



Gilgit-Baltistan Environmental Protection Agency (GB-EPA)



Gilgit-Baltistan

Climate Change Strategy and Action Plan
(Revised)

2022

Gilgit-Baltistan Climate Change Strategy and Action Plan- 2017 (Revised: 2022)

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Government of Gilgit-Baltistan

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Foreword

Government of Gilgit-Baltistan (GB) considers climate change as one of the major impediments in economic growth of the region. Steady increase in the frequency as well as intensity of natural disasters means major portion of development budget is consumed in the shape of compensation to damages and rehabilitation of infrastructure, thus reducing the pace of social sector development agenda. Massive losses of human life, infrastructure and livelihoods and ecosystems in the recent past due to disasters are attributed to the changing climatic patterns.

Although the greenhouse gas emissions of Pakistan are less than 1% of the total global emissions and in GB the emissions are much lower as 100% of its energy generation is based on hydropower. GB has total capacity of 13 MW-installed thermal power, which is only used in case of power failure at large scales.

Adaptation is a priority for the communities living in the valleys hosting largest glaciers with associated risks and unique vulnerabilities. The local communities are the first victims of climate change, which is impacting their natural resources upon which their livelihood is dependent and posing threats to their lives and infrastructure.

Through this Strategy, adaptation to climate change will be integrated into development plans, programs and projects in GB. Development of climate resilient infrastructure would be the first priority of the government followed by capacity enhancement of relevant public and private sector actors and awareness of vulnerable remote mountain communities. There are some context specific threats of climate change in case of GB because of its fragile ecology, which were previously remained unaddressed in the National Climate Change Policy and framework. For instance, Glacial Lake Outburst Flood (GLOF) is one of the most frequently occurring phenomenon which does not find adequate mention in the national climate change policy and previous version of this strategy (2017). This revised strategy, therefore, addresses GLOF as a cross cutting theme in the entire document which is prepared with the support of national GLOF-II project, to address contextual peculiarities of climate change risk reduction strategic planning and programming in Gilgit-Baltistan. Input from line departments, NGO's and other stakeholders have been incorporated through surveys and consultative sessions. Sectoral actions have been devised for each vulnerable sector, and institutional roles have been identified to undertake the proposed measures.

Government of GB is committed to allocate and additionally mobilize resources and conduct planning of the development activities in a sustained way to implement this Strategy. The Government of GB will also facilitate institutional setup and provide administrative support for the effective implementation of this strategy.

Chief Minister
Gilgit-Baltistan



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Abbreviations and Acronyms

AKAH	Aga Khan Agency for Habitat
AKRSP	Aga Khan Rural Support Program
B&R	Building & Roads
BAP	Biodiversity Action Plan
CDM	Clean Development Mechanism
CRI	Climate Risk Index
CSR	Corporate Social Responsibility
DRR	Disaster Risk Reduction
ENERCON	National Energy Conservation Centre
ETI	Economic Transformation Initiative
GB	Gilgit-Baltistan
GBC	Gilgit-Baltistan Council
GBDMA	Gilgit-Baltistan Disaster Management Authority
GBEPA	Gilgit-Baltistan Environmental Protection Agency
GBLA	Gilgit-Baltistan Legislative Assembly
GBRSP	Gilgit-Baltistan Rural Support Program
GCISC	Global Change Impact Studies Centre
GDA	Gilgit Development Authority
GHGs	Greenhouse Gases
GLOF	Glacial Lake Outburst Flood
HEIS	High Efficiency Irrigation System
HKH	Hindu Kush-Karakoram-Himalaya
HVRA	Hazard Vulnerability Risk Assessment
ICT	Information and Communication Technology
IFAD	International Fund for Agriculture Development
INDC's	Intended National Determined Contributions
INGO's	International Non-Governmental Organizations
IPCC	Intergovernmental Panel on Climate Change
IRS	Indus River System
IRSA	Indus River System Authority
KIU	Karakoram International University
LG&RDD	Local Government and Rural Development Department
LSO	Local Support Organization
LUCF	Land Use Change and Forestry
LULUCF	Land Use, Land Use Change and Forestry
MACP	Mountain Area Conservation Project

MaSL	Meters above Sea Level
MNB	Multi-Nutrient Blocks
MRV	Measurement Reporting and Verification
NADP	Northern Areas Development Project
NCCP	National Climate Change Policy-Pakistan
NESPAK	National Engineering Services of Pakistan
NGO	Non-Governmental Organization
NOC	Non-Objection Certificate
NTFP's	Non Timber Forest Products
PEPA	Pakistan Environmental Protection Agency
PEPA-97	Pakistan Environmental Protection Act-1997
PFI	Pakistan Forest Institute
PMD	Pakistan Meteorological Department
PPPS	Public Private Partnership Schemes
PRCS	Pakistan Red Crescent Society
R&D	Research & Development
REDD	Reducing Emissions from Deforestation and Forest Degradation
SAARC	South Asian Association for Regional Cooperation
SDA	Skardu Development Authority
SUPARCO	Space & Upper Atmosphere Research Commission
UN	United Nations
UNFCCC	United Nation Framework Convention on Climate Change
WASA	Water and Sanitation Authority
WASEP	Water and Sanitation Extension Program
WCS	Wildlife Conservation Society
WMO	World Meteorological Organization
WWF	World Wildlife Fund



Executive Summary

Climate change has increasingly become a major global challenge that threatens natural, ecological and human systems. Pakistan is highly vulnerable to the adverse impacts of climate change, in particular extreme hydro-meteorological events. GB is considered highly vulnerable to impacts of climate change due to its fragile mountain ecosystem, topography, geological composition, and geographic location as well as scattered population and socio-economic and geo- political setting.

Situated among three mountain ranges of Hindu Kush, Karakorum and Himalaya (HKH), it is under tremendous pressure from impacts of the climate change. The climate change has multitude effects on various parts of GB, as well as different sectors. Hence, mitigation priorities and adaptation approaches may widely differ. This differential nature of climate change impact necessitates development of diverse and context-specific solutions. Therefore, there is need to enhance awareness about climate change and possible adaptive options as well as coping strategies. One of the most pressing areas of consideration in this climate change strategy is the contextual significance of GLOF its mainstreaming and specific measures to address its risks in all sectors and across Gilgit-Baltistan, this calls for strategizing and implementing the current and future infrastructure and organizational capacities that will thereby minimize the risks from the climate change and contribute to synergistic and cost-effective means of addressing wide-ranging issues.

Sporadic events like high intensity downpour, GLOF, droughts, fast melting of snow and glaciers, and consequent impacts are already affecting people of the area. The frequency and intensity of such events may increase in future, which will adversely affect long medium and even short-term development goals in the region. The climate data for the period of 1984–2013 shows variations in temperature and precipitation levels in Gilgit-Baltistan. It reveals that the region receives most of its precipitation during the months from February to May. The studies established that the glaciers in the HKH ranges have absorbed more heat compared to the plains during the last half century.

The intensity and frequency of climate hazards and extreme climate events appear to have increased in GB during the past few decades. This includes floods, landslides, GLOF events and avalanches around the HKH. Among the type of natural disasters occurring in the area avalanches and GLOF remain major threats followed by wind and snowstorms.

Table 1: Human casualties and Other Damages due to Natural Disasters during 2010 to 2015

Item/Description	Numbers	Unit	Item/Description	Numbers	Unit
Human casualties			Livestock		
Deaths	306	Individuals	Goats & Sheep	3,207	Nos.
Injuries	174	Individuals	Cows & Donkeys	1,855	Nos.
Pakka Houses			Fruit Trees	111,539	Trees
Fully Damaged	15,392	Structures	Non-fruit Trees	239,474	Trees
Partially Damaged	291	Structures	Roads	608	KMs
Kacha Houses			Cultivated Land	110,353	Kanals
Fully Damaged	2,351	Structures	Bridges	56	Nos.
Partially Damaged	12,468	Structures	Water Channels	580,044	RFt.
Cattle Sheds			Protective Bunds	87,070	RFt.
Fully Damaged	5,369	Structures	Water Supply Systems	57	Nos.
Partially Damaged	518	Structures	Shops	111	Nos.

Source: Gilgit-Baltistan Disaster Management Authority (GBDMA)

The process of urbanization is comparatively slow and the built infrastructure is therefore scattered across the region and remains highly vulnerable to climate change impacts. Whereas the built infrastructure in towns is vulnerable, the buildings in rural and remote areas are equally prone to natural disasters. Despite Gilgit-Baltistan being the water tower of country, large quantities of water on way from the source to the arable land is lost, in some cases, the losses are as high as 70%.

Livestock is an integral component of farming system in GB that is most likely to be rigorously impacted by climate change. They are particularly important to food security in local economy. Impacts of climatic changes are clearer at higher altitudes where alpine pastures do exist and are integral part of our rural livelihood.

Forests in GB are under pressure of natural degradation and commercial exploitation. In addition, the population growth, poverty and subsistence cutting are some of the indirect causes of deforestation in the region. Poor forest management and planning, low institutional capacity, lack of community involvement and lack of enabling environment are responsible for further escalating the problems. Being 52% of the total area (GB), rangeland protection from the impacts of climate change is pivotal.

GB is susceptible to climate triggered natural disasters. An assessment of disaster events of the last two decades shows that landslides, torrential floods, GLOF and avalanches are some of the most frequent events in the region. There are strong signals that the impacts of climate change and ensuing natural hazards will further exacerbate in the coming decades in the region as GB is already encountering climate change impacts that are too visible to ignore.

GB is food deficient as more than 50% of its food staples including wheat are supplied from other parts of country. Climate change related disasters hit the region frequently. This further increases the food insecurity of local population. GB endures diverse range of animal and plant species. Though 50% of the area is protected to save endangered species, they continued to be threatened for many reasons like over-exploitation of medicinal plants and habitat destruction.

Agriculture production is strongly linked with the seasonal and long-term variations resulting from climate change. GB has nearly 2% cultivable land out of its total area of 72,971 Km. More than 80% population engages in subsistence farming by which cereal crops, fruits, vegetables and fodders for livestock are produced.

Mountain glaciers of Gilgit-Baltistan comprise of about 30% of the total area and another 40% is under seasonal snow cover and are at the risk of climate change. Research shows that the temperature of the region is rising at a rate twice than that of the plains. Variation in flow of water in the rivers and other water bodies is due to climate change that may impact the fisheries sector. Increasing temperatures, uneven turbidity levels and contamination in water body is impacting trout fish. GLOF is an emerging threat to the lives and livelihoods of downstream mountain communities which is linked to rapid melting of glaciers and ice mass as temperature continues to rise in the high mountain regions.

In Gilgit-Baltistan healthcare has been neglected since a long time, with the common people bearing the brunt of this situation. There are critical challenges in health care, with paucity of trained human resource and deficit of regulated infrastructure and service delivery being the predominant dilemmas. Maternal Mortality Morbidity Rate (MMR) and anemia rates are high in GB. Other problems that plagued health sector are unseemly state of primary and secondary healthcare are in an unseemly state, to say the least. Maternal and child health care, accident, and emergency departments and mental health are among the most undermined and forsaken areas of healthcare.

The number of vehicles in GB are likely to increase manifold because of the heavy traffic on KKH as a result of the increasing trade between China and Pakistan. The ecological balance of mountain regions is considered to be very fragile; and escalating amount of fossil fuels emissions would negatively impact climate of the region.

In context of climate change adaptation, urban migration can lead to reduction in vulnerability of affected communities and reduce pressure on local resources by representing an income source that is generally not disrupted by environmental hazards.

To safeguard against most likely climate change impacts on mountain and glacial areas and to protect their ecosystems and livelihoods of mountain communities, the following recommendations are proposed:

- Maintain an inventory of all the major climate triggered hydro-meteorological disasters which in turn will serve the purpose of monitoring and formulating the risk assessments for future development.
- Promote resilient infrastructure.
- Develop a comprehensive and climate sensitive energy policy for attracting the private sector to invest in the area
- Develop a system of water governance and institutional mechanism to allow fair distribution of water resources and to address issues of access and water inequalities at large across the region. Promote access to safe drinking water and extend sewage treatment facilities and create awareness among communities particularly in disaster prone areas, Map water resources, and introduce efficient water distribution network for agriculture and domestic use
- Improve the rangeland management in Gilgit-Baltistan.
- Introduce environment friendly, modern and ecologically suitable ways of farming in agriculture sector.
- Implement REDD+ and Afforestation/ Reforestation CDM mechanisms to encourage the afforestation in GB.
- Inform the public about impending dangers of disasters, and establish early-warning system in Gilgit-Baltistan.
- Take necessary precautionary measures to achieve food security in the eventualities.
- Enhance the management of existing protected areas and introduce collaborative management regimes involving partnerships between government and local communities.
- Explore means to maximize these benefits and reduce risks to migrant workers, their families, and communities in the region.
- Develop context specific mitigation and adaptation action plans to address the emerging threats of GLOF across GB.
- Institutional strengthening and coordination to be established by Identifying a focal institution (GB EPA) and a CC steering committee to oversee the implementation of GB's CC Strategy and Action Plans.
- Awareness raising and advocacy campaigns are essential for the masses to enlighten them about severity of CC related disasters.



1. Introduction and Background

Climate change has emerged as a new global challenge and poses unprecedented threats to the social and natural systems across the globe. It is characterized by long-term shifts in weather patterns due to variations in temperature and precipitation levels. These changes gradually impact the balance of natural and human systems leading to more frequent catastrophic events including torrential floods, GLOFs, droughts, rise in sea level, glacier melting, and change in precipitation patterns.

Scientific evidence tells that climate change is being driven more by human induced greenhouse gases emitted into atmosphere, particularly after industrial revolution (see Box-1).

With rise in temperatures, melting of glaciers is likely to be further accelerated, resulting in increased flow of water in rivers and, eventually, shortage of fresh water availability over time. The initial surge in river water will end up in seas, giving rise to sea levels by 18 – 36 cm for low emission scenario and 26 – 59 cm for high emission scenario. In parallel with rise in flow of water, the precipitation is likely to increase from mid of the century with frequent and intense precipitation events. Industrialized and developing countries alike are expecting to be affected from the fallouts of rising temperatures and global warming. Countries across the world are therefore, aiming to devise strategies and take necessary actions towards climate change adaptation and mitigation for a safe and secure future.

It is globally recognized that mountain ecosystems are among the most vulnerable to climate change. These vulnerabilities are likely to be intensified due to disproportionate warming in mountain areas; and particularly so in GB that is one of the highly mountainous and glaciated regions of the world outside the Polar Regions.

The need for a GB specific climate change strategy and action plan is justified for several important reasons. There is need to mainstream climate change adaptation and mitigation in the medium to long-term regional development goals which are defined by the contextual peculiarities. For instance, GLOF is one of the most frequently occurring phenomena in Gilgit-Baltistan which does not make adequate mention in the National Climate Change Policy, framework and previous version of GB's CC Strategy. With full incorporation of GLOF, GB Climate Change Strategy and Action Plan provides a comprehensive framework to address all dimensions of Climate Change and its impacts on the mountain ecology. GLOF mainstreaming in this strategy builds on the measures piloted during GLOF-II project and it aims to empower local communities to identify and manage risks associated with GLOF as integral part of climate change debate. It also helps strengthen public services to lower the risk of disasters related to GLOF, and provides roadmap for the improved community preparedness and disaster response. The strategy also outlines the need for review of the existing implementation plans of GB Government vis-à-vis Climate Change

Box-1. Greenhouse Effect

A phenomenon through which the GHGs (carbon dioxide, methane, and nitrous oxide etc.) together with water vapor trap radiation from the sun, preventing it from dissipating back into space. The Greenhouse effect keeps the Earth's average surface temperature at 15°C. Without it, the average temperature of earth would slash down to an inhospitable -18°C. Global Warming is attributed to the high concentration of these GHGs in the atmosphere. Climate data from the year 1880 to 2012 show a successive increase of 0.65 °C to 1.06 °C in global temperatures.

(IPCC, 2014: Climate Change Synthesis Report)

related risks. This means adding practical steps and allocation of resources to address climate change with GLOF as its integral part.

This strategy document works as a key instrument to help the GB-EPA to partner with line departments and other stakeholders in executing the actions in the province for the larger benefit of the communities

The complex nature of causes and effects of climate change transcend many sectors and thus requires synergies among sectors facilitated by GB climate change strategy and action plan. This shall ensure the strengthening of human and institutional capacities to adapt and make the region climate change resilient in the longer run. The Government of GB is committed to take measures for sustainable development of the region. This Strategy reaffirms its commitment to create an important vehicle for collecting and disseminating target-specific adaptation and mitigation actions and to secure the region from the adverse impacts of climate change.



2. Gilgit-Baltistan and Climate Change

GB has one of the most spectacular landscapes of the world. The three mightiest and geologically active mountain ranges in the world—the Hindu Kush-Karakoram-Himalaya (HKH) confluence in the area. Towards the west of GB lies the eastern Hindu Kush, towards the north and east stands the Karakoram Range; and the western Himalaya stands in GB's southern parts.

