

Climate Change and Hazards Risk Management, Community Capability, Resilience and Vulnerability in Swat, Shangla, and Kohistan District, Northwest Pakistan

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Abstract: The study area comprises of humid and undifferentiated highland climates having total precipitation of 52 inches (1320mm) and fluctuation of -5.3 inches or -134 millimeters (1961-2014). The study area was a highly humid climate in 1961, while recently it seems on the porch of sub-humid ambiance. The annual trends show depletion in the precipitation concentration since 1980. Based on temperature, there are three types of temperature zones that are cool, cold and highlands. The maximum temperature recorded in June as well as July and reversed in January. The average temperature indicates a rise of 0.2°C, which is higher during winters and converse in summers. The swell in the degree of hotness enhanced the water anxiety as well as the recoil of glaciers and increased the rate of natural hazards. The hydrology of the area is highly susceptible to the alteration in weather conditions in terms of glaciers retreat; fall in river flow, sub-surface water, natural disasters, desiccation of ponds and water springs. The yearly runoff of the Swat river reveals a decrease of -0.03 m³/Sec, while it is 12.4 m³/Sec in the Ghurband river (Shangla). It is concluded, that the yearly inclination of water runoff is contrary to mean temperature and directly proportional to precipitation. The most frequent natural disasters of the study area comprise of earthquakes, floods, landslides, snow avalanches, forest fires and epidemics (hepatitis, stomachache, and cholera). These hazards can be minimized using well planning (top to bottom) for risk management, preparedness, vulnerabilities and mitigation strategies at the community level in the area.

Keywords: Climate change, surface flow, hazards, community perception, planning, mitigation.

Introduction

Owing to geographical and physiographic circumstances, weather intensity, population stress, plate tectonic movement and vulnerability, the Swat, Shangla and Kohistan districts fall in active disaster-prone areas of Pakistan. Several geophysical, biological and hydro-meteorological disasters are mainly recurring and happen every year due to climate change, while the additional disasters for instance storms, earthquakes and snow avalanches, etc are exceptional but probably extremely critical. Furthermore, many man-made disasters akin to militancy, road accidents, strikes, forest fires, mining as well as civil unrest, etc are threatening to the society, economy and environment of the study area.

The Swat, Shangla and Kohistan districts are experiencing hasty revolution strengthening as of primary to secondary activities based metropolitan wealth system. The society of the study area has mechanisms like self-management, coordination, mohallah committees, etc. that make them able to mitigate the disaster risk around them. An excessive tempo of humans stresses leading to physical destructive conditions, for instance overgrazing, food scarcity, deforestation and domestic needs etc, that may trigger disasters. The weather change triggers to amend summer lows as well as precipitation trends and is envisaged to show the way to the additional stern and fewer conventional inundation and drought events. Rapid urbanization with rare concentration to planning

and housing schemes is rendering the majority of the residents prone to the most severe disasters particularly earthquakes and floods.

The current work discusses three different aspects of disaster, including disaster preparedness, management, and mitigation with special reference to the focused group discussions with the locals. Disasters and its effects on different sectors have drawn the attention of scholars, both on a national as well as global level. Human actions, social and economic escalation as well as physical alterations are interacting amid the event of climate fluctuation and disasters. Furthermore, weather and physical condition akin to drought, land sliding, flood, water flow and scarcity have certain effects on the food demand, crop cultivation, hydrology, health and welfare of humanity in the study area. Moreover, it elaborates on the people's perception of hazards in selected villages of Swat, Shangla and Kohistan districts. Previous studies have already elaborated similar type of community specific hazards and the local's response and perception to mitigate these hazards. The utmost among them are; Buckle (2001), Briscoe and Qamar (2005), Davies and Jenkin (2006), IPCC (2007), Aryal and Gadema (2008), Roohi (2009), GoP (2005, 2010), Khalid, et al. (2011), Flanagan *et al* (2011), Abbasi (2011), Kienzler (2012), Sylvia and Fekete (2014), Moran and Evans (2014).

