.56% population of the Pishin district lives in rural areas. The average household size is 5.81. The literacy rate is 52.97 (67.18 for males and 33.95 for females). The literacy rate significantly varies between urban and rural population. *(Table 2 is a detailed description of the demographic characteristics of Pishin)*

Table 2
Specific Details of District Pishin

District	Area km²	Total HHs (2017)	Population (2017 Census)			Population growth (%/Y)	Ave. HH size	Literacy rate		
			Male	Female	Total			Male	Female	Total
Pishin	6,218	128,080	380,615 (51.48%)	356,227 (48.52%)	736,903	3.59%	5.81	69	36.22	52.97
Rural		102,304	307,807	286,270	594,107 (80.56%)	3.19%	5.84	67.18	33.95	51.02
Urban		25,776	72,808	69,957	142,796 (19.44%)	5.67%	5.66	76.56	45.17	60.88

Source: GOP - Census Report (2017); RSPN, BRSP, NRSP (2017)

2.4.2 District Mastung

District Mastung is located at 29◦48 N and 66◦50 60E in the north of the province. The district is in the south of Quetta city. Administratively, the district is divided into three tehsils and 20 Union Councils. Geographically, the characterized by cool winters and hot-dry summers.

The total area of Mastung district is 3,308 km². According to Pakistan's 2017 census, the population of Mastung district is 265,676, with an annual growth rate of 3.05%. The average household size is 6.84, and 86.82% of the population resides in rural areas. The district's overall literacy rate stands at 39.66%—49.69% for males and 28.92% for females. Moreover, the data reveal a significant disparity in literacy rates between rural and urban populations. *(Table 3 is a detailed description of the demographic characteristics of Mastung).*

Table 3
Specific Details of District Mastung

District	Area km²	Total HHs (2017)	Population (2017 Census)			Population growth (%/year)	Ave. HH size	Literacy rate		
			Male	Female	Total			M	F	Total
Mastung	3,308	38,801	137,504 (51.78%)	128,169 (48.22%)	265,676	3.05%	6.84	49.69	28.92	39.66
Rural		33,781	119,654	111,022	231,332 (86.82%)	3.23%	6.81	45.54	25.16	35.73
Urban		5,020	17,850	17,147	34,997 (13.18%)	2.00%	7.00	75.21	51	63.3

Source: GOP - Census Report (2017); District Mastung Profile

2.4.1 Climate and Water Situation in Selected Districts

Agriculture and livestock are major sources of livelihood in the district. Major agriculture crops and fruit include; wheat, barley, vegetables, fodder, tobacco, tomato, onion, apple, grapes, peach, plum, apricot and pomegranate. On average, the socio-economic conditions are poor. The main source of water for agriculture is groundwater – sucked through tube wells; flood water (locally known as *sailaba*) and rainwater (locally known as *khuskaba*). The springs (locally known as *karez*) have almost gone dry during the last two decades. The district has been suffering from water scarcity, drought spells and flush floods since 1997. It has resulted in increased vulnerability of all population in general and farming communities in particular. *(Table 4 illustrates detailed climatic data of Pishin District).*

Table 4
Climatic data of District Pishin

Mean rainfall			Mean annual Temperature		EWEs Occurrence
Annual rainfall	**Days with rainfall (≥1.0 mm)**	**Days with no rain**	**Min.**	**Max.**	
12.68 mm (0.5in)	24.82 days (6.8%)	340.18 days (93.2%)	17.37°C (63.27°F)	28.59°C (83.46°F)	In winter and early spring: frequent and recurrent moderate droughts, along with wind and hailstorms. In summer: torrential rains followed by high temperatures

Source: Pakistan Meteorological Department (2021); Global Historical Weather and Climate Data (2021); Weather Spark (2021)