GB is spread over an area of 72,971 square km, nearly half of which contains mountain peaks, glaciers, lakes and highlands. There are 14 mountain peaks above 8,000 m (known as 'eight thousander's) in the world, of which five (05) are found in GB. More than 50 peaks above 7,000 m stand within a radius of 500 km in the region. A vast glacial area spread over 15,000 square kilometers comprises of at least 5,000 big and small glaciers, including three of the world's longest outside the polar region (Biafo, Baltoro and Batura). There are nearly 3,000 big and small glacial lakes; out of which at least 36 are considered to be unsafe and they are on the verge of an outburst in different parts of the region. Although, the three major mountain ranges in GB considerably differ from one another, one common feature is the complexity of their topography. A crucial feature of GB is that its mountain ecology and socio-economic systems are strongly inter-dependent. Any imbalance on either side can jeopardize this delicate relationship between human beings and the nature.

The region is one of the highly glaciated areas in the world and it is extremely sensitive to climate change. The volume of ice in a glacier, its surface area, thickness and its length is determined by the balance between input (snow and ice) and outputs (melting and calving). These factors are regulated by temperature, humidity, wind speed and slope. As climate change occurs, this balance may deteriorate, resulting in change in thickness and the advance or retreat of the glaciers. In general, the retreat or receding of glaciers due to the rapid rise in temperature results in the formation, expansion and merging of glacial lakes behind the unstable moraine. These lakes, formed on an unstable moraine, accumulate large amounts of water and they burst under their own weight causing a GLOF event. These impending GLOF events can release millions of cubic meters of water and debris, leading to the loss of lives, property and livelihoods amongst remote and impoverished mountain communities. Out of its total population of 1.8 million, over 480,600 people are now vulnerable to disasters in Gilgit-Baltistan which constitutes 26.7% of total population of the area.

Glaciers in several regions of Asia have been retreating since 1950, including the mountain glaciers of GB. Empirical evidence indicates that 30% to 50% of existing mountain glacier mass could disappear by 2,100, if global warming scenarios in the range of 2-4 °C occurs. For every 1°C increase in temperature, the snowline on mountains shrinks by about 150 m. The smaller the glacier, the faster it will respond to changes in the climate. Shrinking glacial mass will lead to drastic changes in hydrology of mountain regions – as glaciers melt rapidly, they provide enhanced runoff, but as the ice mass diminishes, the total runoff/water flow will reduce to minimum. This occurrence will result in severe consequences to the highlanders in terms of vegetation, pastures, agriculture, hydropower energy and biodiversity including mountain communities of Gilgit-Baltistan.

The impact of climatic change on hydrological characteristics are likely to have significant repercussions not only on GB but also mainland population that depend heavily on mountain water

resources for domestic, agricultural, energy and industrial uses. Seasonal shift in precipitation and increasing temperatures may alter the agriculture patterns and practices.

The prevalent hydrological regime in GB, is greatly responsible to the supply of water to the rest of the country. Significant shift in climatic conditions will have severe effects on social and economic systems throughout country owing to the changes in quantity and quality of water.

The mountainous communities of GB are heavily dependent on natural resources in mountainous terrain and are vulnerable to the changing climatic patterns which have effects on its built environment, lives, livelihood and economy. The expected changes in mountain systems of GB could be the cause of increased hydrometeorological disasters, variations in water flows in streams and rivers, increased temperatures and shift in precipitation levels. Such changes may cause damages to roads and other infrastructures, reduced crop production and droughts, loss of human life and livestock, incidence of diseases and shift in spatial and temporal distribution of vegetation in alpine pastures. The additional risk associated to climate change has increased the maintenance cost of physical infrastructure thus consuming a bulk of the development budget.

Figure 1: Map of Gilgit-Baltistan



Furthermore, GB relies on subsistence agriculture, has low level of economic activity and has limited access to social services. The fallouts resulting from climate change will exacerbate its existing problems. This climate change strategy and action plan will address these fundamental issues of GB, so as to minimize the impacts of climate change.

2.1. GLOF and Climate Change

It is estimated that with the rise in temperature the melting of glaciers in the Hindukush, Karakoram and Himalayan regions has created 3,044 glacial lakes. Though all these glacial lakes pose potential

risks to the life and livelihood of the mountain communities but 33 of them are considered highly hazardous and they are likely to unleash devastation in the form of GLOF. Depending upon their potential of disaster, more than 50 percent of these lakes pose immediate or distant threats to the lives and livelihood of the mountainous communities.

GLOF will not bring about human casualties only in the narrow gorges of GB but it will also damage physical infrastructure including settlements, roads, farmlands, orchards, forests, cattle-sheds, water mills, bridges and hydro-power stations. Even if these structures are not directly affected by GLOF, they will become exposed to high risk due to the active landslides after the GLOF-induced land erosion, and caving in of surrounding or adjacent land.

Hence it is important that both mitigation and adaptation become an integral part of GLOF risk reduction though they may be not mutually exclusive. Mitigation measures are devised to address the root cause of GLOF phenomenon i.e. actions to reduce the pace of melting of glaciers in the long run. It requires regional and international commitments to reduce carbon emissions and long term national planning to overcome deforestation and desertification. Adaptation is about reducing the adverse impact of GLOF or other forms of disasters at the local level which calls for local action to minimize the vulnerabilities of downstream mountain communities. Full-scale mitigation interventions on potentially disastrous glacial lakes is very expensive – it is estimated that mitigation work on a glacial lake costs more than \$3 million on average. When there are more than 3000 such glacial lakes in the mountainous regions of the Himalayas, Hindukush and Karakorum, it would not be prudent to suggest mitigation work. Physical mitigation work on this increasing number of lakes is imprudent if not humanly impossible for a country like Pakistan. Therefore, the best strategy to effectively minimize the adverse impact of GLOF in the mountainous regions must entail a comprehensive early warning system and enhanced preparedness, elaborate awareness raising program as well as technology intensive and cost-efficient adaptation measures.

2.2 Observed Climate Changes

The thirty-year (1984–2013) climate data containing records for mean monthly minimum and maximum temperature; and precipitation level for Gilgit, Skardu, Astore, Chilas and Gupis from 1984 to 2013. From the aggregate temperature data for GB, it was observed that the yearly spread and variation in maximum and minimum temperatures have remained significant. The aggregate precipitation data shows that the region receives most of its precipitation during the months from February to May.

The following graphs show the observed trends in temperature and precipitation levels in five urban centers in GB over thirty-year period (Figure 2).

The data for the thirty years of the five urban centers would not be sufficient to draw a conclusion on the pace of climate dynamics at higher altitudes and glaciated areas which represent 30% of GB. Decreasing precipitation levels, shift in the seasons, increasing hydrological flows, frequently occurring GLOF events and retreating glaciers, increasing frequency and magnitude of natural disasters could be the key indicators of climate change.

For now, it is established that the glaciers in the HKH ranges have absorbed more heat compared to the plains during the last half century. As observed in the illustrations below, an increase of 0.18 °C per decade in average temperature of five weather stations was recorded from 1984 to 2013. Within

the same time period a decrease of -1.9 mm per decade in total annual precipitation can be observed. A decreasing trend in precipitation of September, October and November and increasing in January and February from 1984 to 2013 can be observed below (Refer Annexure – A).

Figure 2: Average Annual Temperature & Total Annual Precipitation of Five Weather Stations

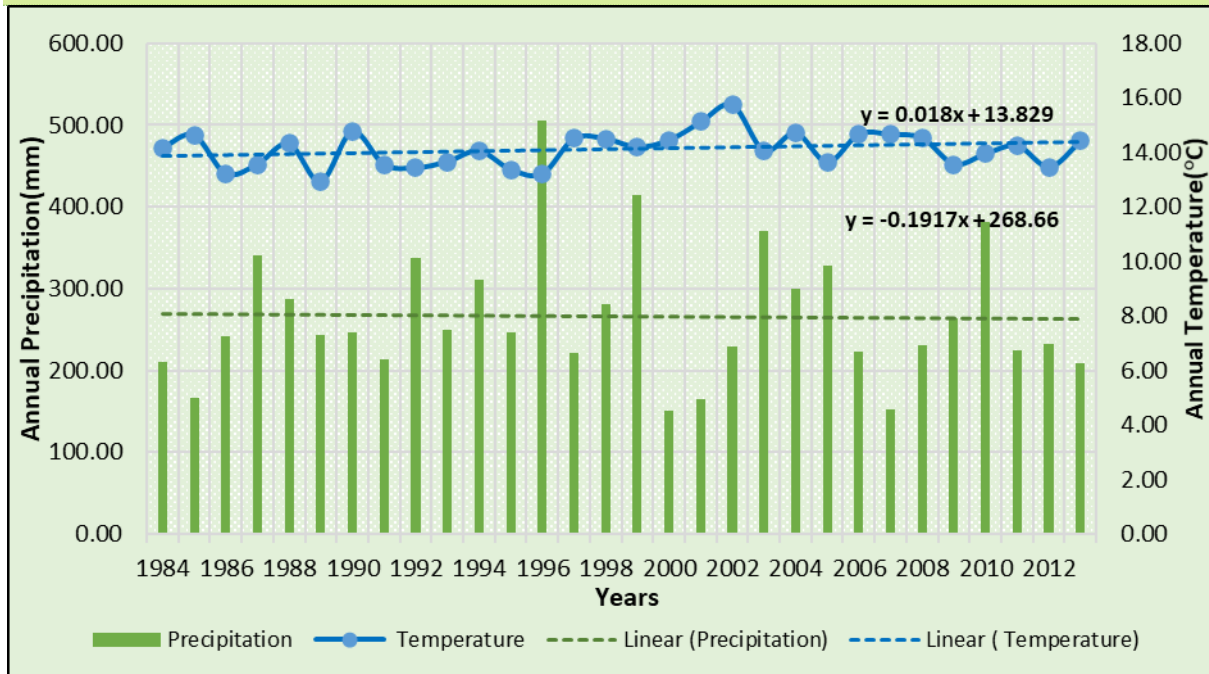
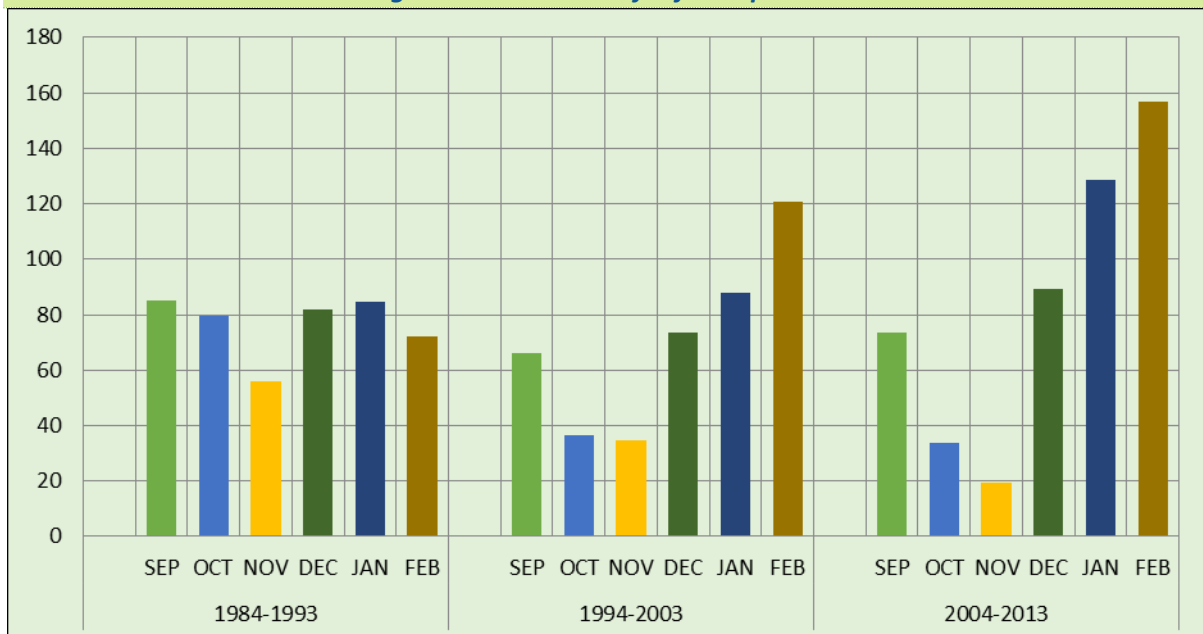


Figure 3: Seasonal Shift of Precipitation



2.3 Nature of Climate Hazards

The intensity and frequency of climate hazards and extreme climate events appear to have increased in GB during the past few decades. This includes floods, landslides, GLOFs and avalanches around the HKH. Pakistan is 8th most vulnerable country to the impacts of climate change rated by German Climate Watch.

Table 2: Climate Changes related Impacts on Pakistan

CRI 2000-2019 (1999-2018)	CRI Score	Fatalities	Fatalities / 100,000	Total loss USD millions	Losses per unit GDP in %	Number of events
8 (5)	29.00	502.45	0.30	3771.91	0.52	173

Source: Global Climate Risk Index (2021)

A brief description of climate change disasters that occurred in recent years and their impacts is presented in Table-3.

Table 3: Recent Climate Change Disaster in GB

Hazard Type	Events/Loss	Vulnerable Areas/Groups
Landslides	<p>Frequent landslides in deep valleys: Frequent landslides occur due to heavy rain in deep valleys of the region.</p> <p>2016 landslides on KKH: KKH and different roads in Gilgit-Baltistan were closed at 175 points due to landsliding</p> <p>January 2010, Attabad landslide disaster: A cracked mountain at Attabad slid down into Hunza river creating 25km long lake taking 20 lives and thousands displaced.</p>	<p>Remote villages across the region: Frequent landslides cause damage to the lands and property of communities living in remote villages of all districts across the region</p> <p>Protracted blockade of KKH: Causes severe social problems including shortage of food and essential medicines in GB</p> <p>Upper Hunza: Attabad village was completely devastated with debris whereas six of small villages and 25km of KKH was totally submerged into newly formed lake.</p>
Avalanches	<p>April 2012, Gyari sector: Near Siachen Glacier; 70 feet of snow engulfed a military base taking the lives of 129 soldiers and 11 civilians.</p>	<p>All areas situated near the seasonal snow cover areas are vulnerable to avalanche phenomena.</p>
Flash Floods	<p>August 2010, Pluvial and Flash Floods: Due to heavy rain in different areas of GB; 122 people dead; 60 injured; 1,230 houses damaged; 12,300 displaced in the region.</p> <p>Ghizer: Dozens of villages devastated in the Tehsils of Yasin, Punial and</p>	<p>All groups and population adjacent to natural streams and along the rivers banks are vulnerable to floods. Roads and infrastructure, power generating stations; and irrigation channels and drinking water supply systems have frequently been hit by flash floods.</p>

	<p>Ishkoman; Heavy casualties in Diamir; and Skardu and Ghanche districts of Baltistan</p> <p>July 2015, Khaplu, Ghanche, Baltistan: The area was hit by devastating floods caused by the heavy melting of glaciers in the summer season. Score of people died and loss of property and land. Damage to 42 power stations across the region</p>	
GLOF	<p>2014 & 2015 Bagrote Valley, Gilgit: The area was hit by multiple GLOF events in 2014 and 2015 that caused huge damage to livelihood and infrastructure.</p> <p>Khanday, Baltistan: GLOF events devastated the Khanday village in Baltistan causing huge damage to the area</p> <p>Gojal, Hunza: Three glacial lake outburst floods (GLOFs) have hit three villages - Passu, Ghulkin and Hussaini-- in Gojal Tehsil, upper Hunza damaging properties, livestock, orchards and disrupting trade and traffic on Karakoram Highway almost every year.</p>	<p>Bagrote Valley, Gilgit: Bagrote valley has witnessed various GLOF events in the current decade and many glacial lakes are reported in the area thus making the valley vulnerable to the GLOF phenomena.</p> <p>Khanday, Baltistan: Most of the area along Khanday Nallah is vulnerable to GLOF.</p> <p>Gojal, Upper Hunza: The area has highest density of glacial lakes, some of which are at the verge of burst. The vulnerability is high due to the fact that KKH is passing through the glacial area and villages are very close to the glaciers.</p>

The most frequent type of natural disasters occurring in the area is avalanches usually followed by wind and snow storms. There have been a number of unreported disasters particularly in the form of GLOFs in GB some of which were even of higher scale and intensity than the reported events of disaster. It is therefore, always hard to estimate the actual magnitude and the damage caused to infrastructure and social systems. An inventory of all the major climate triggered hydrometeorological disasters in GB needs to be maintained that shall also serve the purpose of monitoring and formulating the risk assessments for future development.



Following are few images of hazardous events that have occurred in the region in recent years.



In April 2012, an avalanche hit a Pakistani Military Base in Gyari Sector, near the Siachen Glacier region, trapping 140 soldiers and civilian contractors under deep snow; later found dead.



A massive landslide blockaded Hunza river at Attabad creating 25 km long lake back in 2010. At least five villages and KKH was submerged upstream. About 20 were killed and thousands were displaced.



Scene of landslide on KKH.



People stranded due to blockade of KKH during March 2016.



3. Framework for Strategy and Action Plan

The broader parameters of climate change strategy and action plan for Gilgit-Baltistan are framed in context of the unique geographical placement, demographics and environmental conditions of the region. They are guided by the national policy framework as well as Pakistan's commitments under international agreements on climate change. Following is a brief review of the applicable legal and policy frameworks.