The study area is located at latitudes 34°-6' to 35°-8' North and longitudes 72°-12' to 74° East. The geomorphologic and geological features comprise of

The Hindukush mountains with highest peaks like *Falak Ser* (5947m), *Shapero* (5736m), and *Gor Bala* (5288m), etc. It covers an area of 75,000 square kilometers having a total projected population of 122,852, including 9399 houses, 793 potable water and eight-person household size (GoP, 1998). In the south, it is covered by Malakand Protected Area, Mardan, and Swabi districts, while in the north and northeast by Ghizar, Gilgit and Astore districts of Gilgit-Baltistan province, and in the west by Upper and Lower Dir districts of Khyber Pukhtunkhwa, and in the east by Mansehra and Batgram districts.

Materials and Methods

The work is based on the analyses of climate change as well as hazards risk management, vulnerability assessment, community capabilities and adaptation concerning focus group discussions with locals in Swat, Shangla and Kohistan district. The research is set to evaluate the rainfall as a self-governing element, and temperature, inundation, water scarcity, land sliding, epidemics, health, population, literacy, education, employment, household size, facilities, surface flow, land use, forest fires, flora and fauna as depended variables. The data about temperature, precipitation, and surface flow of Swat, Ghurband, and Indus river (2003-2013) have been collected from Irrigation department Peshawar and National Snow and Ice Data Center, Russia, while the satellite images from NOAA, USA, public opinion through questionnaire survey and focus group discussions, topographic maps of 1:50K from survey of Pakistan.

Principally, the monthly as well as yearly means and deviation have been computed for Saidu Sharif, Besham Qilla, Malam Jabba, and Dassu met-observatories and tabularized in support of annual and seasonal analysis. The study area labeled within two basic seasons (summer and winter) taking into account the temperature condition that further classified into four sub-rainy seasons. To appraise the patterns of wet/cold and dry/hot periods of precipitation and

apparently representing the cold/wet and hot/dry periods of precipitation and temperature in the area. The years above the trend line have been considered as hot in terms of temperature and humid in terms of precipitation, whereas the converse is as cold or dry. Furthermore, the total of departure from the average condition has been determined with the aim to know the optimistic or pessimistic fluctuation of precipitation as well as temperature conditions. The change in precipitation and temperature has been crossed matched with the people’s perception. The same procedure has been used for the analysis of the water discharge data of Swat, Ghurband and Indus rivers. Even so, the main purpose of the people focused group discussion is to carry out a participatory risk assessment to know the impacts of disaster and climate change on people’s lives and develop action plans. Generally, 21 settlements have been considered in the focus group discussions, including nineteen-revenue villages and two sub-settlements. The group discussions were organized by the locals, including farmers, businessmen, affected people, government agencies, and people from the education department, etc. The data have been organized and divided into charts and diagrams for the purpose of the analysis and results.

Results and Discussion

Precipitation Fluctuation

Rainfall is a basic variable of weather and climate which influences surface as well as underground hydrology of Swat, Shangla and Kohistan districts. The study area receives a total of 52 inches (1320mm) precipitation per year and a fall in the humid climate. The summation of departure reveals a total dwindle of -5.3 inches (-134mm) during 1961-2014 (Table 1). The average precipitation of the area was 17.2 inches (436mm) within 2014 as compared to 19.4inches (492mm) during 1961 and shows a fall of almost - 2.2inches (50.8mm) throughout the study period. The Saidu Sharif observatory is located at the edge of the

Table 1 Swat, Shangla, and Kohistan Districts Mean Monthly Precipitation (Inches) 1961-2014, PMDC, Karachi.

District	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum	Mean	Devi.
Saidu Sharif	3.3	3.0	4.2	2.9	1.4	3.9	5.5	4.2	3.2	3.0	3.0	3.1	40.7	3.4	-5.5
Kalam	4.5	6.5	7.9	6.6	2.2	1.6	1.2	1.1	2.0	3.7	4.5	4.3	46.0	3.8	0.2
Malam Jabba	4.5	4.5	5.4	3.6	2.0	6.4	9.7	7.2	4.7	3.8	4.0	4.3	59.9	5.0	0.01
Pattan	5.8	6.7	7.4	5.1	2.4	4.6	6.0	4.5	3.9	4.4	5.2	5.6	61.4	5.1	0.2
Mean/Sum	4.5	5.2	6.2	4.5	2.0	4.1	5.6	4.3	3.4	3.7	4.2	4.3	52.0	4.3	-5.1

Table 2 Swat, Shangla, and Kohistan District, Mean Monthly Temperature °C (Source: PMDC, Karachi).