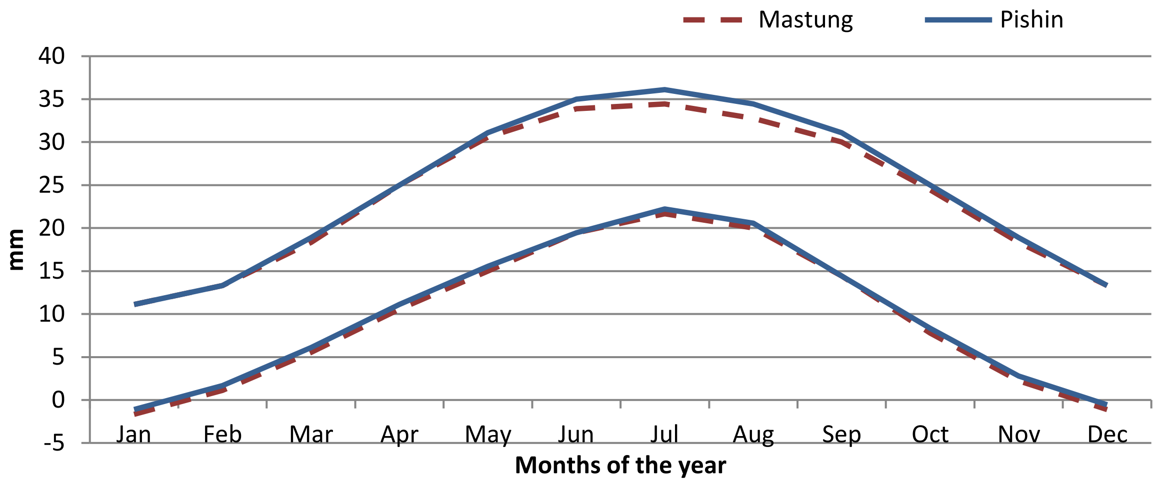

Figure 4
Average Monthly Min. & Max. Temperature in Selected Districts

Source: Weather Spark (2021)

District Mastung
About two-thirds of the rural population depends upon agriculture and livestock for their livelihood. Major crops in the district include wheat, barley, vegetables, fodder, tobacco, tomato, onion, apple, grapes, peach, plum, apricot and pomegranate. The sources of irrigation include groundwater sources (tube wells, springs, *karezes* and open surface wells. Once Mastung district was well-known for its abundance of springs (*Karez*). There had been more than 360 springs (*Karez*) in the district. However, climate variability, temperature changes and hydro-climatic disasters have severely affected water availability during the last two decades. Almost all springs, *karezes* and open surface wells have got dried, while the water table has declined so deep that electric tube wells have suffered to a moderate level. Resultantly, segments of the population that are dependent on water-related occupations such as farming communities have been affected badly. Flooding is not a common phenomenon in most parts of the district. *(Table 5 illustrates detailed climatic data of Mastung District)*

Table 5
Climatic data of District Mastung

Mean rainfall			Mean annual Temperature		EWEs Occurrence
Annual rainfall	Days with rainfall (≥1.0 mm)	Days with no rain	Min.	Max.	
12.81 mm (0.5in)	25.08 days (6.87%	339.92 days (93.13%)	17.55°C (63.59°F)	28.89° C (84.0°F)	In winter and early spring: frequent and recurrent moderate droughts, along with wind and hailstorms. In summer: torrential rains followed by high temperatures,

Source: Pakistan Meteorological Department (2021); Global Historical Weather and Climate Data (2021); Weather Spark (2021)