In 1997, Pakistan Environmental Protection Act (PEPA-97) was promulgated to provide for the protection, conservation, rehabilitation and improvement of environment, prevention and control of pollution, and promotion of sustainable development. The PEPA-97 was extended to GB in 2001. As a result of this Act, the Gilgit-Baltistan Environmental Protection Agency (GBEPA) was created in 2007 with a mandate to oversee the environmental issues in the region. Following the enactment of Gilgit-Baltistan (Empowerment and Self-Governance) Order, 2009 and 18th Amendment in the constitution of Islamic Republic of Pakistan in 2012, GBEPA developed Gilgit-Baltistan Environmental Protection Bill, which was approved by the GBLA in 2016 and it is effective as an Act throughout GB since then. The GBEPA conducts environmental reviews in implementation of the Act in the region.

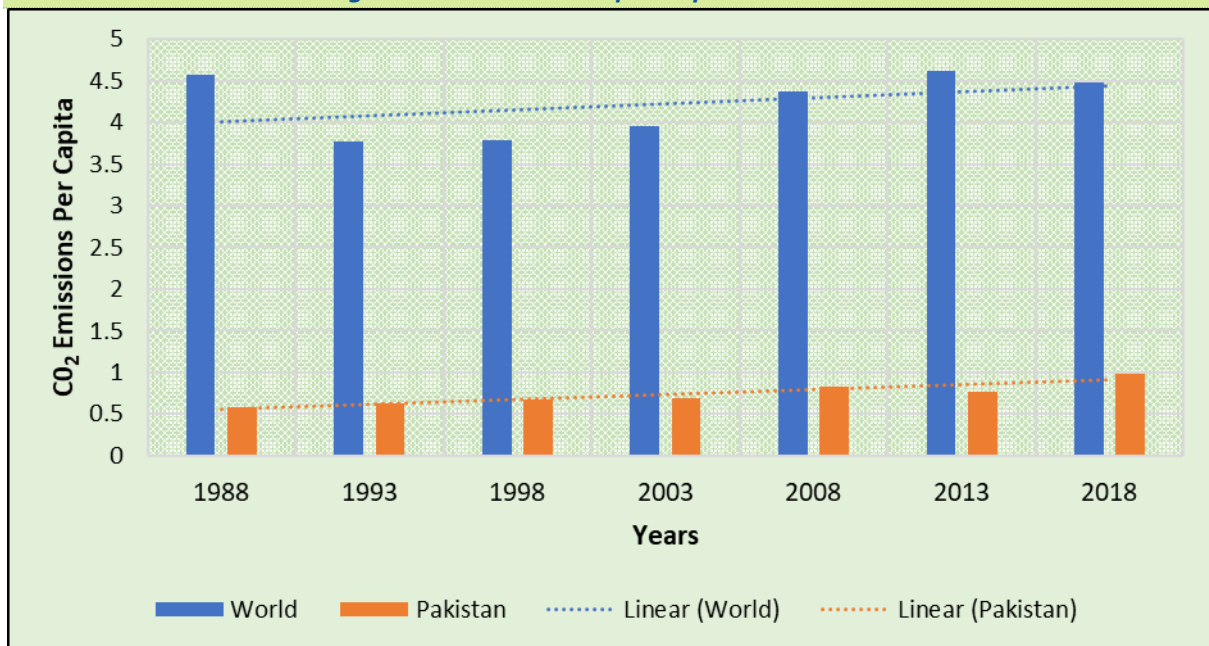
The UN Convention on Climate Change and its protocols establish international treaties to stabilize Greenhouse Gas concentrations in the atmosphere at a level that will not disturb the natural balance in the earth's climate system. Pakistan signed the United Nations Framework Convention on Climate Change (UNFCCC) as a non-Annex-I Party in June 1994. It subsequently adapted the Kyoto Protocol in 1997 and ratified it in January 2005.

In appreciation of the above commitments and realizing the importance of environmental protection and climate change, Pakistan announced and implemented the Clean Development Mechanism (CDM) Operational Strategy in 2005 as a signal for its entry into the global carbon market. The country then developed its first National Environmental Policy in 2005 with the overall goal to protect, conserve and restore Pakistan's environment in order to improve the quality of life of the citizens through sustainable development.

In 2012, the "National Climate Change Policy" was promulgated with the overarching goal to make the country climate change resilient through mainstreaming climate change in the vulnerable sectors of the country. In 2014, the Federal Ministry of Climate Change developed a framework for the implementation of "National Climate Change Policy" at the provincial and regional levels. This framework requires that all the provinces and regions may develop their own comprehensive Climate Change Strategies and Action Plans. In addition, the Climate Change Act, 2016 that has been recently approved by the Parliament aims to speed-up measures needed to support and implement climate actions in the country. The new law establishes a policy-making Climate Change Council, along with a Climate Change Authority which in collaboration with the provincial governments will prepare and supervise the implementation of projects to help Pakistan to adapt to climate impacts and to put a bar on carbon emissions.

GB climate change strategy and action plan 2017 thus steers through the policy guidelines provided by National Climate Change Policy of Pakistan and its implementation framework.

Figure 4: CO₂ Emissions per Capita 1988 - 2018



Source: Data is sourced from Carbon Dioxide Information Analysis Center, United States. Data can be accessed from <https://data.worldbank.org/indicator/EN.ATM.CO2E>.

GHG emissions of Pakistan are 0.9 tons of CO₂ emissions per capita. This is much lower when compared to the current global average of nearly 5 tons. Yet the country has committed to reduce its carbon emissions by 30% in the next ten years as part of 'Intended Nationally Determined Contributions' (INDCs) towards the reduction of GHGs and mitigation of climate change.



4. Scope and Guiding Principles

The broader objective of this strategy and action plan is to *‘mainstream climate change mitigation and adaptation aspects into future development planning in Gilgit-Baltistan’*. The aim is *‘to take possible mitigation and adaptive measures, improve climate resilience among vulnerable population, undertake participatory enhance resource planning and strengthen institutional mechanism to minimize the adverse impacts of climate change through whole of society approach’*. The scope of this Climate Change Strategy and Action Plan is tailored to address the challenges in the wake of growing concerns for dealing with the impacts of global phenomena - climate change. Typical of a highly mountainous region, the environmental systems of GB are highly exposed to hazards resulting from rising temperature, melting glaciers and unpredictable variations in precipitation levels. Emissions from transport and firewood burning are the main sources contributing in GHG emission in GB. They have reciprocating effects in summers where transport sector is dominant due to tourist influx and in winters firewood emission prevails to cope with the freezing temperatures. Specific measures are needed to be taken to secure the region from the catastrophic impacts and severity of climate change. In order to address these challenges, strategy and action plan for each key sector and thematic areas in GB, including water & power, irrigation, drinking water and sewage, agro-biodiversity (agriculture & livestock) and fishery, forestry and rangeland, disaster management, food and fuel security, biodiversity and wetlands, mountains and glaciers, public health; transport sector; and migration remittance and adaptation have been presented. This strategy is based on the following guiding principles Mainstreaming Climate Change into Policy and Development:

Recognizing the need for prioritization of climate change issues in the context of GB’s vulnerabilities by integrating and mainstreaming it in strategies, plans and sectoral development processes.

Adaptation to Climate Change Impact:

Recognizing and accepting adaptation as a sole option to protect the region and people from the impacts of climate triggered natural disasters and shifting weather patterns, adaptation will be the main focus of the strategy.

GB Specific and Area Driven Climate Change Interventions:

Recognition of GB’s vulnerability and risks associated with climate change and to seek a response tailored for local conditions to effectively and efficiently mitigate and adapt to climate change. For instance, integration of GLOF as a unique theme to recognize as one of the context specific phenomenon of increasing vulnerabilities helps design well-informed and effective interventions

Sustainability and Environmental Stability: Recognition of the need to maintain resource sustainability in GB coupled with environmental stability.

Stakeholder Participation in Climate Change Policy Implementation: Recognition of importance of meaningful participation in the planning, development and implementation of climate change actions at local and grassroots level, ensuring participation of all stakeholders including communities, civil society, women, children and other vulnerable groups and application of local/indigenous knowledge for adaptation. Give due consideration to vulnerable groups in disaster management plans including; female and child headed households, old aged people and people with

disability, as they are most vulnerable during disaster events. To ensure that the communities in Gilgit-Baltistan are safe from the natural disasters resulting from the frequent landslides, floods and avalanches; that the human, social and capital loss is minimized in the event of such disasters in Gilgit-Baltistan; that the poorest and most vulnerable in the society, including women children and elderly, are protected from the devastations.

Guided by the above principles, the sector-wise strategies review the challenges and propose overall strategic objectives for that sector to counter climate change impacts, to be achieved in short, medium and long term. The action plan presents specific adaptation and mitigation measures needed to be taken in each of the seventeen thematic areas, in which infrastructure resilience, capacity building, institutional planning and stakeholder's participation are the key cross cutting themes. For each objective and set of corresponding strategies and actions, the implementing line department(s) and agency has been identified. The time horizon for each strategy objective and action plan has been set for Short Term (2021-2024), Medium Term (2021-2028) and Long Term (2021-2031).



5. The Climate Change Strategy and Action Plan of Gilgit- Baltistan

The following strategies, objectives and action plans in each of the 17 thematic areas are proposed for the adaptation and mitigation of climate change in Gilgit-Baltistan.

Theme- 1: Infrastructure Resilience

Infrastructure and built environment is the key sector that can be severely hit by potential climate change related disasters. Securing the infrastructure and enhancing its resilience is therefore important not only in reducing risk of human casualties but also in supporting the capacities of communities to reduce the overall damaging impacts of climate change. GB is comparatively a sparsely populated region with total population of nearly 1.5



A village in Gudai, Astore (Imran Shah)

million and a population density of nearly 20 people per square kilometers. Gilgit and Skardu are the major urban cities where nearly 20% of the population is residing. The majority of people live in nearly 1,000 big and small villages. The process of urbanization is comparatively slow and the built infrastructure is therefore scattered across the region and remains highly vulnerable to climate change impacts. Whereas the built infrastructure in towns is vulnerable, the buildings in rural and remote areas are equally prone to natural disasters. It is likely that extreme events as well as gradual changes in climate shall increase the vulnerability of built infrastructure in the region including transport and communication infrastructure, electricity and power, irrigation channels, water and sanitation systems, public and private buildings, hospitals, schools, places of worship, homes, animal dwellings, markets and commercial areas, hotels etc. Frequent disaster events such as unexpected torrential rains, GLOF, floods, landslides and avalanches cause huge damage to the built infrastructure and loss of property.

Special measures are needed to secure the built infrastructure from the climate change impacts at first and foremost. Secondly, there is need to amend the existing and/or make new building laws and codes for infrastructure. Moreover, hazard mapping and zoning is needed to be done for entire GB. Awareness and promotion of climate resilient construction practices have to be taken. The following strategies and action plan are proposed in order to promote infrastructure resilience in GB.

Objective T1.O1	To make laws to ensure climate resilient infrastructure and create an awareness on importance of infrastructure resilience
Aspect	Adaptation
Responsibility	Works Department, Local Government & Rural Development Department (LG&RDD), Gilgit Development Authority (GDA), Skardu Development Authority (SDA), Municipal Committees (MC's), District Administration, District Councils, Civil Society
Time Frame	Short Term (2021 – 2024)
Strategy T1.O1_S1	Making building codes and laws and run public awareness campaigns on infrastructure resilience
A. #	Actions
T1.O1_S1.A1	Develop building codes and laws by adopting and modifying the existing national and provincial ones. Amend existing codes and laws/rules to ensure that all building infrastructure is constructed using designs appropriate for climate resilience
T1.O1_S1.A2	Run public awareness campaigns to highlight the importance of infrastructure resilience particularly in hazard prone areas
T1.O1_S1.A3	Develop vulnerability-Index for major cities, towns and rural areas and make it public for awareness
T1.O1_S1.A4	Ensure capacity building of all the stakeholders with regards to infrastructure resilience.

Objective T1.O2	To enhance climate resilience of existing public and private sector building infrastructure
Aspect	Adaptation
Responsibility	Works and Education Department, GB
Time Frame	Medium Term (2021 – 2028)
Strategy T1.O2_S1	Upgrading the existing built infrastructure in public, private, NGOs and communities to ensure their climate resilience
A. #	Actions
T1.O2_S1.A1	Upgrade existing public sector buildings to enhance their resilience to natural hazards. The buildings include schools, colleges, hospitals, buildings under the use of government offices and all the rest of buildings in public sector
T1.O2_S1.A2	Encourage general public to upgrade and strengthen the reliance of buildings under their use including housing, animal sheds, mosques etc. technical support and awareness shall be provided by the Government.
T1.O2_S1.A3	Encourage the private and civil society and businesses to upgrade and strengthen the resilience of buildings under their use including markets, shops, private education institutions etc.
T1.O2_S1.A4	Upgrade the resilience of existing public infrastructure against the climate change hazards including hydropower projects, roads and communication networks, food storage depots and all the other kind of public infrastructure.
T1.O2_S1.A5	Build new structures i.e. residential, commercial and social at a reasonable distance from the traditional flood courses and the gorges with high risk of GLOF

Objective T1.O3 To undertake GB's hazard zoning to identify low risk areas for future use

Aspect	Adaptation
Responsibility	Works Department, LG&RD Department, GBDMA, NGOs, Private Sector, General Public. Research institutions/ academia
Time Frame	Long Term (2021 – 2031)
Strategy T1.O3_S1	Hazard mapping, zoning and identifying low risk areas for future land use
A. #	Actions
T1.O3_S1.A1	Make geological, seismic survey and EPA guidelines mandatory for any new construction site
T1.O3_S1.A2	Control construction in ecologically fragile and disaster prone areas
T1.O3_S1.A3	Identify low risk areas for future land use
T1.O3_S1.A4	Restore and conserve archeological sites for religious, aesthetic and recreational purposes
T1.O3_S1.A5	Make it mandatory for the INGOs and NGOs to consult works department for NOC before infrastructure development in hazard prone area
T1.O3_S1.A6	Conduct detailed geological survey of GB for better identification of hazardous areas

Objective T1.O4	To promote construction of climate resilient infrastructure and housing in rural areas
Aspect	Adaptation
Responsibility	LG&RD Department.
Time Frame	Long Term (2021 – 2031)
Strategy T1.O4_S1	Promoting construction of climate resilient infrastructure in public and private sector particularly in hazard prone areas
A. #	Actions
T1.O4_S1.A1	Identify technological and design innovations; and reinforcements for construction of climate resilient future infrastructure in public and private sector in GB
T1.O4_S1.A2	Develop standards and protocols in compliance to infrastructure resilience for rural areas
T1.O4_S1.A3	Design and construct special shelters in flood prone areas due to the downpour or GLOF as a rescue measure where applicable
T1.O4_S1.A4	Discourage and prevent the settlement of populations on river beds or near the nullahs as a safety measure against torrential flood damages, GLOF and other disasters
T1.O4_S1.A5	Discourage and prevent settlement at areas of vulnerable terrain
T1.O4_S1.A6	Conduct regular monitoring and follow-up of implementation of applicable rules and laws

Theme-2: Water and Power

Mountain glaciers and snow are main sources of water in GB, ice and snow melt water flows down through the streams. The water from the streams and rivers is diverted for agriculture, power generation and domestic use. Hydropower is the major source of electricity in the region, and the efficient functioning of water and power sector is thus essential to the regional economy. The climate change may have damaging impacts on water and power infrastructure. Efficient functioning of water and power sector, effective management, conservation of water resources and wise use of hydropower potential in GB is pivotal.

The current demand for energy in GB is more than 500 MW. Although there are more than one hundred operational hydropower stations in GB and several thermal stations that supply a total energy of nearly 150 MW, with suppressed load to about 65% population. The generation capacity of these stations peak during the summers when water flow in streams is high; this however reduces to minimum during the winters producing far below their installed capacity. The generation potential of hydropower in GB is more than 40,000 MW on Indus River, tributaries, sub-tributaries and streams. This hydropower potential is not yet harvested. There are sufficient numbers of hydropower sites that have been identified for immediate development, and low cost hydropower energy can become accessible to entire population of the region.



Waterfall in Naltar, Gilgit (Imran Shah)

Appropriate measures are needed to be taken to develop a comprehensive energy policy attracting the private sector to invest in the area; establish an independent power development board, establishment of regional grid and its connectivity with the national grid, minimize the transmission losses to the extent possible, effective operation and maintenance of existing hydropower stations.

Furthermore, appropriate design standards shall be ensured in construction and operation of hydropower projects ensuring resilience to the climate change hazards such as high floods, GLOFs etc. Following are the strategies and action plan for water and energy sector.