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Aver	Devi
Saidu Sharif	3.4	5.2	10.8	16.7	24.4	25.8	23.3	21.8	18.7	14.7	9.3	5.3	15.0	0.1
Kalam	-12.6	-10.4	-5.9	-1.0	5.6	11.4	14.2	13.4	8.4	2.1	-5.4	-10.6	0.8	-0.2
Malam Jaba	-0.5	1.3	6.9	12.8	20.1	22.0	20.1	18.7	15.6	11.4	5.7	1.6	11.3	0.1
Pattan	-5.5	-3.9	0.8	6.7	14.4	17.9	17.4	16.2	12.7	7.8	1.5	-3.3	6.9	-0.1
Mean/Sum	-3.8	-2.0	3.2	8.8	16.1	19.3	18.8	17.5	13.9	9.0	2.8	-1.8	8.5	-0.1

temperature, a tendency line has been depicted on the chart throughout the period that represented an

sub-humid climate (41 inches), whereas the precipitation shows an increasing trend at the

observatory of Pattan that is from humid to wet climate (61inches). The area remained wet in March (157 mm) and dry in September (86mm). Generally, the study area obtains winter and summer precipitation having a concentration in the winter season. The higher altitude mountains fall in undifferentiated highland climates and characterized with lasting snowfall and hoar frost. It has been observed that the winter season of the study area lasts from September to March (seven months), whereas the summer season ranges from May to September (five months). On the basis of rainfall, these foremost seasons of Swat, Shangla and Kohistan districts have further been classified in sub-rainy seasons, specifically cold, pre-monsoon, monsoon, and the post-monsoon seasons. The cold season of the study area ranges from mid-November to mid-April, pre-monsoon from mid-April, the monsoon from July to mid-September and post-monsoon from mid-September to mid-November.

The yearly pattern of rainfall indicates a sharp decline in rainfall in the earlier period of seventy-four years (1961-2014) with the heaviest precipitation during 1998, 2005 and 2010. The deviation of mean precipitation has 0.4inches (10mm) in 1961 that dropped to 0.17inches (4mm) in 2014 (almost one-third decline). The summation of digression from the average state is -5.1inches (129mm) which constitutes a total decrease in the rainfall. The trend remained positive at the observatories of Kalam, Malam Jaba, and Pattan, while it is the converse at Saidu Sharif, Swat (Table-1).

Temperature Fluctuation

Based on temperature conditions, the study area has been divided into three temperature zones namely cool, undifferentiated highlands and warm ambiance. It has been observed that the mean monthly temperature of all districts is 8.5⁰C (1961-2014) having the highest of 19.2⁰C (June), and the lowest -3.8⁰C in January. The

observatory of Pattan is located at the left bank of Indus river, under the influence of marine climates and characterized by river and land breezes. Based on temperature conditions, the summer and winter seasons are further divided into cold, warm, hot, and cool seasons. The cold season of the area ranges as of mid-November to mid-April, warm-season (mid-April to June), the hot season (July to mid-September) and cool season (mid-September to mid-November). The mean monthly temperature shows an increasing trend of 0.2⁰C having the swelling pattern all over the period. The area is extremely cold with a mean monthly temperature of -0.2⁰C in 1961 and hot (1.9⁰C) in 2009 (almost 1.7⁰C warming). It was this high temperature that helped the glaciers to retreat and a caused flood in 2007. Due to rise in the mean monthly temperature at Saidu Sharif, Kalam and Malam Jabba, the glaciers of the area retreated and caused a decline in the flow of the Swat river (Swat) as well as a Ghurband river (Shangla). The increase in summer, as well as winter temperatures, will cause the melting of glaciers and increased the rate of evapotranspiration from exposed surfaces. Furthermore, the change in temperature condition will decrease the length of the winter season and also caused an increase in the summer months (Table 2).

Impact on Water Resources

Water is the source of wealth for the humankind and devoid of hydro-recourses availability, it becomes stiff for the humans to stay alive. The hydro-resources are participating in key functions in the advancement of the social communities in Swat, Shangla and Kohistan districts and the catchment areas of the major drainage. The water flow in all major rivers of the study area is consecutively dried up and hoped that it will be additionally influenced owing to the continuing climate fluctuation and causing the decrease in crop production and affecting the well being of the people. The river flow remains high during July (15.8MAF)

Table 3 Shangla district, Ghurband river, mean monthly flow m³/sec (Irrigation department, Peshawar, 2001-2010).