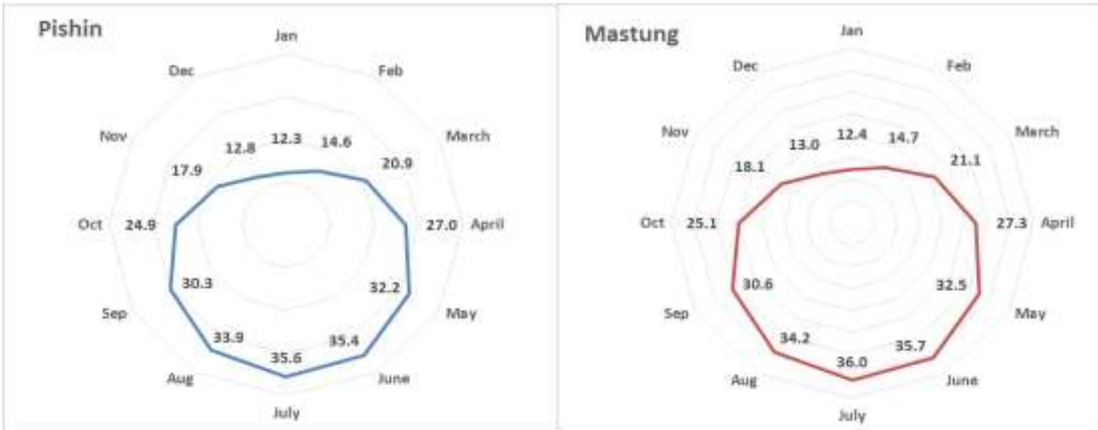

Figure 5
Average Temperature by Month in Selected Districts

Source: Pakistan Metrological Department (2021); Weather Spark (2021)

2.4.2 Ground Water-table Changes over the Last 30 Years

PLB has observed an extensive decline in the ground water-table since recurring drought spells for more than two decades. Studies show that the depletion rate is more than 5 meters in 2020 per year (Qureshi, 2020) which was more than 3 meters per year in 2007 (IDP, 2007) and 1.52 meters per year in the early 90s (World Bank, 1991). Smallholder farmers, key informants and officials reported an average difference in water-table over the last thirty years in both selected districts. Further, farmers and the local community were also inquired about observed water-table depletion at local tehsil and union council wise.

Table 6
District-wise Ground Water-table Changes over the Last 30 Years

Location	Current Ground Water Level (2021)		Ground Water Level 30 Years ago		Mean Difference over 30 Years	Annual Decline over last 30 Years
	Range	Mean	Range	Mean		
Pishin District	300-900	566.67	10-90	34.92	531.75	17.7
Mastung District	350-900	605.97	10-80	38.18	567.79	18.9
Overall study area	**300-900**	**586.32**	**10-90**	**36.55**	**549.77**	**18.3**

Source: Field Survey 2021
Note: Data is in feet

As reflected in Table 6, a huge difference in the underground water table is observed by farmers over a period of thirty years in both selected districts. The current average water table in Pishin District is 566.7 feet (ranging from 300 to 900 feet, varying from the local area to area), while 30 years ago the average water-table in the district was 34.92 feet that ranged between 10-90 feet. A huge difference of 531.75 feet on average is observed by farmers with a decline of 17.7 feet (5.39 meters) per year. Similarly, the current mean water table in Mastung District is 605.97 feet (ranging from 350-900) while 30 years ago the mean water table was 38.18 feet (range 10-80 feet). The difference in mean water table decline over the last 30 years is 567.79 feet with an annual decline of 18.9 (5.76) feet. Statistics of field survey statistics show that farmers have observed a very alarming decline in ground water-table of 18.3 feet per year.

Statistics at the Tehsil level were also computed to assess groundwater-table variations over the last thirty years. Table 7 analyses the current groundwater level in all Tehsils of both selected districts. In district Pishin, the lowest water table is in Tehsil Karezat with a mean water level of 672.7 feet (ranging from 450-900 feet in different union councils). The average water table in Tehsil Pishin is 612 feet, and 525.8 feet in Tehsil Huramzai. The water table in Tehsil Barshore is better as compared to other Tehsils of the district with a mean water table of 456 feet.

In Mastung district, both Dasht and Mastung tehsils have almost the same water table (as a mean of all surveyed UCs) with a water table of 654.6 and 650 feet respectively, while in tehsil Kirdgap, it is better with average water-table 513.4 feet. The current average water table in the surveyed union council of both selected districts is 586.36 (178.7 meters).