Objective T2.O1 To promote green growth in the energy sector	
Aspect	Mitigation
Responsibility	Water and Power Department, GB
Time Frame	Short Term (2021 – 2024)
Strategy T2.O1_S1	Giving preferential status to development and promotion of hydropower generation.
A. #	Actions
T2.O1_S1.A1	Carryout detailed survey for identification of hydropower potential sites in GB

T2.O1_S1.A2	Ensure incorporation of climate change impacts and water rights of locals while designing the hydropower infrastructure.
T2.O1_S1.A3	Develop mechanisms to support the Public Private Partnership in mobilizing, financing and enabling investments in hydropower projects
T2.O1_S1.A4	Encourage and promote updated energy technologies
T2.O1_S1.A5	Promote run of the river larger projects to meet the energy needs rather than constructing nullah based micro hydels stations which become exposed to GLOF and torrential floods
Strategy T2.O1_S2	Promoting development of renewable energy resources and technologies such as smart hydropower, solar and biofuel energy and incorporate it in building laws.
A. #	Actions
T2.O1_S2.A1	Undertake extensive survey to map other renewable energy potential in GB
T2.O1_S2.A2	Introduce investment friendly policy with incentives to attract private sector interest and investment in the renewable energy sector in GB
T2.O1_S2.A3	Develop mechanism to support the private sector investment in renewable energy projects and make sure its implementation through proper legislation
T2.O1_S2.A4	Develop and encourage indigenous low cost technology (renewable energy) through research and development (R&D) activities
T2.O1_S2.A5	Ensure participation of concerned officials in national and international renewable energy conferences/exhibitions to get low carbon emission ideas and techniques
Strategy T2.O1_S3	Promoting buildings design with solar panels for energy self-sufficiency, especially in public sector buildings and ensure its implementation through proper legislation.
A. #	Actions
T2.O1_S3.A1	Identify and introduce energy efficient building materials, designs and technologies
T2.O1_S3.A2	Initiate solar energy projects on pilot basis in GB
T2.O1_S3.A3	Promote enterprises to produce energy efficient products and ensure availability of the same in the local market;
T2.O1_S3.A4	Set appropriate building construction codes and laws consistent with local climatic conditions for energy conservation.

Objective T2.O2	To promote energy efficiency and conservation
Aspect	Mitigation
Responsibility	Water and Power Department, Works Department, NGOs, Private Sector
Time Frame	Medium Term (2021 – 2028)
Strategy T2.O2_S1	Ensuring quality management of energy production and supply, including reduction in transmission and distribution losses.
A. #	Actions
T2.O2_S1.A1	Design auditing of energy supply and transmission system to control distribution losses
T2.O2_S1.A2	Strengthen quality management system of energy production to improve efficiency
T2.O2_S1.A3	Devise a sustainable mechanism to effectively repair and maintain the operational hydropower projects in GB
Strategy T2.O2_S2	Improving energy efficiency in building and use of energy efficient electric

	appliances
A. #	Actions
T2.O2_S2.A1	Improve energy efficiency in buildings through standardized building and construction codes
T2.O2_S2.A2	Encourage and incentivize modification of existing building design for better insulation and energy efficiency
T2.O2_S2.A3	Incentivize the introduction of energy efficient products

Objective T2.O3	To strengthen the resilience of hydropower infrastructure
Aspect	Adaptation
Responsibility	Water and Power Department, GB
Time Frame	Long Term (2021 – 2031)
Strategy T2.O3_S1	Strengthen the resilience of existing and ongoing hydropower stations
A. #	Actions
T2.O3_S1.A1	Undertake hazard mapping and zoning of areas before construction of hydropower stations
T2.O3_S1.A2	Design hydropower projects with all the safety measures for hazard minimization considering the climate change and ensure its implementation during operation
T2.O3_S1.A3	Formulate guidelines for climate resilient design of hydropower projects and apply them as a pilot first and then take the scale up to ensure sustained power supply in case of extreme climatic events

Theme-3: Irrigation Water

GB has a complex network of irrigation water system that remains exposed to climate related disasters. Irrigation is the largest sector consuming water in the region and is strongly interlinked with arable land and food security. Water channels are constructed based on local wisdom and modern engineering techniques. However, water sector is confronted with a number of challenges. For example, due to huge variations in the stream flow and seasonal water shortages, the irrigation systems cannot be operated on the demand basis.

Moreover, large quantities of water on way from the source to the arable land is lost, in some cases, the losses are as high as 70%. The increasing amount of silt and sediment deposition in channels leads to decrease in the water carrying and conveyance capacity affecting the overall operational efficiency of irrigation system.

Water management is presently governed by 'water



A water channel in Gojal (Imran Shah)

customs' that are voluntarily followed by the members of the beneficiary community. This traditional system of water management may work well in specific circumstances but creates water inequalities between different valleys. Communities living in one water catchment have equal user rights on water though ownership rights may differ. It is important to develop a system of water governance and institutions that will allow fair distribution of water resources and replace water inequalities with regulatory rules by the government across the region. This can be materialized by creating water organizations at tehsil level and water boards at district level; and allow increased participation of water users in the design, development, operation, maintenance and financing.

Furthermore, water resource mapping will have to be conducted while introducing and adopting efficient design and construction of water channels and courses. Mapping of villages vulnerable to droughts and floods should be done; and take appropriate measures for, adaptation and resilience.

Objective T3.O1 To take appropriate measures and techniques for water conservation	
Aspect	Adaptation
Responsibility	LG&RDD, Agriculture and Water Management Department, Works Department, Development Authorities, Municipalities, Economic Transformation Initiative (ETI), AKRSP and LSOs
Time Frame	Short Term (2021 – 2024)
Strategy T3.O1_S1	Enhancing public awareness to underscore the importance of conservation and sustainable use of water resources.
A. #	Actions
T3.O1_S1.A1	Prepare water management strategy for Gilgit-Baltistan
T3.O1_S1.A2	Rationalize gross water availability estimates
T3.O1_S1.A3	Improve current irrigation water conveyance systems and practices to reduce water loss
T3.O1_S1.A4	Demonstrate and implement area specific High Efficiency Irrigation System (HEIS) at district level and promote such technologies in private sector
T3.O1_S1.A5	Revisit the existing cropping patterns to conserve maximum water throughout the region
T3.O1_S1.A6	Facilitate water efficient technology transfer to subsistent farmers by giving them trainings, incentives and subsidies etc.
T3.O1_S1.A7	Ensure irrigation water pricing for generating the financial resources for the sustainability of irrigation infrastructure
T3.O1_S1.A8	Facilitate and provide guidelines to NGOs for adapting right policies on water management

Objective T3.O2 To develop and implement integrated water resource management (IWRM) plan	
Aspect	Adaptation
Responsibility	Works Department, Agriculture and Water Management Department, ETI, AKRSP and LSOs
Time Frame	Medium Term (2021 – 2028)
Strategy T3.O2_S1	Ensuring water allocations are made according to changes in sectoral demands
A. #	Actions
T3.O2_S1.A1	Undertake a study to estimate the impacts of climate change on water demand for irrigation and domestic use; and on water availability in glacier-fed micro irrigation systems

T3.O2_S1.A3	Establish an inventory of water resources and develop a database for knowledge management and disseminate information through information and communication technology (ICT) across GB.
T3.O2_S1.A4	Encourage community participation and empowerment in planning, implementation, monitoring and operation & maintenance of irrigation water systems.
T3.O2_S1.A5	Give priority to water allocation for drinking purposes over other uses.
Strategy T3.O2_S2	Identify the areas that are prone to water stress and drought, and adopt appropriate mitigation measures.
A. #	Actions
T3.O2_S2.A1	Assess the vulnerability of water stressed and potential drought areas; and estimate the changes in the gross regional water availability due to climate change.
T3.O2_S2.A2	Chart out ways for mitigating such risks and provide alternatives to rehabilitate drought and water stressed areas.
Strategy T3.O2_S3	Protect watershed areas and water channels from silting and contamination
A. #	Actions
T3.O2_S3.A1	Identify the processes for rectifying contamination and degradation of watershed channels and overall irrigation systems by engaging local community organizations and relevant government departments
T3.O2_S3.A2	Design water quality conservation and protection plan for specific watersheds
T3.O2_S3.A3	Identify local community leaders to support and implement a regional water quality plan
T3.O2_S3.A4	Provide incentives to local population living in watershed areas to ensure plantation, vegetation and management through their participation

Objective T3.O3	To strengthen the resilience of irrigation water infrastructure
Aspect	Adaptation
Responsibility	Agriculture and Water Management Department, Works Department, ETI, AKRSP, LSOs Local Communities.
Time Frame	Long Term (2021 – 2031)
Strategy T3.O3_S1	Strengthen the resilience of irrigation water channels and reservoirs
A. #	Actions
T3.O3_S1.A1	Undertake hazard mapping and zoning of areas before construction of water infrastructure like irrigation water channels, storage tanks and reservoirs etc.
T3.O3_S1.A2	Reinforce the existing water channels by structural changes using engineering and bio-engineering techniques
T3.O3_S1.A3	Design new water irrigation channels by integrating climate resilience, HVRA studies and engineering feasibilities in order to protect the infrastructure from climate triggered disasters like floods due to torrential rains and GLOF



Theme-4: Drinking Water and Sewage

Glaciers and snow deposits are vulnerable to the impacts of climate change. The melted water from glaciers and snow enters streams, which subsequently feed man-made channels that bring water into the settlement for agriculture use, domestic requirements and livestock. Conventionally rural areas depend mainly on the irrigation channels for the



Safe drinking water supply (AKDN.ORG)

supply of water for domestic purposes and livestock usage. Water from the dug pits generally reserved for drinking and cooking purposes. Water availability during winter is minimum, due to reduced snow and glacier-melt, which affect the quality of stored water. In summers the water is replenished more frequently.

Improved water supply system has been designed by GDA using River Bank Infiltration Technique to the left bank areas of Gilgit city from Sakarkoi to KIU with additional water treatment system at higher elevation and subsequent distribution through gravity. Urban centers including Gilgit, Skardu and secondary cities receive clean water that is supplied through pipes from a central water storage system which is continuously fed from the nearest natural stream. There is need to promote access to safe drinking water and sewage facilities and ensure proper maintenance involving the beneficiaries of these schemes, create awareness among communities particularly in disaster prone areas to conserve water as much as possible and also promote mechanisms for reuse and recycling of wastewater.

Furthermore, identification and mapping of drinking water and infrastructure needs in areas that are prone to the impacts of climate change and suggest appropriate measures.

Objective T4.O1 To promote access to safe drinking water and ensure maintenance of water supply systems.	
Aspect	Adaptation
Responsibility	LG&RD Department, Works Department, GDA, SDA, WASEP and Local Communities
Time Frame	Short Term (2021 – 2024)
Strategy T4.O1_S1	Enhancing access to safe drinking water and sustainable operation & maintenance of water supply systems.
A. #	Actions
T4.O1_S1.A1	Ensure supply of drinking water and proper operation and maintenance of water supply systems particularly in major cities, urban and semi urban areas
T4.O1_S1.A2	Improve access to safe drinking water in rural areas, particularly the hazard prone areas
T4.O1_S1.A3	Strengthen water supply system and sewage; and ensure provision of safety measures against hazards and climate change risks

Objective T4.O2	To promote domestic and drinking water conservation techniques and technologies
Aspect	Adaptation
Responsibility	LG&RD Department, Works Department, GDA, SDA, WASEP and Local Communities
Time Frame	Medium Term (2021 – 2028)
Strategy T4.O2_S1	Developing and extending technologies and techniques for saving domestic and drinking water
A. #	Actions
T4.O2_S1.A1	Promote domestic and drinking water conservation techniques and technologies
T4.O2_S1.A2	Promote installation of water meters to check the indiscriminate use of drinking water supplies
T4.O2_S1.A3	Develop and enforce 'drinking water quality standards'
T4.O2_S1.A4	Promote cost effective and appropriate technology options for water supply systems

Objective T4.O3	To develop wastewater and sewerage treatment systems in urban settlements
Aspect	Adaptation
Responsibility	LG&RD Department, Works Department, GDA, SDA, WASEP and Local Communities
Time Frame	Long Term (2021 – 2031)
Strategy T4.O3_S1	Developing system for treatment of wastewater and sewerage particularly in urban settlements
A. #	Actions
T4.O3_S1.A1	Identify the sources and estimate the amount of wastewater available for recycling in major towns and urban areas
T4.O3_S1.A2	Design appropriate, cost effective and environment friendly wastewater treatment plants for sewage systems in major towns
T4.O3_S1.A3	Demonstrate wastewater reuse and recycling in water stress areas
T4.O3_S1.A4	Install water quality measuring equipment near all water reserves to ensure water safety
T4.O3_S1.A5	Make appropriate wastewater treatment facilities integral part of all development projects



Theme-5: Agriculture

Agriculture production is strongly linked with the seasonal and long-term variations resulting from climate change. GB has nearly 2% cultivable land out of its total area of 72,971 Km². More than 80% population engages in subsistence farming by which cereal crops, fruits, vegetables and fodders for livestock are produced. Wheat, Maize and Barley as basic food staple for human population and fodder for livestock are major part of



Agricultural activity in Chapursan, Gojal (Imran Shah)

rural economy. During winter cropping season, 70% of cultivable land is devoted to growing wheat or barley followed by maize. Fruits and nuts are widely grown throughout the region, including cherries, mulberries, apples, apricots, pears, grapes, plums, walnuts and almonds. Most of which is used for domestic consumption and the surpluses are either dried or wasted. Vegetables such as tomatoes, beans, peas, onions, carrots, turnips, capsicums, spinach, potatoes etc. are also produced. Cash crops like potatoes and peas have been commercialized and are being exported to down country and abroad. Exportation of fresh fruits and dry fruits processed and semi-processed is increasing with the passage of time due to the fact that government has facilitated the system and NGOs also assisted the farmers.

Due to harsh mountainous geography and fragile balance of ecosystem, Gilgit-Baltistan may not be suitable for intensive farming practices involving use of high yielding varieties and high inputs of fertilizers, herbicides and pesticides. Environmental friendly, modern and ecologically suitable ways of farming will help the region counter the climate change effects.

Objective T5.O1	To enhance the understanding of climate change issues by farmers and agricultural stakeholders in order to make informed decisions
Aspect	Adaptation
Responsibility	Agriculture Department, GBEPA, AKRSP, LSOs and communities
Time Frame	Short Term (2021 – 2024)
Strategy T5.O1_S1	Dedicate a section in agriculture department to devise adaptive strategies for projected impacts of climate change on agriculture.
A. #	Actions
T5.O1_S1.A1	Dedicate a section on climate change at agriculture department
T5.O1_S1.A2	Establish meteorological and cropping information hubs in major towns
T5.O1_S1.A3	Streamline information flow through agriculture extension services for climatic conditions and related crops
T5.O1_S1.A4	Undertake awareness campaign among all stakeholders to give due importance to climate change impacts on agriculture
T5.O1_S1.A5	Involve farmers in policy formulation and strategic dialogues
T5.O1_S1.A6	Conduct review and harmonize existing legislations, policies and plans in

	agriculture sector to include climate change adaptation and mitigation measures
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Objective T5.02	To enhance crop productivity through improved irrigation & land management techniques
Aspect	Adaptation
Responsibility	Agriculture Department, ETI
Time Frame	Medium Term (2021 – 2028)
Strategy T5.02_S1	Improving crop productivity by increasing the efficiency of various agricultural inputs
A. #	Actions
T5.02_S1.A1	Promote research on innovative techniques in cropping patterns to enhance agricultural productivity under stressed water conditions.
T5.02_S1.A2	Train farming communities to promote irrigation water conservation techniques in disaster prone areas.
T5.02_S1.A3	Discourage the use of agriculture land for other purposes
Strategy T5.02_S2	Promote energy efficient farm mechanization to increase yield, while conserving water
A. #	Actions
T5.02_S2.A1	Ensure systematic mechanization of farming production processes that are based on energy efficient equipment.
T5.02_S2.A2	Increase yields while conserving water, train farmers to adapt innovative techniques and equipment that are locally adjustable.
T5.02_S2.A3	Promote tools and equipment that increase yields and save labor in all farming activities.
T5.02_S2.A4	Support the promotion and development of light weight agriculture machinery in the region.
Strategy T4.02_S3	Improve farm practices by adapting modern techniques
A. #	Actions
T5.02_S3.A1	Ensure improvement in cropping patterns and crop diversification with optimized planting calendar and promote the practice of laser land leveling to minimize water losses
T5.02_S3.A2	Introduce and promote contour farming, inter cropping system (ally cropping) and soil conservation techniques throughout the region

Objective T5.03	To build climate change resilience of agricultural sector
Aspect	Adaptation
Responsibility	Agriculture Department, GBEP, AKRSP
Time Frame	Long Term (2021 – 2031)
Strategy T5.03_S1	Develop a risk management system to safeguard against crop failures due to extreme climatic events
A. #	Actions
T5.03_S1.A1	Undertake hazard mapping of agricultural land that is prone to flash floods, GLOF, avalanches and land sliding
T5.03_S1.A2	Propose and promote locally acceptable measures, adaptation and mitigation strategies to cope with climate change impacts
T5.03_S1.A3	Involve the farming community to manage the local risk identification process and to devise the safeguard methods against the risks of flash floods, GLOF ,

	avalanches and land sliding
T5.O3_S1.A4	Promote climate change resilient crops that could survive both changes in temperature and precipitation, and still be high yielding and less prone to insect-pests
T5.O3_S1.A5	Recognize, identify and promote the complementarities of traditional food crops (e.g. barley, millets, beans and others, recently relabeled as 'Future Smart Foods') with existing staple crops for nutrition enhancement, climate change resilience and diversification of cropping systems.
T5.O3_S1.A6	Set programs for identifying and reclaiming agriculture land that is denuded due to impacts of climate change, especially plant river-beds and slopping lands with trees and shrubs.