Year	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Mean	Devi
2001	2.0	2.0	5.5	9.9	7.4	8.1	15.4	5.6	7.8	4.2	5.8	2.8	6.4	-6.0
2002	3.7	5.5	22.9	26.7	21.8	18.3	12.3	14.0	10.5	3.4	2.6	2.4	12.0	-0.4
2003	2.3	7.4	26.6	38.0	25.0	16.8	13.6	14.8	12.3	6.6	5.3	5.4	14.5	2.1
2004	4.6	6.5	11.2	13.5	6.9	7.2	8.3	7.1	7.1	12.4	5.8	5.0	8.0	-4.4
2005	7.8	11.5	36.3	24.1	20.4	15.4	15.8	13.6	9.0	10.1	6.3	5.1	14.6	2.2
2006	8.4	16.3	14.5	16.9	15.1	11.2	14.3	18.7	11.1	6.8	9.0	11.1	12.8	0.4
2007	8.1	10.9	18.0	18.9	14.2	13.6	14.1	11.2	10.6	5.9	4.7	4.6	11.2	-1.2
2008	6.1	7.6	13.5	19.4	14.1	14.7	17.2	14.8	10.0	7.0	6.8	11.1	11.8	-0.6
2009	10.8	15.6	19.8	29.3	23.5	15.1	14.3	13.9	10.5	4.9	4.7	4.4	13.9	1.5
2010	3.6	15.9	22.3	19.4	18.9	12.5	37.5	31.5	20.3	16.1	13.6	11.8	18.6	6.2
Mean/Sum	6.2	10.8	20.6	22.9	17.8	13.9	16.4	15.5	11.3	8.1	6.5	6.8	12.4	-0.2

Table 4 Swat, Shangla, and Kohistan districts, health facilities in surveyed settlements (Field Survey).

District	BHU	Nearest	MHC	Nearest	FPC	Nearest	PMC	Nearest	TBA	Nearest	LHV	Nearest	Drugstores	Nearest
Swat	2	4	0	15	1	30	20	1	8	5	9	6	17	1
Shangla	2	5	1	4	0	7	8	2	3	17	2	11	11	2
Kohistan	3	2	2	5	0	46	9	5	2	5	6	5	18	5

and remains low in January (1.02MAF). The discharge of the streams and rivers of the area is generally comparable to ascend and descend in temperature conditions. The flow is high during monsoon seasons and reverses in the excluding seasons of the year. The average water discharge of the Indus River at Dassu (Kohistan district) is 62.13MAF. The departure as of the average water discharge shows that it was 2.9MAF during 2010 that declined to 0.77MAF during 2014 (-2.1MAF). The annual flow of the Swat river indicates that the water flow remains high in July (255.9 m³/Sec) due to the rise in temperature and the arrival of the monsoon season. Commonly, the water discharge has remained low between October-April (winter season) and finer from May to September (summer season). The river flow is directly related to the temperature condition and converse to the rainfall in the area. The mean water discharge of the waterways is 192.2m³/sec from 2010 to 2014 having a decrease of -0.03m³/Sec (Khan, 2014). The yearly discharge of the river shows vicissitudes after every three years. The yearly discharge of the Ghurband river (Shangla district) is 12.4m³/sec during 2001-10. The divergence of the river indicates a decline of -0.2m³/sec during the period (Table 3). The discharge of the river remained high during 2010 (18.6 m³/sec) and remained low in 2001 (6.4m³/sec). Generally, the flow of water shows an increasing trend after 2008 but it is expected that it will be declined on ward 2010. The annual march of the flow of Ghurband river shows that the flow of the river is high during April (22.9m³/sec) and low in January (6.2m³/sec). During the summer season, the river flow remains low due to squat precipitation from monsoon lows and high during the winter season.

Generally, the economy of Swat, Shangla, and Kohistan district is based on primary activities. The major factors that have been discussed with the community and locals are agriculture, self-employment, transportation, hunting (fishing), cattle, etc. The socioeconomic condition plays a vital role in a reduction of disaster and climate change impacts on the locals. If they are stable economically, then it is effortless for them to handle the worst climate change condition using their funds and resources. But if poverty is on the threshold of the inhabitants, then it will hard for them to search for food, shelters, transport, etc for themselves and their families.