Farmers in both districts reported that the major source of water for agriculture is groundwater (91%). The use of rain and flood water has reached to a minimum level due to recurring and intensive drought spells over the last 25 years. Springs and *karez* in both districts have almost gone dry due to which water utility from these sources has become very rare

Conclusion and Policy Recommendations

The Pishin Lora Basin represents a critical case of climate-induced water crisis where recurrent droughts, rising temperatures, and unsustainable groundwater extraction have pushed rural communities to the brink of collapse. Groundwater levels have fallen catastrophically—over 500 feet in three decades—while traditional water sources such as karezes and springs have dried up, leaving 91% of farmers entirely dependent on rapidly depleting aquifers. Agriculture, the primary livelihood for approximately 80% of the population, has been severely compromised, resulting in widespread poverty, massive livestock losses, fruit orchard destruction, and increasing out-migration. The basin's annual groundwater balance of -0.396 billion m^3 confirms an alarming rate of aquifer mining. To address this emergency, immediate policy interventions are required. Authorities must enforce strict regulation of tubewell installation and abstraction through licensing and metering, while simultaneously investing in the rehabilitation of traditional karez systems via community-based water management. Climate-resilient agricultural practices, including drought-tolerant crops and high-efficiency irrigation such as drip and sprinkler systems, should be promoted alongside rainwater harvesting techniques. Artificial recharge structures like check dams and recharge wells are needed to capture ephemeral flood flows. Finally, comprehensive awareness campaigns and livelihood diversification programs—including off-farm employment and livestock insurance—must be launched to reduce dependence on groundwater and build long-term community resilience against hydro-climatic hazards. Without such integrated action, the basin faces irreversible aquifer depletion, food insecurity, and large-scale human displacement.

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References

ADB-PRM (2006). Integrated Water Resources Management in Balochistan, PPTA Studies of Balochistan Resource Management Programme, Asian Development Bank, Pakistan Resident Mission, Islamabad

Ashraf , M., Majeed, A. (2006). Water requirements of major crops of Balochistan. IUCN Water Programme, Balochistan Programme Office, pp. 139.

Ashraf, M., Majeed, A., Saeed, M. (2016) Impact evualtion of a karez irrigation scheme in Balochistan-Pakistan: Issues and options, Pakistan Journal of Agriculture Science. Vol. 53(3), 661-671

Ashraf, M., Routray, J.K., Saeed, M. (2014). Determinants of farmers' choice of coping and adaptation measures to the drought hazard in northwest Balochistan, Pakistan. Nat. Hazards, 73, 1451–1473.

Ashraf, M., Sheikh, A.A. (2017) Sustainable Groundwater Management in Balochistan, Pakistan Council of Research in Water Resources, Islamabad, Pakistan.

Baloch, Z. A., Tan, Q., & Fahad, S. (2022). Analyzing farm households' perception and choice of adaptation strategies towards climate change impacts: a case study of vulnerable households in an emerging Asian region. Environmental Science and Pollution Research, 1-11.

Bhatti, S. S., Khattak, M. U. K., & Roohi, R. (2008). Planning water resource management in Pishin-Lora river basin of Balochistan using GIS/RS techniques. In 2008 2nd International Conference on Advances in Space Technologies (pp. 91-97). IEEE. DOI: 10.1109/ICAST.2008.4747693

GOB (2005). Balochistan Small Scale Irrigation Project, Environmental and Social Assessment. Irrigation and Power Department, Government of Balochistan.

GOP (2005). Agricultural Statistics of Pakistan, Ministry of Food, Agricultural, and Livestock, Economics Wing, Islamabad, Government of Pakistan.

GOP (2017). National Census Report 2017. Federal Bureau of Statistics, Government of Pakistan.