Theme-6: Livestock

Livestock is an integral component of farming system in GB that is most likely to be rigorously impacted by climate change. They are particularly important to food security in local economy. Livestock account for nearly 40% of the household farm income, provide fertilizer for traditional farming. Animals such as bulls and yaks are still used in rural parts of the region as an alternate to

mechanization; they provide traction and horsepower.

Rangelands and livestock in Gilgit-Baltistan complement each other and thus constitute an integral part of rural economy. According to 2013 estimates livestock headcount, there are more than 1.6 million reared animals in the region. Cows, goats and sheep are the major part of livestock but a sizeable number of donkeys, buffalos, horses, mules, and yaks make out the list. Half a million of domestic poultry is also been used as source of eggs and protein. At higher altitudes, livestock rearers practice transhumant in which the households keep a primary home at lower altitudes where they live along with their animals for seven months. During winter where livestock is kept and feed on straw, hay and dry alfalfa. Problems arise due to acute shortage of fodder supply during late winters and early spring. Livestock during this period become thinner and under-nourished due to low nutrition value of dry fodder. On contrary, during summers the animals gain their optimum weight as they are taken to the mountain grazing lands and alpine pastures where they are very well fed on fresh grass and shrubs. This annual cycle of over-nourishment and under-nourishment in animals is a major cause of low milk, meat and wool production; as well as low immunity level of animals against viral and bacterial diseases. The provision of veterinary services is a challenge and is constrained by insufficient provisions of staff, drugs, equipment, and awareness of farmers; and seasonal movement of livestock to inaccessible places.



A shepherd boy with livestock in Diamer (Imran Shah)

Impacts of climatic changes are clearer at higher altitudes where alpine pastures do exist and are integral part of our rural livelihood. It is proved that the increases in temperature in the northern alpine zone is much higher than the plains and the subsequent impacts of temperature rise on the ecosystem at and above 3,500 meters is more obvious. The impacts reported are the upward shifting of snowline, diminishing vegetation, reposition of water sources and natural disasters that more frequently hit such areas.

Objective T6.O1 To improve the nutritional quality of livestock	
Aspect	Adaptation
Responsibility	Livestock Department, Wildlife and Forest Department
Time Frame	Medium Term (2021 – 2028)
Strategy T6.O1_S1	Improve and promote nutritional quality of livestock feed and its conservation techniques
A. #	Actions
T6.O1_S1.A1	At the farm level improve livestock feed quality by preparing supplements of Multi-Nutrient Blocks (MNB)
T6.O1_S1.A2	Design program to involve local communities to develop MNB locally or as near the rangelands as possible
T6.O1_S1.A3	Encourage and assist farmers to develop cost-effective livestock feed through “Silage Making” techniques and by using “Urea Treatment” from maize, rice and wheat low quality roughages
T6.O1_S1.A4	Minimize livestock impact on vegetation and crops in view of climate change projected stresses.
T6.O1_S1.A5	Improve storage system for feed and fodder in the areas which are more prone to impacts of climate change
T6.O1_S1.A6	Introduce drought resistant multi-cut varieties of feed and fodder

Objective T6.O2 To improve access to veterinary services	
Aspect	Adaptation
Responsibility	Livestock Department,
Time Frame	Medium Term (2021 – 2028)
Strategy T6.O2_S1	Improving veterinary services and access to livestock rearers in remote areas
A. #	Actions
T6.O2_S1.A1	Ensure access to veterinary extension services livestock rearers in remote areas
T6.O2_S1.A2	Improve existing veterinary facilities as a proactive approach towards livestock epidemics and ensure availability of veterinary medicines and services
T6.O2_S1.A3	Introduce mobile units dispensaries in remote areas
T6.O2_S1.A4	Conduct and encourage regular vaccination and deworming campaigns in thickly livestock populated areas
T6.O2_S1.A5	Conduct research on yak and goat breeds locally acclimatized for meat and milk purpose

Objective T6.O3 To develop and introduce better breeds of livestock	
Aspect	Adaptation
Responsibility	Livestock Department
Time Frame	Long Term (2021 – 2031)
Strategy T6.O3_S1	Developing and introducing climate resilient breeds of livestock

A. #	Actions
T6.O3_S1.A1	Initiate research on local livestock species-breed improvements especially of sheep and cow for production of beef, mutton and milk.
T6.O3_S1.A2	Promote indigenous livestock species through awareness, advocacy, incentives and pilot projects
T6.O3_S1.A3	Introduction of new foreign breeds through quarantine
T6.O3_S1.A4	Promote improved livestock prior to testing management skills and animal husbandry practices to increase the productivity of livestock
T6.O3_S1.A5	Promote construction of well built, safe and secure animal sheds to reduce loss of livestock in natural disasters
T6.O3_S1.A6	Introduce artificial insemination programs where breeding facilities are not available
T6.O3_S1.A7	Provide climate change adaptation trainings in the field of livestock

Theme-7: Fisheries

Variation in flow of water in the rivers and other water bodies is due to climate change that may impact the fisheries sector. Both exotic (6 all cultured) and local varieties (17 all wild species) of fish are found in the region. The exotic breeds include twenty different trout fish varieties. Major families of local fish species are Snow Trout, Loaches, Cat Fishes and



© Raza's Photography 2018
Handarap Lake in Ghizer (Asif Raza)

Bagridae. The indigenous/local breeds include four different

varieties of carp fish mostly found in the river water. Most of the fish are found in natural ponds, lakes and rivers. Government fishery department runs hatcheries where primarily the trout fish are cultured in ponds. The fishery department is also responsible to provide extension services in fish farming, as private and commercial fish farming is being popular among communities especially in Ghizer district. Fishing (trout fishing in particular) is done primarily as leisure and sport activity.

Trout fish being a bio-indicator of the health of aquatic ecosystem, it is sensitive to the water temperature fluctuation, turbidity, water quantity, dissolved oxygen and geological features of the water body. It is being impacted by increasing temperatures, uneven turbidity levels and contamination in water body.

Objective T7.O1	To design habitat preservation program for different varieties of fish
Aspect	Adaptation
Responsibility	Fisheries Department
Time Frame	Short Term (2021 – 2024)
Strategy T7.O1_S1	Conducting research to assess climate change impacts on fisheries and aquatic life

A. #	Actions
T7.O1_S1.A1	Monitor biological, chemical and physical properties of water on periodical basis for the existing and potential fishery sites
T7.O1_S1.A2	Monitor and report unusual fish migration/movement due to climate change or any other reason
T7.O1_S1.A3	Design an inventory/baseline data regarding aquatic resources in GB

Objective T7.O2 To design habitat preservation program for aquatic resources	
Aspect	Adaptation
Responsibility	Fisheries Department
Time Frame	Medium Term (2021 – 2028)
Strategy T7.O2_S1	Address climate change bearings on fish habitat.
A. #	Actions
T7.O2_S1.A1	Environmental Impact Assessment in all commercial fisheries projects and other hydro power projects.
T7.O2_S1.A2	Manage the existing natural habitat and identify new potential sites for introduction and propagation of fish and fisheries
T7.O2_S1.A3	Design and implement habitat preservation for indigenous fish fauna by establishing fish protected areas (sanctuaries and reserves).
T7.O2_S1.A4	Develop habitat management plans for commercially viable fish species
T7.O2_S1.A5	Encourage private fish farming practices through Public Private Partnership Schemes (PPPS)
T7.O2_S1.A6	Initiate the rehabilitation programs for degraded aquatic resources
T7.O2_S1.A7	Develop and propagate successful community based fishery conservation models

Objective T7.O3 To strengthen the resilience of fish farms and hatcheries infrastructure	
Aspect	Adaptation
Responsibility	Fisheries Department
Time Frame	Medium Term (2021 – 2028)
Strategy T7.O3_S1	Strengthening the resilience of all the built structures that contain fish and aquatic life
A. #	Actions
T7.O3_S1.A1	Stringent hatchery and fish farming site selection criteria be designed to avoid disaster, GLOF and flood prone areas.
T7.O3_S1.A2	The hatchery and fish farming built structure designs should be strong enough to withstand any potential disasters



Theme-8: Forestry

Forest plays a fundamental role and are said to be carbon sinks as they play pivotal role in reducing the impacts of climate change. They prevent soil degradation and erosion as well as are helpful in minimizing effects of flood and landslides.

GB's natural forests are considered to be most important in Pakistan. These forests protect the watershed of Indus River, support a rich biodiversity and serve as an important source of forage and



Coniferous forest in Chilim, Astore (Imran Shah)

pastures for the region's livestock population, contribute to supply of softwood, firewood and timber to the region and the country. They provide wildlife habitat and a good supply of medicinal herbs, spices, honey and mushrooms and have tremendous potential for recreation and ecotourism. Total natural forest cover in GB is nearly 4% of the total area. These forests are spread across the southwestern part of the region in Diamer district, in upper valleys of Astore, southern Gilgit, Punial district Ghizer, Chaprote and Bar valley in district Nagar and some pockets in Baltistan. The agro-forestry including the plants in arable areas constitute nearly 6% of the area spread across the region. A part of natural forests is owned by local communities of Chilas, Darel and Tangir and jointly managed by Gilgit-Baltistan Forest Department and is responsible for regulating commercial timber market. Forest in Haramosh and Sai are state owned forest but still is used for timber extraction.

Forests are under pressure of natural degradation and commercial exploitation. In addition, the population growth, poverty and subsistence cutting are some of the indirect causes of deforestation in the region. Poor forest management and planning, low institutional capacity, lack of community involvement and lack of enabling environment are responsible for further escalating the problems. Implementation of REDD+ and A/R CDM mechanisms will be helpful to encourage the afforestation in GB.

GB has abundant water resources available in its valley streams that flow down to the river. This can be used to grow plants and trees to increase the acreage of existing and new forests. Such measures are crucial for the region due to the looming threats of climate change. The forests can play a vital role in mitigating the environmental risks and creating an ecological balance in the region. There is a need to build up institutional capacity and scientific research to protect and promote the forests.

Objective T8.01	Promote scientific research to improve understanding of forests in relation to climate change
Aspect	Adaptation
Responsibility	Forest Department
Time Frame	Short Term (2021 – 2024)
Strategy T8.01_S1	Addressing the essential knowledge gaps about climate change impacts on

	region
A. #	Actions
T8.O1_S1.A1	Undertake 'forest ecosystem' based research and map out ecosystems of high and low resilience to climate change.
T8.O1_S1.A2	Organize research projects in response to various forest types to increased temperature and drought spells
T8.O1_S1.A3	Initiate studies on forest management systems to explore new tools and adaptation options for managing forest areas in wake of climate change.
T8.O1_S1.A4	Include forest pathology, entomology, water management, watershed management, flood risk management, soil conservation and other interrelated disciplines as integrated part of forestry research programs depending on the research objective(s).
T8.O1_S1.A5	Develop an appropriate 'Risk Management Framework' and include the research findings into it.

Objective T8.O2	To enhance ecological resilience of forest ecosystems from projected adverse impacts of climate change.
Aspect	Adaptation
Responsibility	Forest Department
Time Frame	Medium Term (2021 – 2028)
Strategy T8.O1_S1	Taking appropriate measures to adapt to the projected adverse impacts of climate change and increase ecological resilience of forest ecosystems
A. #	Actions
T8.O2_S1.A1	Based on conservancy approach, identify important forest fragments and connect them to provide natural migration corridors for plant and wildlife species for important ecosystem functions.
T8.O2_S1.A2	Promote the use of indigenous and locally adapted plants in agroforestry
T8.O2_S1.A3	Identify and promote measures that are appropriate to forest management practices which will address the likely impacts of climate change based on scientific research.
T8.O2_S1.A4	Initiate demonstration projects, in line with the research findings, on area and species specific appropriate silvi-cultural systems to minimize damages caused by forest pathogens and pests.
T8.O2_S1.A5	Enhance forest cover on uphill watershed areas through rapid afforestation and reforestation measures on account of increased intensity of rainfall and flood risks.
T8.O2_S1.A6	Promote the role of GIS/ RS techniques in mapping climate change prone forests, monitoring and implementation of ecosystem based adaptation.

Objective T8.O3	To build institutional and professional capacities for development and implementation of REDD plus and A/R CDM mechanisms
Aspect	Mitigation
Responsibility	Forest Department
Time Frame	Long Term (2021 – 2031)
Strategy T8.O3_S1	Building institutional capacities of stakeholders for effective development and implementation of innovative mechanisms aiming to avoid deforestation and enhancing forest carbon stocks.
A. #	Actions

T8.O3_S1.A1	Pursue massive afforestation and reforestation programs for enhancing the region's forest cover and establish forest areas as effective carbon sinks.
T8.O3_S1.A2	Investigate incidence of disease in indigenous trees, such as poplar, willow and Russian olive; conduct research and propagate sea buckthorn on marginal lands
T8.O3_S1.A3	Develop forest cover assessment at district level through GIS/ Remote Sensing in decision making and forest carbon accounting system to assess changes in carbon stocks in forest areas.
T8.O3_S1.A4	Develop effective mechanisms to avoid illicit cutting of forests and strictly enforce such measures in all forest types
T8.O3_S1.A5	Intensive encouragement of farm forestry and agroforestry practices through plantation of multipurpose and fast growing tree species to meet the demands of local population for fuel, timber and fodder for livestock.
T8.O3_S1.A6	Initiate projects and programs to provide alternate fuel and livelihood priority options for forest dependent communities and to compensate deforestation

Theme-9: Rangeland

Being 52% rangeland out of the total area in Gilgit-Baltistan, protection from the impacts of climate change is pivotal. Rearing livestock, protection of water catchment and supporting biodiversity are main functions of rangelands. It is important to improve the rangeland management in Gilgit-Baltistan as the productivity of livestock is linked with improved practices in land grazing and pasturing.



Grasslands in Shandur, Ghizer (Imran Shah)

There is need to improve the quantity and nutritional quality of fodder on agriculture lands and promote use of supplementary livestock feed, and reduce pressure on grazing lands. Moreover, there is need to assess the impacts of climate change on rangeland and alpine pastures of the region.

Objective T9.O1	To safeguard the rangelands and pastures from environmental degradation.
Aspect	Mitigation
Responsibility	Forest Department
Time Frame	Medium Term (2021 – 2028)
Strategy T9.O1_S1	Safeguarding the soil against erosion through vegetative barriers and improve soil quality
A. #	Actions
T9.O1_S1.A1	Devise vegetative barriers for rangelands that are particularly vulnerable to erratic precipitation, strong winds and increased soil erosion;
T9.O1_S1.A2	Develop community based programs to plant shrubs and trees most suited for

	these rangelands and pasture above the water channels
T9.O1_S1.A3	Design and implement programs to ensure optimal livestock densities according to the rangelands' carrying capacities;
T9.O1_S1.A4	Organize awareness raising and training programs for local shepherds and farmers so as to maintain the 'rangeland ecosystem'
T9.O1_S1.A5	Use native and hybrid soil nutrient fixing vegetation for improving soil quality, such as seabuck thorn
Strategy T9.O1_S2	Promote grazing system to facilitate regeneration of rangelands
A. #	Actions
T9.O1_S2.A1	Conduct research to identify 'fragile' and 'resilient' rangelands and pastures and calculate the carrying capacities in each district according to their local climatic conditions
T9.O1_S2.A2	Design rotational program for periodic movement of livestock from fragile to resilient rangelands and pastures
T9.O1_S2.A3	Establish experimental plots of native, hybrid and adapted vegetation species for improved rangeland and pasture management
T9.O1_S2.A4	Designate alternative pastures and passages, aware local shepherds and farmers to adopt "Sustainable Range Management Techniques"

Theme-10: Disaster Management

Gilgit-Baltistan is susceptible to climate triggered natural disasters, and the assessment of disaster events of last two decades show that landslides, floods and avalanches are some of the most frequent events in the region. The unpredictability of GLOFs and flash floods add to the dangers of these disastrous events. The road infrastructure in the region got hit by these unpleasant events. Due to protracted blockade of roads, the people living in remote areas run into difficulties i.e.



Landslide at Attabad, Hunza (Unknown)

having access to food and other life-saving supplies. Similarly, damage to property, livestock and agriculture debilitate the people's ability to recoup after the disasters. In particular, the economically and socially weaker segments of the population are more affected.

Heightened vulnerabilities to disaster risks are outcome of increasing population, urbanization and development within high-risk zones, environmental degradation add to the problems resulting from impacts of climate change. The women, sick, elderly and juveniles are more exposed to the risks of natural disasters and require particular care and attention. Early-warning system is now essential to be established across Gilgit-Baltistan to inform the public of impending dangers of disasters.

There are strong signals that the impacts of climate change and ensuing natural hazards will further exacerbate in the coming decades in the region as GB is already encountering climate change impacts that are too visible to ignore. Inherited hazards of the region often lead to disasters due to the fact that the aspects of Disaster Risk Reduction (DRR) are neglected in urban sprawl or in any form of new settlements, adopting climate-resilient development pathways can minimize the risk to the extent possible.