The total agricultural land of the study area comprises 3.6 million kanals in Swat, 25 thousand kanals in Shangla, and 17 thousand kanals in Kohistan district. The agricultural land of the study area is divided into cultivated, irrigated, and rain-fed land. The total cultivated land in Swat district is 1.1 million kanals, Shangla district, 9.5 thousand kanals and Kohistan district, 8.1 thousand kanals. As far as the community resources in the sample villages are concerned, there is no bank in the target villages and the nearby banks are located at a distance between 2-18 km (Table 4). Keeping in view the security issues, there is only one police station in the sample villages of Swat district,

while in Kohistan and Shangla, it is located at a distance ranging between 5-50 km. Due to non-availability of the Police stations in the target villages, it is hard for government agencies to secure the population immediately during any kind of disaster. The local market plays a vital role in the socioeconomic development of the area and food supply during an emergency. Commercially, there are only three local markets that exist in the sample villages of Swat and one in Shangla district. In the remaining target villages, the local markets are located in the range of 8-40 km. Most of the sample villages in Swat are the tourist spots and consist of about 19 hotels, whereas there is no restaurant in the sample villages of Shangla and Kohistan districts. Almost, all sample villages have the facilities of public transport excluding Ashar Garai village in Swat district, *Bankeel*, *Daad*, and *Ghambeer* villages of Kohistan. As far as communication is concerned, most of the villages in Swat district have cellular as well as land line facilities, but the level of these facilities is poor in the sample villages of Shangla and Kohistan districts. It is these factors that fall the local community in problems to communicate with the nearby places during hazards. Likewise, there are only two post offices in the target villages of Swat district (Table 4).

Health Facilities

Health facilities constitute a basic element in the hazard management and rescue processes. As the area is exposed to different natural as well as anthropogenic hazards, therefore the health facilities at the threshold of the inhabitants will be more beneficial to secure their health and wealth. The health facilities in the target villages comprise the Basic Health Unit (BHU), the Maternity Home Center (MHC), Foreign Policy Centre (FPC), and drug stores (Table 4). The sample villages of Swat are without Maternity Home Center services, whereas, there is one Maternity Home Center in the sample villages of Shangla and two in Kohistan district. As far as veterinary health facilities are concerned, most of the target villages in Swat, Shangla and Kohistan districts are without veterinary health facilities.

Education Facilities

Education is the primary element that helps the locals to be aware and mitigate hazards properly. The educational institutions in the sample villages vary from primary to the high school level. The total numbers of primary schools in the target villages of Swat district are 19, seven in Shangla district, and 9 in the Kohistan district. The numbers of middle schools in the surveyed villages are six in Swat, two in Shangla district and not an iota in the Kohistan district. The numbers of high schools in Swat surveyed settlements are six, seven in Shangla and not an iota in Kohistan district. There is no educational institute at the college level in all sample villages however, the nearby higher

secondary educational institutes are located at a distance of 5-24 kilometers (Table 4).

Community Based Vulnerabilities and Buoyancy

The vulnerability, as well as resilience, is increasing in usage in the field of disaster preparedness and management. Both are poorly defined, or at least have many different definitions. For the current work, it is not necessary to define these terms more closely than to say that vulnerability refers to the potential to experience some loss and resilience refers to the capacity to prevent, resist or restore that loss. During group discussions, it was noted that the majority of the residents are vulnerable to the earthquake, flood, land sliding, hydrological drought, etc and call for community-based adaptation. Among the vulnerable groups, children are the leading ones, followed by the elders and women. The average of women vulnerable groups in the study area is 17 persons, whereas the children are 3.8 thousand persons and the elder group is 0.4 thousand people. Swat is the leading district, where the average of vulnerable women is 32, with 5.8 thousand children and 0.8 thousand aged people. In the Shangla district, the vulnerable women are 17, children are 3.8 thousand, and the aged are 0.1 thousand. In the Kohistan district, the average of vulnerable women is 2, with average children of 2.1 thousand, and older age of 0.2 thousand people (Table 5).

The common epidemic diseases in Swat, Shangla, and Kohistan district consist of dengue, diarrhea, and hepatitis, etc. The average of 2.2 thousand human epidemic cases were reported in the surveyed villages. In which, the average contribution of Swat district is 0.3 thousand persons, Shangla districts are 3.3 thousand persons, and Kohistan districts is 3.9 thousand persons. The ratio of the epidemic diseases is different in rural as well as urban sectors of the area and mostly caused by the water supply, floodwater, waterlogging and drainage, etc (Table 5).