Halcrow (2007). Supporting Public Resource Management in Balochistan. Basin-wide Water Resources Availability and Use. Asian Development Bank: Supporting Public Resource Management in Balochistan.

Halcrow (2008). Supporting Public Resource Management in Balochistan, Pishin Lora Basin Management Plan: Final Report. Irrigation and Power Department, Government of Balochistan, Royal Netherland Government. Halcrow Pakistan (Pvt) in association with Cameos.

Halcrow Pakistan and Cameos (2008). Pishin Lora Basin Management Plan. Asian Development Bank: Supporting Public Resource Management in Balochistan.

IPCC (2014). FWGII AR5 Technical Summary: Climate Change 2014 Impacts, Adaptation and Vulnerability. Cambridge, Cambridge University Press.

IPD (2006). Assessment of Water Resources Availability for Balochistan, Department of Irrigation and Power, Government of Balochistan.

IUCN (2000). Balochistan conservation strategy, International union for conservation of nature and natural resources (IUCN), Karachi, Pakistan: IUCN Pakistan and Govt. of Balochistan, pp. 354.

Jairath, J. (2008). Droughts and Integrated Water Resource Management in South Asia: Issues, Alternatives and Futures; Sage Publications: Sauzendeaux, CA, USA.

Jamro, S., Dars, G.H., Ansari, K., Krakauer, N.Y. (2019). Spatio-temporal variability of drought in Pakistan using standardized precipitation evapotranspiration index. Appl. Sci. 9, 4588.

Kakar, Z., Ahmad, M. (2016). Study on the causes of water scarcity in Pishin Lora Basin of Balochistan. Journal of Applied and Emerging Sciences, 4(2), pp135-140.

Khair, S. M., Culas, R.J., Hafeez, M. (2010). The Causes of Groundwater in Upland Balochistan Region of Pakistan: Implication for Water Management Policies. Paper Presented at the 39th Australian Conference of Economics September, 27-29.

LEAD-Pakistan (2017) Sustainable Development Goal 13: A Legislative and Policy Gap Analysis for Balochistan. Leadership for Environment and Development, Pakistan.

Majeed, A., Qureshi, J.D. (2000). Balochistan Conservation Strategy: Background Paper, IUCN-The World Conservation Union, Pakistan.

Mazari, H., Baloch, I., Thinley, S., Kaye, T., & Perry, F. (2022). Learning continuity in response to climate emergencies: Preliminary insights on supporting learning continuity following the 2022 Pakistan floods. EdTech Hub.

P-Lama, A., & Tatu, U. (2022). Climate change and infections: lessons learnt from recent floods in Pakistan. New Microbes and New Infections, 49

Qureshi, A. S. (2020). Groundwater governance in Pakistan: From colossal development to neglected management. Water, 12(11), 3017.

Rural Support Program Network (RSPN), Balochistan Rural Support Program (BRSP), National Rural Support Program (NRSP) (2017). District Pishin Profile. Rural Support Program Network, Balochistan Rural Support Program (BRSP), National Rural Support Program.

Sekhsaria, P., (2001). Balochistan's thirst, India's National Magazine, vol. 18, no. 8, 2001.

Shahid, A., Azeem, S., Shahzil, M., Ghafoor, M. S., Shah, J., & Cheema, H. A. (2022). Catastrophic floods in Pakistan: an urgent appeal for action. Disaster Medicine and Public Health Preparedness, 1-2.

UNDP (2020). Pakistan National Human Development Report 2020; The three Ps of inequality: Power, People, and Policy. United Nations Development Program, Pakistan

World Bank (1991). Balochistan Minor Irrigation and Agriculture Development Project, World Bank.

Zahid, M., Rasul, G. (2009). Rise in Summer Heat Index over Pakistan. Pakistan Journal of Meteorology, Vol. 6, Issue 12.

Zarai Taraqiati Bank Limited (ZTBL), Pakistan (2016). Retrieved from: https://ztbl.com.pk/economic-data/annual-report/#