Objective T10.01 To increase awareness and understanding of climate related natural hazards, processes and impacts	
Aspect	Adaptation
Responsibility	Gilgit-Baltistan Disaster Management Authority (GBDMA), GBEPa, District Administration, NGOs, INGOs
Time Frame	Short Term (2021 – 2024)
Strategy T10.01_S1	Improving awareness on issues related to preparedness and risk reduction of climate induced disasters through public participation
A. #	Actions
T10.01_S1.A1	Promote awareness among communities on the increasing frequency and intensity of natural disasters in particular about the frequently occurring GLOF phenomena
T10.01_S1.A2	Develop mechanism to formalize and promote strong sectoral coordination among sectors responsible for DRM (Disaster Risk Management)
T10.01_S1.A3	Conduct special awareness campaigns for different segments of society and particularly for those communities living in vulnerable areas, through radio, TV, print media and participatory workshops
T10.01_S1.A 42	Strengthen local institutions for improved coordination and collaboration with the entities responsible for GLOF risk reduction.
T10.01_S1.A5	Conduct practical demonstration exercises and simulation campaigns for the downstream mountain communities vulnerable to GLOF induced risks. Run specialized awareness messages through radio, TV, print media and participatory workshops
T10.01_S 1.A 6	Develop an integrated information system to manage temporal and spatial information on GLOF risk reduction
T10.01_S 1.A 7	Documentation and analysis to handle natural disasters in order to fill in cavities after lessons learned from past events. For instance, the lesson learned from GLOF I project must be incorporated among other sources and studies vis-à-vis disaster hazards
T10.01_S1.A 8	Conduct practical demonstration exercises and simulation campaigns for the downstream mountain communities vulnerable to GLOF induced risks. Run specialized awareness messages through radio, TV, print media and participatory workshops
T10.01_S1.A9	Develop an integrated information system to manage temporal and spatial information on GLOF risk reduction

Objective T10.02 To ensure the availability of timely natural disaster's early warning information	
Aspect	Adaptation
Responsibility	GBDMA, District Administration, NGOs, INGOs

Time Frame	Medium Term (2021 – 2028)
Strategy T10.O2_S1	Developing and strengthening natural hazard early warning system for providing warnings to the public
A. #	Actions
T10.O2_S1.A1	Improve real-time meteorological and hydrological data collection and processing for better understanding of natural processes and advent of disasters.
T10.O2_S1.A2	Strengthen natural hazards early warning system for efficacy and linkage with refine mitigation measures and actions
T10.O2_S1.A3	Develop improved “Early Warning dissemination System (EWS)” using radio, TV, SMS, and mosque loudspeakers etc. in vulnerable mountain areas
T10.O2_S1.A4	Develop standard operating procedures, clearly defining the role and responsibilities of each concerned department during natural hazards.
T10.O2_S1.A5	Improve and strengthen flash flood and GLOF response mechanism of local & district disaster managers to minimize the damages
T10.O2_S1.A6	Strengthen linkages with media, particularly with electronic media, for timely dissemination of early warning in local languages and for effective cross-sector coordination in disaster risk reduction actions
T10.O2_S1.A7	Set-up remote-sensing and ground based mechanism to monitor the development of GLOF
T10.O2_S1.A8	Develop evacuation strategies in case of GLOF for vulnerable areas
T10.O2_S1.A9	Invest in women’s skill development on climate resilient agricultural practices, and disaster preparedness
T10.O2_S1.A10	Enhance institutional capacity, especially at local level, through trainings, cross-sectoral learning and successful evidences from similar regions in other countries.

Objective T10.O3	To formulate and enforce hazard zoning laws and regulations as part of disaster risk reduction strategies
Aspect	Adaptation
Responsibility	GBDMA, Water and Power Department, GBEPa, District Administration, NGOs, INGOs
Time Frame	Long Term (2021 – 2031)
Strategy T10.O3_S1	Developing and strengthening natural hazard zoning and mapping system for providing the reliable information to the public
A. #	Actions
T10.O3_S1.A1	Prepare an integrated natural hazard mapping and zoning map of GB that should <i>inter alia</i> incorporate the research findings of GLOF I
T10.O3_S1.A2	Identify areas vulnerable to natural disasters at local level and develop mitigation strategies against those vulnerable areas and communities.
T10.O3_S1.A3	Identify low flood and GLOF risk areas for future land use and planning
T10.O3_S1.A4	Encourage resettlement/ relocation of villages outside the flood plains
T10.O3_S1.A5	Develop safe havens for livestock during disaster
T10.O3_S1.A6	Identify safe areas for evacuation and develop evacuation plans with the consent and participation of local communities and also provide training to them.
T10.O3_S1.A7	Incorporate water, food hygiene, and sanitation management in disaster preparedness and evacuation plans.
T10.O3_S1.A8	Set-up system where senior citizens, children and differential-abled gets special

	care during evacuation.
T10.O3_S1.A9	Develop waste management strategies for post disaster situations
T10.O3_S1.A10	Integrate hazard zoning into land use and urban development through zoning regulation.
T10.O3_S1.A11	Formulate river laws to protect Streams, rivers banks and its flood plain areas from encroachments
T10.O3_S1.A12	Develop efficient rescue mechanisms, relief and rehabilitation options and implementation plans before the onset of disaster

Theme-11: Food and Fuel Security

Food and fuel security, in general and particularly during the times of disaster, becomes a fundamental concern for the communities, government and all other stakeholders. It is an important fact that GB is still food deficient and more than 50% of its food staples including wheat are supplied from down country. The region got hit by climate change related disasters frequently; and there is need to take necessary precautionary measures to achieve food security in the event of these disasters.

The landslides badly affect the operational condition of road infrastructure in the region, particularly, the KKH which is the main access route to down country, resulting in blockades which leads to food insecurity, fuel shortage and halt transportation.

The magnitude and frequency of disasters are expected to increase in future, under changing climate, therefore necessary precautionary measures are needed to be taken at regional and district level. The district food departments need to develop capacity of storing key food supplies for at least one-month, such that any possibility of food crises can be averted. In addition, the retailers and wholesalers shall also be encouraged and supported to increase their storage capacity for at least one-month demand. Furthermore, it is also important that the fuel supplies are also sufficiently available, therefore fuel storage capacity shall be increased for at least one month to ensure availability during the crises times. This shall help maintain the mobility of population during disasters.



*Women collecting fuelwood in Baltistan
(Imran Shah)*

Objective T11.O1 To strengthen the resilience of non-agricultural production systems to achieve sustainable food security in the face of climate change.

Aspect	Adaptation
Responsibility	Food Department and Provincial Government, GBDMA, NGO's, iNGOs
Time Frame	Short Term (2021 – 2024)

Strategy T11.O1_S1	Diversifying the non-agricultural income sources to enhance the flexibility of people's livelihoods for strengthening the resilience to climate change.
A. #	Actions
T11.O1_S1.A1	Promote local products such as handicrafts (e.g., woodcarving, shawls, carpets, caps etc.) and ensure related institutional services (e.g. capacity building in production and value-chain development, market access, credit supply, insurance facility and ICT).
T11.O1_S1.A2	Encourage agroforestry, tree farming for timber, and NTFPs and medicinal plants as additional sources of income.
T11.O1_S1.A3	Establish local fruit processing and storage facilities for primary and value added products in collaboration with private sector.
T11.O1_S1.A4	Support small and medium enterprises through incentives such as subsidized credit facility, capacity building trainings, insurance facility, and regulated product collection centres.
T11.O1_S1.A5	Develop and harness environmental services, and promote eco-tourism and recreational activities.
T11.O1_S1.A6	Link ecotourism with traditional handicrafts and foods by exhibiting local products to tourists, and including local food dishes (mainly prepared from traditional crops) in hotel menus.

Objective T11.O2	To ensure food security and fuel availability in the event of disasters and crises
Aspect	Adaptation
Responsibility	Food Department, GBDMA, District Administration, NGOs, INGOs
Time Frame	Short Term (2021 – 2024)
Strategy T11.O2_S1	Establishing food and fuel reserves in each district of GB and ensure supply of necessary food and fuel items during disaster events
A. #	Actions
T11.O2_S1.A1	Prepare contingency plans for food and fuel supplies in all districts so as to counter the dangers of food shortages during times of natural disasters and prolonged blockade of KKH
T11.O2_S1.A2	Estimate the total per month consumption of food items including wheat, pulses, cooking oil and essential medicines for each district
T11.O2_S1.A3	Establish food and fuel reserves and storage areas with at least capacity to store one month's stock, in respective districts
T11.O2_S1.A4	Run awareness campaigns to inform the public to store their food supplies at least for one month
T11.O2_S1.A5	Involve civil society and the community to overcome the food and fuel shortages that may occur due to blockade of roads to the down country.
T11.O2_S1.A6	Advise respective district governments to issue fuel and food items to the market so that the public will then buy without the fear of food shortages in the event of natural disasters.

Theme-12: Biodiversity & Wildlife

GB endures diverse range of animal and plant species such as snow leopard, brown bear and eagles which are potentially impacted by severe climate related events. In addition to this, the region also witnesses agro-diversity having different varieties of fruit and wide range of native livestock. In order to forefend endangered species more than 50% of the area is protected but they continued to be threatened for many reasons like over-exploitation of medicinal plants and habitat destruction.



Golden Eagle in Khunjerab National Park (Imran Shah)

In order to address these problems, the in-situ conservation of biodiversity has to be further strengthened by enhancing the management of existing protected areas; introducing collaborative management regimes involving partnerships between government and local communities. Outside the protected areas, initiating village based and sustainable use programs will tremendously help. For example, one of the success stories in conservation and rationalizing of wildlife is the trophy hunt program in Gilgit-Baltistan. A permission license is issued to hunt carefully selected and seasoned ibex for a fee payment. From one trophy hunt of Markhoor community get 100,000 USD. These proceeds from the hunting go to the welfare of village communities as well as for betterment of the park.

Similar schemes can be expanded for the conservation of medicinal plants and other elements of flora and fauna. One of threats facing biodiversity in the region is the degradation of habitats due to impacts of climate change. The snowline is moving up the mountains due to rising temperatures as well as the glaciers are receding; this phenomenon has serious implications for biodiversity found at high altitudes. Impacts of climate change on environmental processes and compartments are rather complicated and the subsequent affects are needed to be explored in order to understand the impacts on wildlife and biodiversity.

Little information is available on epidemiology of animals and to draw the line between wildlife and livestock amid the growth of the later and increasing competition between wildlife and domestic animals for range biomass, leading to decline in wildlife population. Further scientific research is needed to understand the declining productivity and biodiversity of GB's alpine pastures.

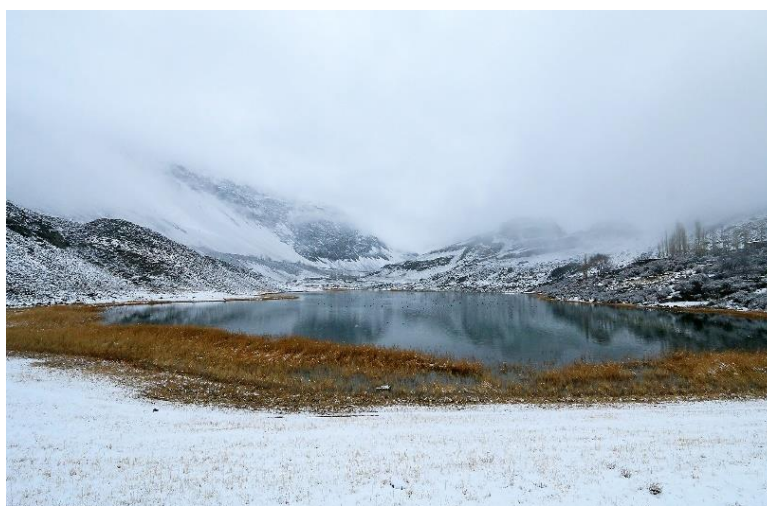
Objective T12.O1 To strengthen legal and institutional set up to materialize efforts towards biodiversity conservation	
Aspect	Adaptation
Responsibility	Wildlife & Parks Department, WWF, Wildlife Conservation Society (WCS), Community conservation structures

Time Frame	Short Term (2021 – 2024)
Strategy T12.O1_S1	Strengthening institutions and implementing the existing measures taken so far to enhance biodiversity conservation
A. #	Actions
T12.O1_S1.A1	Support the enhancement of biodiversity conservation activities in Gilgit-Baltistan; promote public and political sensitization activities to put biodiversity conservation as one of the top priority agendas
T12.O1_S1.A2	Take concrete measures to push previously prepared Biodiversity Strategy and Action Plan for Gilgit-Baltistan
T12.O1_S1.A3	Review and update the existing plans periodically based on the lessons learnt during practical implementation phases.

Objective T12.O2	To enhance scientific research and implementation of biodiversity conservation
Aspect	Adaptation
Responsibility	Wildlife & Parks Department, GBEP, WWF, WCS, Civil Society and Community based organizations
Time Frame	Medium Term (2021 – 2028)
Strategy T12.O2_S1	Promoting research in the field of biodiversity with its relevance to the effects of climate change to fill the knowledge gap between policy and practice.
A. #	Actions
T12.O2_S1.A1	Initiate meaningful applied research on biodiversity conservation in wake of climate change in Gilgit-Baltistan
T12.O2_S1.A2	Document and integrate indigenous knowledge into the latest scientific findings/ information for use in conservation planning and activities
T12.O2_S1.A3	Extend conservation practices in joint collaboration with the local communities making use of their knowledge in local perspective
T12.O2_S1.A4	Integrate biodiversity conservation practices into all relevant disciplines such as forestry, wildlife, aquatic and agriculture
T12.O2_S1.A5	Promote in-situ as well as ex-situ conservation of valuable species for research and other purposes in biodiversity rich regions

Theme-13: Wetlands

Wetlands are important for their biodiversity and needed to be protected from the impacts of climate change. GB has one of the world's highest plateaus – the Deosai Plains that has an elevation of above 4000 m. It is primarily a wetland that remains wet and humid during the summers and clad with snow during the winters. These plains are known for their scenic beauty and biodiversity. Another such



Borit Lake in Hunza (Imran Shah)

area is the Katpana Lake in Skardu, Baltistan which is a swamp and home to a whole diversity of flora and fauna. There are a number of alpine pastures that have smaller wetlands spreaded over different parts of the region.

Wetlands play an important role in maintaining and sustaining regional ecological processes. However, these wetlands are vulnerable to ecological impacts of climate change. A dramatic change in their ecosystems may affect their ability to function as habitat for endangered, rare animals and plant species.

Objective T13.O1 To protect habitat of birds and biodiversity in wetland ecosystem	
Aspect	Adaptation
Responsibility	Wildlife & Parks Department, World Wildlife Fund (WWF), Wildlife Conservation Society (WCS), Community conservation structures, Academia
Time Frame	Short Term (2021 – 2024)
Strategy T13.O1_S1	Promoting research on wetland ecosystem and design management plans to safeguard biodiversity in wetlands
A. #	Actions
T13.O1_S1.A1	Promote research on the immediate and projected climate change impacts on the wetlands and extend the research possibilities to recognize and enhance the roles played by wetlands in natural disaster protection.
T13.O1_S1.A2	Design appropriate management plans to maintain and safeguard the wetlands and their biodiversity
T13.O1_S1.A3	Control the use of pesticides and fertilizers in the immediate surroundings of the wetlands.
T13.O1_S1.A4	Encourage the use of biological control for disease and weed control in agricultural crops.

Objective T13.O2 To ensure sustainability of wetland ecosystem	
Aspect	Adaptation
Responsibility	Wildlife & Parks Department, WWF, WCS, Community conservation structures
Time Frame	Medium Term (2021 – 2028)
Strategy T13.O2_S1	Supplying the adequate ecologically necessary water contribution to the wetlands by efficient management of the resources
A. #	Actions
T13.O2_S1.A1	Ensure adequate water supply allowing ecologically necessary water flows to wetlands of the region
T13.O2_S1.A2	Support existing conservation activities in wetlands and promote public awareness
T13.O2_S1.A3	Develop adaptation mechanisms for wetlands and communities who depends on them
Strategy T13.O2_S2	Taking remedial measures to reduce siltation of the wetlands
A. #	Actions
T13.O2_S2.A1	Ensure control of siltation of wetlands by reducing deforestation and felling of timber in the catchments areas.
T13.O2_S2.A2	Conduct research to identify causes of siltation in the wetlands and take remedial measures accordingly.
T13.O2_S2.A3	Develop wetlands maintenance programs to control siltation and other debris with efficient participation of the local communities.

Theme-14: Mountains and Glaciers

Mountain glaciers of Gilgit-Baltistan are about 30% of the total area and another 40% is under seasonal snow cover and are at the risk of climate change. Research shows that the temperature of the region is rising at a rate twice than that of the plains. This is causing faster melting of snow and glacial ice mass resulting in number of ecological and environmental problems.