Fire is another hazard, which affected humans, animals, agriculture and residential areas in Swat, Shangla, and Kohistan districts. As it not only destroyed the residence and economical resources of the locals but also caused air pollution, increased temperature and turns the area warmer. The average numbers of the people affected by forest fires are 1.5 thousand persons. The fires cases highlighted during interviews are two thousand houses in the residential areas, while the remaining cases have been recorded in the forest areas. The average affected people in Swat district is 1.6 thousand persons and one thousand houses. In the Shangla district, it is 2.6 thousand people and two thousand houses, whereas very little damages of forest fires were reported in Kohistan district having an effect of about two thousand houses.

The earthquake is one of the most important natural hazards that strike the area once a month. As the area falls in the active tectonic seismic and fault zones,

therefore the earthquake hazard is more effective and causing damage to human infrastructure. Almost, all of the sample villages are affected by the earthquake of 2005 and partially by 2010 event. The average (partially) affected population by the earthquake disaster is 10.4 thousand persons, with 2.9 thousand animals and 1.0 thousand houses. The average humans, animals, and houses loss in Swat district is higher as compared to Shangla and Kohistan districts (Table 5).

Flood is another major natural hazard that caused damages to human settlements, agriculture land, transportation infrastructure, flora, and fauna in Swat, Shangla and Kohistan districts. During group discussion, people have the opined that the heavy flow mostly eroded the river banks and causes damages to agricultural land. During the last ten years, the average number of affected people in the study area is 348 persons and 156 animals. The average damages to agriculture land are about 120 kanals and 19 residences. Due to non-availability of planning, the locals are exposed to flood disaster and lose their properties, crops and houses every year. Almost, all sample villages are affected by floods, but it is more severe in Kohistan and Shangla districts as compared to Swat district (Table 6).

The hailstorms and thunderstorms are frequently caused in pre-monsoon and post-monsoon seasons in the area resulting in damages to crops, gardens as well as humans. Due to hailstorm most of the fruit gardens (apple, and pearl, etc) are destroyed during flowering season in Swat, Shangla, and Kohistan districts and affected the socioeconomic condition of the area. The average damages to agriculture in the sample villages are 3.6 thousand kanals including 7.7 thousand kanals in Swat, 1.1 thousand kanals in Shangla, and 1.8 thousand kanals in Kohistan. Snowfall is the gift of nature to the locals for the beauty and evergreen forests that covers the slopes of the high mountains. The group discussion shows that almost all sample villages are affected by the snowfall. The average damages caused by the snowfall are including 278 houses in Swat, 201 in Shangla, and 125 houses in Kohistan respectively (Table 6).

People Perception towards Hazards Priority

For the current study, some of the specific natural, as well as anthropogenic hazards, have considered understanding the people's opinion towards the priority of each disaster and climate change-related elements in terms of preparedness, management, vulnerability, and mitigation. The specific elements that have been considered for the stated purpose are epidemics, earthquakes, hailstorms, floods, fire, and water scarcity (Table 7). To mitigate the hazard problem, the people have presented their priority of 27 percent for the floods, followed by an earthquake and epidemic disease.

Hazards Impacts on Different Sectors

The prominent sectors that affected by hazards in Swat, Shangla, and Kohistan districts are human, fauna, agriculture, residential, infrastructure (roads), drainage and health, etc. The major earthquakes in the last ten years happen between 1974 and 2005. The total damages to humans in the sample villages were 161, animal’s fatalities of 124, 20% of agricultural land, 280 to the residence, and partially damages to infrastructure. As far as Swat district has been concerned, the more hazardous earthquake happened in 2005 that mess up 3 people, 34 animals, 38 residences, and affected most of the infrastructure. In the same year, the damages in the sample villages of Shangla have been observed are 48 fatalities to human and 105 residences, partially damages to the infrastructure. In Kohistan, the most dangerous earthquake has been occurring in 1974, when most of the Pattan village was destroyed. The second one has been noted in 2005 that caused partial damages to the settlements after shocked. The total fatalities in both of the earthquakes in the sample villages of the Kohistan district are 110 to humans, 90 animals, 280 residences and partial damages to infrastructure (Table 8).

1975, 2010, and 2014. The sufferers recorded are 67 humans, 20 animals, 200 kanals agricultural land, 128 residential houses and is partially damaging to the agriculture and transportation infrastructure.

Landslide and snow avalanches are common hazards in winter as well as the summer seasons in areas where there is the heaviest snowfall. The total loss of human lives is 4 persons with 5 animals, partially damages to agriculture, infrastructure and five houses. The damages are higher in the Swat district as compared to Shangla and Kohistan districts. As far as the drought is concerned, there is no loss of human lives in the area. The sum of 50 animals have been affected because of water scarcity, while the damages to agriculture count for 40 kanals, and 20 houses, and partially damages to agriculture and forests. Generally, the total losses caused by snowfall to human lives are 24 persons, 16 houses and partially damages to agriculture and transportation infrastructure. Hail storms occurred mostly in the pre-monsoon (April to June) and post-monsoon seasons (September to November). The hailstorm’s effects are noted in the production of the crops and fruit gardens. The most disastrous hailstorms in the study area have recorded in 1964, 2010, 2013,

Table 5 Swat, Shangla, Kohistan districts, vulnerability to epidemics and forest fires in surveyed settlements (Field Survey).

District	Human	Fauna	Crops	Residence	Fire	Human	Fauna	Crops	Residence
Swat	311	0	0	0	0	1562	0	0	139
Shangla	3268	0	0	0	0	3560	0	0	210
Kohistan	3938	0	0	0	0	0	0	0	185
Average	2139	0	0	0	0	1593	0	0	171

Table 6 Swat, Shangla, Kohistan districts, vulnerability to earthquakes and floods in surveyed villages (Field Survey)

District	Human	Fauna	Crops	Residence	Human	Fauna	Crops Area	Residence
Swat	16248	3856	0	2000	27	12	160	6
Shangla	7682	3174	0	220	144	600	0	19
Kohistan	3938	1477	0	165	1000	0	160	38
Average	10414	2972	0	1005	348	156	120	19

Table 7 Swat, Shangla, Kohistan districts, people perception to hazards priority in surveyed villages (Field Survey)

District	Epidemics			Earthquake			Hail Storm			Flood		
	Freq	Impact	Priority	Freq	Impact	Priority	Priority	Impact	Priority	Freq	Impact	Priority
Swat	11	13	10	9	10	13	11	10	12	15	9	12
Shangla	5	6	6	6	5	6	0	0	0	6	7	5
Kohistan	5	9	9	6	17	6	0	0	0	6	14	10
Sum	21	28	25	21	32	25	11	10	12	27	30	27

Table 8 Swat, Shangla, Kohistan districts, impacts of earthquake hazards in surveyed villages (Field Survey)

District	Year	Human	Animals	Cultivated Area (Kanals)	Residence	Infrastructure
Swat	2005	3	34	0	38	Partially
Shangla	2005	48	0	10	105	Partially
Kohistan	1974-05	110	90	10	137	Partially
Sum	1974-05	161	124	20	280	Partially

Every year, the study area is facing flood hazards in monsoon and winter season respectively. The major sectors affected by the flood disaster are human, animals, agriculture, residential, and infrastructure, etc. The study area has been passed many times by flood disaster, but the disastrous floods recorded in the years

and 2014 which affected the fruit gardens in the area.

Epidemics are a major hazard that exist in the area and generally caused by the turbidity and the hardness of the drinking water and dengue virus. There were 285 epidemic cases reported during 1960, 1990, 2010 and

2014. The highest of 270 cases were recorded in the Swat district, followed by Shangla and Kohistan districts. Two major epidemic diseases recorded are dengue and diarrhea. The total cases of dengue recorded in the study villages are 52 to 329 of diarrhea. Generally, the epidemics are higher in Swat district, while it is opposite in the Shangla and Kohistan districts. The people have opined that the forest land in Kohistan districts declined to 61%, wildlife 46%, water bodies 20%, pasture lands 36%, livestock 50%, medicinal plant 58% and fisheries 72 percent during 50 years. The forest area decreases at a high rate in the Shangla district, followed by Swat, and Kohistan districts that need adaptation.