Rakaposhi Basecamp (Imran Shah)

Increasing temperatures and decreasing precipitation in early winters and increasing in late winters have complicated the situation. Upsurge in melting rates coupled with decreasing snowfall in winters have a cumulative decreasing effect on the overall volume of the glaciers. The mass balance in glacial volume is a function of the time of snow received, time for conversion of snow into ice and the altitude. From the past thirty years' data it is revealed that the time of snowfall pattern shifted that doesn't allow enough time for its maturation and a subsequent heat wave melts it and results into a disaster downstream. GLOFs, flash floods, early avalanches and landslides are results of the phenomena are mentioned above.

To safeguard against most likely climate change impacts on mountain and glacial areas and to protect their ecosystems and livelihoods of mountain communities, the following strategy and action plan is proposed with measures that shall help preserve the fragile mountainous ecosystem of the region.

Objective T14.O1 To sustain and protect mountain ecology from degradation and pollution	
Aspect	Adaptation
Responsibility	Gilgit-Baltistan Environmental Protection Agency (GBEPA), GBDMA, WWF, NGOs, INGOs
Time Frame	Short Term (2021 – 2024)
Strategy T14.O1_S1	Discouraging activities that contribute towards depletion of mountain ecology while encouraging those that help in rejuvenating feasible climate at higher altitudes.
A. #	Actions
T14.O1_S1.A1	Develop conservation strategies for protecting the mountain ecology
T14.O1_S1.A2	Devise mechanisms to avoid accumulation of solid waste, trash and other unwanted material in hill stations and popular tourist destinations
T14.O1_S1.A3	Take actions to avoid accumulation of unwanted biomass in areas of higher altitudes so as to prevent clogging of mountain water channels
T14.O1_S1.A4	Organize localized programs for removal and disposal of solid waste from the mountainous areas

T14.O1_S1.A5	Promote growing natural shrubby barriers on slopes to avoid soil erosion, windstorm, hailstorm and snowstorm related damages
T14.O1_S1.A6	Introduce and encourage the use of bio-degradable products in mountain tourism and expeditions

Objective T14.O2 To protect and promote research on climate change impacts on the glaciers	
Aspect	Adaptation
Responsibility	Gilgit-Baltistan Environmental Protection Agency (GBEPA), NGOs and Academia
Time Frame	Medium Term (2021 – 2028)
Strategy T14.O2_S1	Declaring glaciated areas as ‘protected areas’ to protect glaciers in Karakorum, Himalayan and Hindukush Ranges; and promoting scientific research on glacier dynamics , GLOF phenomenon and cryosphere
A. #	Actions
T14.O2_S1.A1	Declare glaciated areas as ‘protected areas’ to ensure protection of glaciers in Karakorum Himalayan and Hindukush Ranges
T14.O2_S1.A2	Promote GLOF related research to understand the glacier dynamics
T14.O2_S1.A3	Develop projects for conservation of glaciers in Karakorum and Himalayan range
T14.O2_S1.A4	Expand data networks horizontally and vertically to ensure representative data of all altitudinal, spatial and temporal aspects
T14.O2_S1.A5	Establish a data base resource center in GB under a climate change unit in GBEPA to acquire, store, process and interpretation of climate, weather, environmental and hydrological flows in order to establish a climate baseline and change detection.
T14.O2_S1.A6	Include glaciology as a main (core) course in universities in order to give awareness and promote research at grass-root level
T14.O2.S1. A7	Prepare a trend chart of GLOF events and prepare a coping and adaptation mechanism to minimize the adverse impact on lives and livelihoods

Theme-15: Public Health

Protecting and improving the health facilities of communities through education, policy making and research for disease and injury prevention is summed as public health. Quality healthcare delivery is the bedrock to exponentially accelerate the development of any region. Unfortunately, in Northern Pakistan healthcare has been neglected since a long time, with the common man bearing the brunt of this acute situation. There are critical challenges in health care, with paucity of trained human resource and deficit of regulated infrastructure and service delivery being the predominant dilemmas. Primary and secondary healthcare are in an unseemly state, to say the least. Maternal and child health care, accident, and emergency departments and mental health are



Community in Frano, Khaplu (Imran Shah)

among the most undermined and forsaken areas of healthcare, primarily in the far flung regions of Gilgit-Baltistan.

Increasing temperatures have impacted the air and drinking water quality in the region that was contamination free some two decades ago. Poor sanitation services like absence of sewerage collection and treatment system; and solid waste management has aggravated the situation. Many alien diseases are now prevalent in the region and it is likely to receive more with increasing climatic changes. Dengue is a tropical disease that is moving to subtropical areas and to the altitudes that are hostile to the virus. The outbreaks of vector borne communicable disease and water-borne disease have increased and are reported, like outbreak of appendicitis at Chamograh in district Gilgit and in Phander valley of district Ghizer. Diarrhea, Hepatitis and typhoid outbreaks are often reported in summers from remote areas and sometimes in major towns also. Deteriorating air quality in addition to increasing temperatures has impacted the health of the urban populace due to heavy PM10 and PM2.5 concentrations round the year especially in winters as a result of firewood burning and transportation load.

Women in GB are the major victims of health related issues. Presently malnutrition, prenatal, natal, antenatal and postnatal care and psychological problems are main health issues of women of Gilgit-Baltistan. These issues affect not only the women's health badly but also children's health at large. According to public health specialists Maternal Mortality Morbidity Rate (MMR) and anemia in GB are very high that indicates more investment in the sector and also need to attract donor agencies.

Objective T15.01 To assess and reduce health vulnerabilities to climate change	
Aspect	Adaptation
Responsibility	Health and Works Department, P&DD, LG&RDD, GDA, SDA, GBEPa, Waste Management Companies, Population Welfare Department, WASEP, private health care units.
Time Frame	Short Term (2021 – 2024)
Strategy T15.01_S1	Assessing and reducing health vulnerabilities to climate change by taking necessary adaptation measures
A. #	Actions
T15.01_S1.A1	Assess the regions' vulnerability including identifying those populations and regions that are most vulnerable to vector borne diseases.
T15.01_S1.A2	Identify the vulnerable population groups with each urban and rural locality that might be directly affected by natural calamities like floods and cyclones.
T15.01_S1.A3	Establish baseline conditions of human health risk of current climate variability and recent climate change.
T15.01_S1.A4	Design health systems out-reach programs that could reach the designated areas for quick emergency health services.
T15.01_S1.A5	Built effective infrastructures and means of communications to quickly counter any epidemic spreading due to climate change induced natural hazard.
Strategy T15.01_S2	Ensuring that appropriate measures to address health related climate change issues are incorporated into national health plans.
A. #	Actions
T15.01_S2.A1	Identify financial resources and personnel training facilities, particularly focused on climate change related health hazard requirements.
T15.01_S2.A2	Estimate the possible additional burden of adverse health issues (future risk) likely to change over the coming decades due to climate change.
T15.01_S2.A3	Assess the current capacity of health and other sectors to manage the risks of climate sensitive health outcomes.

T15.O1_S2.A4	Design health plans that not only have out-reach components, but are able to provide first aid medical help to a large number of injured and sick during a natural disaster.
Strategy T15.O1_S3	Educating and sensitizing health personnel and the public about climate change related health issues.
A. #	Actions
T15.O1_S3.A1	Design communication strategies to inform the general public of climate change related health hazard and its geographical span, particularly, alerting health personnel in the vicinity.
T15.O1_S3.A2	Use media and civil society organizations to educate and sensitize public as well as health personal to the climate change related health issues particularly arising during the natural disasters.
T15.O1_S3.A3	Conduct assessments on the impacts of climate change on vector/waterborne and nutritional diseases.
Strategy T15.O1_S4	Ensuring that the medications and clean drinking water are available to the general public easily and cost effectively particularly during climate related extreme events
A. #	Actions
T15.O1_S4.A1	Design and build emergency vaccines and medication storage facilities near each DC's office to be used in case of injuries and epidemics due to natural hazard.
T15.O1_S4.A2	Keep mobile water purification facilities ready to be shifted to disaster stricken areas at short notice.
T15.O1_S4.A3	Develop and promote household water treatment options.
Strategy T15.O1_S5	Upgrading and extending disease out-breaks monitoring and forecasting systems to counteract the possible climate change health impacts
A. #	Actions
T15.O1_S5.A1	Strengthen disease monitoring and forecasting systems for prior planning and timely effective interventions
T15.O1_S5.A2	Develop effective intervention strategies in national health plans to build and design climate change related health impacts control system.
T15.O1_S5.A3	Develop an effective response system to deal with any vector-borne diseases like malaria and dengue epidemics, which are expected to rise in changing climate patterns.



Theme-16: Transport Sector

Reduction in emissions from transport sector can be effectively used as a strategy for mitigating the impacts of climate change. Although Gilgit-Baltistan has lowest road density of 0.7 km/km² of its area, the region has seen the number of vehicles growing, particularly after popularity of the cheaper custom duty unpaid vehicles. Gilgit-Baltistan has a total road length of nearly 4,000 km across all of its districts, out of which 1,000 km are metal roads and 3,000 km are unpaved and graveled. The total number of vehicles in the region is 33,500 including motor bikes, cars, jeeps, vans, buses, trucks and tractors. Out of which, some 7,500 vehicles including cars and vans are Non-Custom Paid.



Gilgit-Skardu Road (Imran Shah)

Though the towns of Gilgit-Baltistan have more vehicles than their capacity, yet it constitutes around 1% of nearly 4 million total vehicles in Pakistan. This is likely to increase many fold because of the heavy traffic on KKH as a result of the trade transit between China and Pakistan on the economic corridor. The ecological balance of mountain regions is considered to be very fragile; and escalating amount of fossil fuels emissions may negatively impact climate of the region. It is attributed that the GHG trapping nature of deep mountain valleys of the region receive a localized triggering effect of climate change as the region lies out of the wind corridor. These local phenomena in addition to the global climate change effect impacts the region severely and is amplifying with increasing number of Non-Custom Paid vehicles.

About a quarter of carbon-dioxide emission is attributed to transport sector in Pakistan, therefore, it is one of the leading contributing factors to GHG emissions; other than the industrial and agriculture sectors. But in Gilgit-Baltistan, transport sector is among one of the key factors contributing towards GHG emissions. Thus managing or slowing down the growth of emissions in transport sector is significantly important to overall mitigation efforts for tackling climate change.

Transport sector has not been regularized in respect of environmental standards, this implies that the malfunctioning vehicles with excessive emissions are being registered and/or renewed without any environmental safeguards. People are used to purchase low price Non-Custom Paid vehicles initially but do not care for their regular maintenance or functional inspections that also results in excessive vehicular exhaust emissions.

What makes the task of reducing emissions in transport difficult is the fact that the scope for technical improvement is limited, at least, in the short run transport volumes are closely linked to economic growth. There is the need to strike a balance between the imperatives of economic development in the region and mitigation of climate change. This can be achieved through effective strategies and policies for management of transport sector in Gilgit-Baltistan.

Objective T16.O1	To minimize GHG Emissions from transport sector
Aspect	Mitigation
Responsibility	GBEPA, Excise and Taxation Department, Traffic Police
Time Frame	Short Term (2021 – 2024)
Strategy T16.O1_S1	Sensitizing public to the importance of proper vehicle maintenance for fuel efficiency enhancement and reduction of emissions.
A.#	Actions
T16.O1_S1.A1	Initiate media campaigns to create public awareness that how proper maintenance of vehicles can contribute to the fuel efficiency and reduction of emissions.
T16.O1_S1.A2	Involve civil society and the corporate sector to join in the campaign for emission reduction and fuel efficiency by proper vehicle maintenance.
T16.O1_S1.A3	Arrange regular vehicle maintenance technical courses in all urban centers of the region.
T15.O1_S1.A4	Setup vehicle maintenance service centers in all urban areas
Strategy T16.O1_S2	Ensuring the provision of efficient public transport system
A. #	Actions
T16.O1_S2.A1	Develop and provide quality efficient public transport system in the region to encourage people to slowly move from the use of private cars to the public transport system.
T16.O1_S2.A2	Encourage foreign investment to start and maintain high quality public transport in all major urban areas
T16.O1_S2.A3	Develop public private partnership for the provision of fuel efficient local and mass transport.
Strategy T16.O1_S3	Setting-up emission standards and discourage vehicle smuggling.
A. #	Actions
T16.O1_S3.A1	Set-up emission standards and vehicle emission testing stations in urban centers
T16.O1_S3.A2	Discourage smuggling of vehicles into the area and ban on NCP vehicles
T16.O1_S3.A3	Develop a law enforcement system with a clear mandate to enforce vehicle emission standards.



Theme-17: Migration, Remittance and Adaptation

In context of climate change adaptation, migration can lead to reduction in vulnerability of affected communities and reduce pressure on local resources by representing an income source that is generally not disrupted by environmental hazards. Also, it can help people to better withstand the impacts of environmental stressors; and allow for better access to information and social networks.



Darkut Valley in Yasin (Imran Shah)

The migration can thus act as a “pressure release valve” to lessen the risk of displacement by reducing exposure to climate hazards, and is therefore a strong contributing factor to individual and societal adaptation to adverse climatic conditions.

Sending a member away from home is a substantial investment strategy, conventionally undertaken by a migrant sending household, whose ensuing monetary returns (remittances) provide the households with an additional source of disposable income that actually help diversify the migrant households’ income portfolio, which in return can help improve their living standard. Research on remittance flows to developing countries has suggested various uses of these transactions and their impact on household welfare.

The immigration of locals to the cities down the country and abroad is highly popular amongst the communities in GB. The immigrants go to other places for better economic opportunities, education and other purposes. An estimated 40% of the total population of GB lives outside the region that acts as major source of remittances being sent back into the region. A recent study shows that the villages having high percentage of out-migrant ratios had received more remittances than the villages having less number of migrant sending households across GB. The migration and remittances thus can be used as leverage for climate change adaptation. There is need to explore means to maximize these benefits and reduce risks to migrant workers, their families, and communities in the region.

The GB government aims to have a migration sector inclusive provincial climate change action plan, so that the issues resulting from impacts of climate change can be addressed at grass root level. It acknowledges that migration and remittances received and related benefits of skills and knowledge, brought back by the migrant from outside of the community can play as an adaptive strategy. The following are the proposed strategies and action plan that shall be helpful in using immigration and remittance as leverage for addressing climate change vulnerabilities at grass root level.

Objective T17.01 To increase climate resilience among migrant sending vulnerable mountain communities through non-traditional climate change adaptation strategies

Aspect	Adaptation
Responsibility	GBDMA, Finance Department, Population Welfare Department, Home

	Department, District Administration, PRCS, AKAH, NGOs and locally active INGOs
Time Frame	Medium (2021 – 2028)
Strategy T17.O1_S1	Foster action research to identify and address key knowledge gaps concerning climate change, migration, remittance and adaptation nexus in the context of mountain areas
A.#	Actions
T17.O1_S1.A1	Engage relevant research and policy institutions to conduct action research on climate change related existing and emerging issues including human mobility, displacement, migration and re-settlement. in the social, economic and environmental contexts of GB
T17.O1_S1.A2	Publish articles and position papers to establish and enunciate climate migration and adaptation narratives for the government and other policy forums to discuss and streamline migration, remittance and adaptation in climate change policy discourse
T17.O1_S1.A3	Form and notify a multi-stakeholder policy campaign group in the P&DD essentially with effective representation from most relevant government and private sectors, to help government develop effective climate policies, strategies and action plans
T17.O1_S1.A4	Develop an integrated and interactive Climate Information Management System to manage temporal and spatial information on potential hazards, risks and possible risk reduction strategies / response measures
T17.O1_S1.A5	Regularly organize climate Roundtables at district and GB / provincial levels to deliberate and conclude on existing and emerging climate issues, their drivers, impacts and possible adaptation / mitigation measures to facilitate informed decision making process
Strategy T17.O1_S2	Raise awareness among public and decision makers about role of migration and remittances in climate change adaptation at household and community levels
A. #	Actions
T17.O1_S2.A1	Organize series of awareness raising sessions for different stakeholders to help them understand the cause and effect relationship of existing as well as emerging climatic vulnerabilities, for effective disaster preparedness and building climate resilience
T17.O1_S2.A2	Organize training sessions on financial literacy for flood preparedness to improve adaptation for different segments of society and particularly for those communities living in vulnerable areas to cope with climate risks.
T17.O1_S2.A3	Mobilize media (press, radio, cable and TV networks) and especially local journalists to address climate change issues in their programs to educate urban, sub-urban and rural segments of the mountain society about climate change
T17.O1_S2.A4	Organize workshops for migrant sending rural communities, especially for women, on financial literacy, disaster preparedness and climate smart agriculture build their resilience against climatic and other disaster risks at household levels
T17.O1_S2.A5	Design and teach courses on Climate change mitigation and adaptation to students of the Environmental Sciences department at KIU under the framework of Mountain Studies, as a mandatory course to be attended by all. Add new areas of research including the most significant threats of GLOF

Objective T 17.02 Develop institutional mechanism and framework for climate action	
Aspect	Adaptation
Responsibility	GBDMA, Finance Department, Population Welfare Department, Home Department, District Administration, PRCS, AKAH, NGOs and locally active INGOs
Time Frame	Medium (2021 – 2028)
Strategy T17.02_S1	Foster action research to identify and address key knowledge gaps concerning climate change, migration, remittance and adaptation nexus in the context of mountain areas
A.#	Actions
T17.02_S1.A1	Engage relevant research and policy institutions to conduct action research on climate change related existing and emerging issues including human mobility, displacement, migration and re-settlement. in the social, economic and environmental contexts of GB
T17.02_S1.A2	Publish articles and position papers to establish and enunciate climate migration and adaptation narratives for the government and other policy forums to discuss and streamline migration, remittance and adaptation in climate change policy discourse
T17.01_S1.A 3	Develop an integrated and interactive Climate Information Management System to manage temporal and spatial information on potential hazards, risks and possible risk reduction strategies / response measures
T17.01_S1.A 4	Regularly organize climate Roundtables at district and GB / provincial levels to deliberate and conclude on existing and emerging climate issues, their drivers, impacts and possible adaptation / mitigation measures to facilitate informed decision making process
Strategy T17.01_S2	Raise awareness among public and decision makers about role of migration and remittances in climate change adaptation at household and community levels
A. #	Actions
T17.01_S2.A1	Organize series of awareness raising sessions for different stakeholders to help them understand the cause and effect relationship of existing as well as emerging climatic vulnerabilities, for effective disaster preparedness and building climate resilience
T17.01_S2.A2	Organize training sessions on financial literacy for flood preparedness to improve adaptation for different segments of society and particularly for those communities living in vulnerable areas to cope with climate risks.
T17.01_S2.A3	Mobilize media (press, radio, cable and TV networks) and especially local journalists to address climate change issues in their programs to educate urban, sub-urban and rural segments of the mountain society about climate change
T17.01_S2.A4	Organize workshops for migrant sending rural communities, especially for women, on financial literacy, disaster preparedness and climate smart agriculture build their resilience against climatic and other disaster risks at household levels
T17.01_S2.A5	Design and teach courses on Climate change mitigation and adaptation to students of the Environmental Sciences department at KIU under the framework of Mountain Studies, as a mandatory course to be attended by all. Add new areas of research including the most significant threats of GLOF.