Community based Planning

- Management and service provision should occur as much as possible at the community or municipal or village level. Pakistan's strategies, services and resources should supplement and complement local recovery initiatives rather than replace local endeavor.
- Emphasis should be given to supporting and maintaining the identity, dignity and autonomy of affected individuals, families and communities in the study area.
- Management of recovery should occur in the context of clear and agreed arrangements, and involve processes of consultation and co-operation through established communication channels between the government agencies and the local community.
- Whenever possible, the normal management and administrative structures and practices of the agencies involved in recovery should be used. Efforts should be made to ensure that these structures and practices are responsive to the special needs of affected population.
- Recovery information and recovery services need to be readily accessible to affected individuals, groups and communities and responsive to their needs and aspirations.

Emergency Recovery

- As the area is exposed to the ongoing climate changes as well as disasters, therefore, assistance measures for community based emergency recovery should be made available, and seen to be available in a timely, fair and equitable way.
- Effective recovery from disaster requires the establishment of planning and management arrangements, which are accepted and understood by recovery agencies, combat agencies and the locals.
- Recovery management arrangements are most effective, when they recognize the complex,

dynamic and protracted nature of recovery processes and the changing needs of affected individuals, families and groups within the community over time.

- The management of disaster recovery is best approached from a community development perspective and is most effective when conducted at the local level with the active participation of the affected community and a maximum reliance on local capacities and expertise.
- It will most effective when human service agencies play a major role in all levels of key decision making which may influence the well being and recovery of the affected community.
- Recovery from disaster is best achieved where the recovery process begins from the moment of disaster impact.
- It will most effective where the locals supported by training programs and exercises, which ensure that recovery agencies and personnel are properly prepared for their role. It will be appreciated if the government involved the locals in their planning and recovery programs.

Community Capability

- To develop climate change and hazards related skills in the community and to train them about climate change sever events.
- To ensure local access to hazards and climate change control services in the area.
- To develop local knowledge about climate change and hazard preparedness, management, and recovery, etc for the awareness of the community.
- To make sure the access of local to the hazards management resources.
- To widen data sharing and communal arrangements within a society and too aware of how to combat hazards.
- To develop community potential based on the existing arrangements and reserves in the area.
- The people have demanded the National Disaster Management Fund, as well as local disaster management funds, would be launched in sort to permit the central administration as well as the locals to organize emergency response effectively.
- The options for setting up hazards funding plans should be searching with the international donors, Banks and insurance agencies. The people have spoken out to extend the structure of the National Disaster Management Authority (NDMA) and Provincial Disaster Management Authority (PDMA)

into district municipality, tehsil, town, union councils and community-based organizations (mohallah committees) for the purpose of emergency response as well as proper recovery and rehabilitation work.

Conclusion and Recommendations

Generally, two types of weather and climate, namely humid and undifferentiated highlands were observed having decreasing trends in the precipitation and increasing trend in the temperature condition throughout the series. The area was strongly humid during 1961 and currently hanging on the threshold of the sub-humid climates. The area characterized by long summers and short winters (concentration) with four sub-rainy seasons. During cold and pre-monsoon seasons, the trend is negative since 1990 with a slight increase in precipitation during monsoon and post-monsoon seasons. The annual flow of the rivers is directly proportional to the mean maximum temperature and inversely proportional to precipitation. The flow of rivers shows decrease throughout the series, which is more severe during the last ten years. Due to geophysical conditions, climate extremes, and high degrees of exposure and vulnerability, the Swat, Shangla and Kohistan districts of Northwest Pakistan fall in severely disaster-prone areas. A number of hydro-meteorological, geophysical and biological hazards including avalanches, storms, water scarcity, floods, earthquakes, landslides, and epidemic pose risks to the inhabitants of the study area. Some of these hazards (floods, landslides, etc) are predominantly seasonal, whereas other hazards such as earthquakes, storms, and avalanches etc are rare events but potentially more destructive.

The people have the recommendations that a supportive, knowledgeable community with access to resources and the skills to use those resources will be better able to support hazards management and preparedness. The construction of the river embankments, re-forestation, improvement in the transportation and communication infrastructures, training and support programs, climate change and disaster management education, community-based mitigation strategies, advance forecasting and monitoring, climate change and disaster policy, protective and supportive hazards management works and health facilities for the locals. Furthermore, for the analyzing risks and developing appropriate management strategies for the hazards affected areas, sustainable and equitable development, community based training programs should be launched for the sustainable hazard management, financial support of the locals to enable them in the rebuilding of their shelters and to overcome the other issues.

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