7. Capacity Building and Institutional Strengthening

Climate change has become a provincial subject after the 18th Amendment to the constitution of Pakistan. This means that, in addition to the devolution of the power of legislation down to the province, it has led to fiscal federalism too. While other provinces of Pakistan have their own revenues to invest in climate change adaptation and mitigation, Gilgit-Baltistan being the most affected region by climate change is dependent on annual grants from the federal government.

The 18th Amendment has not been extended to GB, therefore all federal laws and policies are still valid as governing framework in GB. In practice, however, this is much complicated given the lack of local institutional capacity, lack of financial resources at the disposal of the federal government and the political disenfranchisement of the people of GB. It calls for an efficient institutional mechanism including a well-functioning climate change ministry and an autonomous regulatory function to ensure the compliance of climate change strategy and action plan. GB EPA needs to be further strengthened to help enforce the climate change strategy and action plan in its letter and spirit. Gilgit-Baltistan lacks the requisite professional expertise and institutional strength to deal with the emerging threats of climate change. While fragile ecology multiplies the vulnerabilities of people in the area the consecutive governments did not invest adequately to develop the required human resource and institutional mechanisms to address the emerging threats. Since the climate change has been the least focused area of national policy, investment the share of Gilgit-Baltistan in climate change investment has been much less than the national average despite its ecological significance. In order to tackle the increasing threat of Climate Change it is of utmost importance that Gilgit-Baltistan must have enough climate change scientists, modelers, technologists and experts who can help the government devise a workable roadmap to address the challenges of climate change. Apart from the general challenges of climate change outlined in the National Climate Change Policy, Gilgit-Baltistan has context specific threats which have national and regional impacts. For instance, the rapid melting of glaciers due to rise of temperature has far reaching impacts for Pakistan and South Asia. In the absence of credible institutions and policy think-tanks it would be an uphill task for the government to initiate a process of regional engagement for collective action against the impending threats of climate change. Similarly, there is a lack of credible institutions in Pakistan to deal with comprehensive climate change. There are also some other context specific threats like GLOF whereby the provincial government of Gilgit-Baltistan lacks human and institutional capacity as well as the technology to mitigate risks and devise a comprehensive adaptation plan. In order to overcome these human, institutional and technological deficiencies, the government of Gilgit-Baltistan will take the following steps.

7.1. Policy Measures

7.1.1. Institutional framework

- GB EPA to serve as the focal institution for providing a coordination role and also for steering and guiding the implementation of GB's Climate Change Strategy and Action Plans.
- A regional Climate Change Steering committee to be formed by GB EPA, comprised of members from all relevant departments of GB Government, to oversee the implementation

of CC Strategy, action plans and projects/initiatives. Composition and TORs of CC Steering Committee should be devised by the Focal institution after consultations required.

- Appoint Climate Change focal persons in each relevant department of GB Government, to mainstream climate change as a key ingredient of development planning.
- Establish an autonomous policy think-tank for technical backstopping.
- Develop a robust monitoring, reporting and verification regime for assessing the emission reductions, GLOF threats, cryosphere depletion and hydrological flows
- Develop the local institutional capacity for undertaking tasks related to the implementation of national commitments on climate change and to address the context specific challenges
- Develop an integrated framework to connect climate change and development planning and priorities for the long term socioeconomic transformation of Gilgit-Baltistan.
- Integrate the action plans of agriculture, water, forest, energy, GLOF and other DRR related climate-induced vulnerabilities and make them part of all relevant policy documents.
- Make all necessary arrangements to realign administrative structures and procedures of GB-EPA and department of Planning and Development to integrate and address climate change concerns during the initial screening of environmental assessment processes
- Ensure the compliance of IEE/EIA and other screening protocols in all development projects, particularly infrastructure projects, by the concerned agencies on merit

7.1.2. Capacity Enhancement

- Develop a critical mass of climate change champions within each ministry with dedicated responsibility to engage policy makers for the integration of climate change
- Establish climate change fund in coordination with the Federal Ministry of Climate Change to finance the research of young climate change scientists on the merit basis.
- Establish a provincial climate change research institution and equip it with modern facilities, technology and human resource to produce quality research in coordination with the leading global universities and local communities
- Introduce curriculum on climate change and environmental planning with particular emphasis on Disaster Risk Reduction (DRR) and GLOF and introduce it into the formal education system as coursework at Karakorum International University and postgraduate colleges
- Improve the capacity of existing institutions like EPA, forestry and wildlife department and establish clean Development Mechanism unit to generate revenue from carbon-trading.
- Develop knowledge-based management and networking with strategic climate change research establishments and academic institutions like KIU and Upper Indus Basin Network to benefit from cutting edge research on climate change.
- Arrange training programs, sensitization drives and organize exposure visits of international best practices to key staff and experts of line departments to equip them for climate action

- Develop a formal mechanism to measure and monitor seasonal carbon emissions from various sectors including trans-boundary pollution and maintain a database as a policy support system
- Develop a vulnerability map based on the potential threats of disaster and prepare an area specific mitigation and adaptation plan
- Expand and upgrade meteorological services, early warning systems and monitoring stations in various disaster-prone areas parts, particularly in the regions identified with GLOF risks.
- Ensure capacity development for making reliable projections of climate changes scenarios, seasonal forecasts and inter-annual forecasts across Gilgit-Baltistan
- Promote the use of GIS/RS based studies to assess and quantify past temporal trends and monitor future changes in snow cover, glacial volume, glacial lake formation and burst, deforestation, land degradation and soil erosion
- Undertake scientific studies to preserve glaciers and explore grafting techniques.



8. Awareness Raising

Campaigns of community engagement and public education are instrumental to create awareness of climate change issues and its impact on the life, livelihood and nature. These campaigns can be carried out through community-based organizations, social networks, social media platforms, radio and local newspapers so that the public becomes aware of and is well prepared to cope with the potential threats of disasters. The Government of Gilgit-Baltistan in collaboration with concerned entities will take the following measures for awareness raising;

8.1. Policy Measures

- Conduct surveys across Gilgit-Baltistan to map the perceptions, opinions and functional capabilities of key stakeholders and potential partners to cope with disasters
- Develop a provincial climate change awareness program involving communities, various ministries and departments;
- Ensure advocacy and mass awareness regarding the importance of water and energy conservation, the impact of climate change on various sectors including forest ecosystems, biodiversity and so on, using mass media, public private partnerships, students and community mobilization; and incorporate these issues into the formal education systems at all levels;
- Arrange climate change sensitization workshops for local policy makers including government officials, ministers and media persons



References and Useful Links

- BBC News, 12 May 2012, Pakistan declares Siachen avalanche buried dead.
- Bugmann, H. (2001). Global change and mountain regions (No. 363.73874 G562g). A. Becker (Ed.). IGBP.
- Burck, J., Marten, F., Bals, C., & Höhne, N. (2014). The climate change performance index: Results 2015. Berlin: Germanwatch.
- Chaudhry, Q. Z., et al, 2004, Agro-climate classification of Pakistan, Science Vision, Vol.9 No.1-2 (Jul - Dec, 2003) & 3-4 (Jan - Jun, 2004)
- Din, K., Tariq, S., Mahmood, A., & Rasul, G. (2014). Temperature and precipitation: GLOF triggering indicators in Gilgit-Baltistan, Pakistan. Pakistan Journal of Meteorology, 10(20).
- European Union, Joint Research Centre – Emission Database for Global Atmospheric Research (EDGAR).
- Fitzharris, B. B. (1996). The cryosphere: changes and their impacts. CAMBRIDGE UNIVERSITY PRESS, NEW YORK, NY(USA)., 241-265.
- Government of Pakistan and IUCN, 2003. Northern Areas Strategy for Sustainable Development. IUCN Pakistan, Karachi. xxiii+85 pp.
- Government of Pakistan, (2005), National Environmental Policy, 2005. Islamabad: Ministry of Environment.
- Government of Pakistan, (2012), National Climate Change Policy, 2012. Islamabad: Ministry of Climate Change
- IPCC Special Report on Emissions Scenarios, 2000, IPCC Working Group III, Intergovernmental Panel on Climate Change.
- IUCN Pakistan Program, 2003, background paper on water, Northern Areas Strategy for sustainable development
- IUCN Pakistan Program, 2003, Customary Laws governing natural resource management in Northern Areas
- Jaffery, S. H. I., Khan, M., Ali, L., Khan, H. A., Mufti, R. A., Khan, A., & Jaffery, S. M. (2014). The potential of solar powered transportation and the case for solar powered railway in Pakistan. Renewable and Sustainable Energy Reviews, 39, 270-276.
- Jodha, N. S. (1992). Mountain perspective and sustainability: A framework for development strategies.
- Ledley, T. S., Sundquist, E. T., Schwartz, S. E., Hall, D. K., Fellows, J. D., & Killeen, T. L. (1999). Climate change and greenhouse gases. Eos, Transactions American Geophysical Union, 80(39), 453-458.
- Meier, M.: 1998, Land Ice on Earth: A Beginning of a Global Synthesis. American Geophysical Union Spring Meeting, Boston, MA, 26 May 1998
- Ministry of Climate Change, Government of Pakistan: Policies and Plans. Accessed from:
- Noble, I., & Gitay, H. (1998). Climate change in desert regions. The Regional Impacts of Climate Change, 191-217.
- Pachauri, R. K., Allen, M. R., Barros, V. R., Broome, J., Cramer, W., Christ, R., ... & Dubash, N. K. (2014). Climate change 2014: synthesis report. Contribution of Working Groups I, II and III

to the fifth assessment report of the Intergovernmental Panel on Climate Change (p. 151). IPCC.

- Pakistan Meteorological Department, 2009, Climate Change indicators of Pakistan, Technical Report No. PMD-22/2009, August 2009
- Rasul, G. (2010). An analysis of knowledge gaps in climate change research. Pakistan Journal of Meteorology, 7(13).
- Rasul, G., Chaudhry, Q. Z., Mahmood, A., Hyder, K. W., & Dahe, Q. (2011). Glaciers and glacial lakes under changing climate in Pakistan. Pakistan Journal of Meteorology, 8(15).
- Ribot, J. (2010). Vulnerability does not fall from the sky: toward multiscale, pro-poor climate policy. Social dimensions of climate change: Equity and vulnerability in a warming world, 2, 47-74.
- Shabir, O. (2013). A summary case report on the health impacts and response to the Pakistan floods of 2010. PLoS currents, 5.
- Solomon, S. (Ed.). (2007). Climate change 2007-the physical science basis: Working group I contribution to the fourth assessment report of the IPCC (Vol. 4). Cambridge university press.
- Solomon, S. (Ed.). (2007). Climate change 2007-the physical science basis: Working group I contribution to the fourth assessment report of the IPCC (Vol. 4). Cambridge university press.
- The Ministry of Finance, Government of Pakistan, Economic Highlights 2014 -2015.
- UNFCCC 2005, The Kyoto Protocol, United Nations Framework Convention on Climate Change.
- World Bank, 2010, Gilgit-Baltistan Economic Report: Broadening the Transformation, Report No. 55998-PK, Document of the World Bank, Washington DC.
- Hussain, Amir , 2021, The News: Integrating GLOF into policy
- Hussain, Amir , 2021, The News: GLOF, vulnerabilities and local action



Annexures

Annexure A: Analysis of thirty years' climate data

The thirty years' climate data record acquired from Pakistan Meteorological Department, is analyzed as primary data for estimating the variations in temperature and precipitation levels. The datasets contain records for mean monthly minimum and maximum temperatures; and precipitation levels for Gilgit, Skardu, Astore, Chilas and Gupis from 1984 to 2013. The data for Hunza is available only from 2007 to 2013. This solely available climate data for the major towns of Gilgit-Baltistan is considered to be credible and representative for the whole region except for the high altitude and alpine areas.

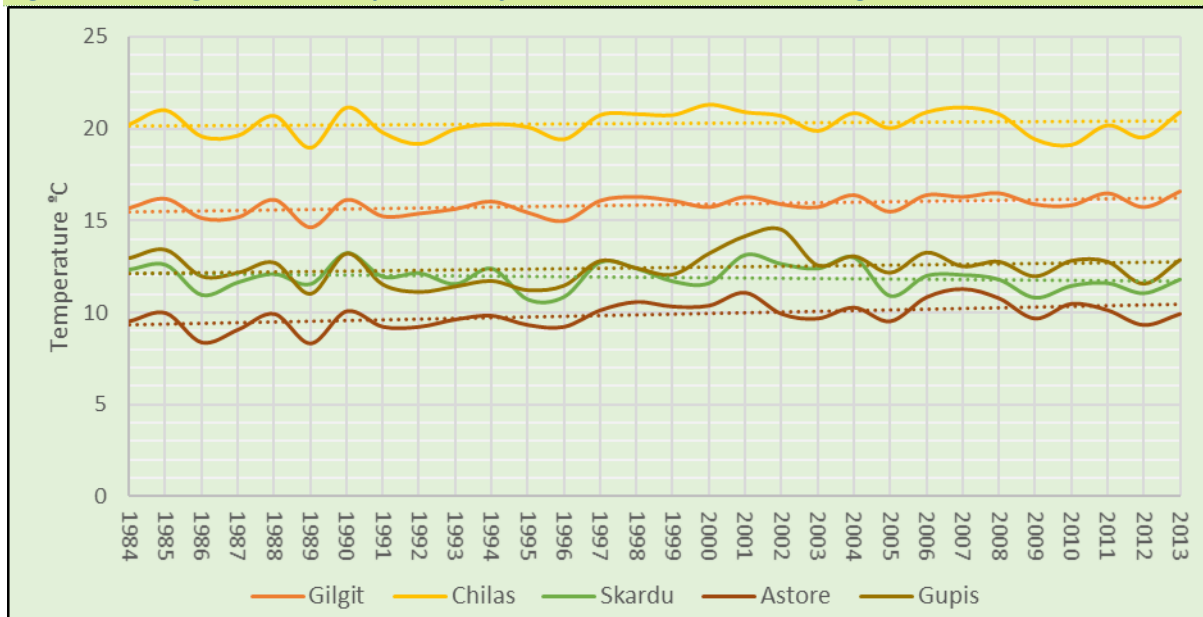
Based on this information, linear trends have been derived for assessment of changes and variations in climate and their impact on ecology and socioeconomic environment in Gilgit-Baltistan over the period of time. These trends have been linked with the climate scenarios for the future assuming that the ongoing trends will persist in the decades to come. These findings underpin the strategies and actions for adaptation and mitigation in the face of impacts of climate change being experienced in the region.

The preceding data models based on aggregate data show that the region has gone through climatic fluctuations during the last thirty years. It can be observed that the spread and variation in maximum and minimum temperatures have remained significant for twelve months during the past three decades. The total annual precipitation data shows that the region receives most of its precipitation during the months of February to May. Climate change impacts are driven in Gilgit-Baltistan at the expense of glaciers and snow on mountain ranges. For it is now established that the glaciers in the HKH ranges have absorbed more heat compared to the plain areas during the last half century.¹

¹ Ghulam Rasul et al, Glaciers and Glacial Lakes under Changing Climate in Pakistan, Pakistan Journal of Meteorology, Vol. 8, Issue15.

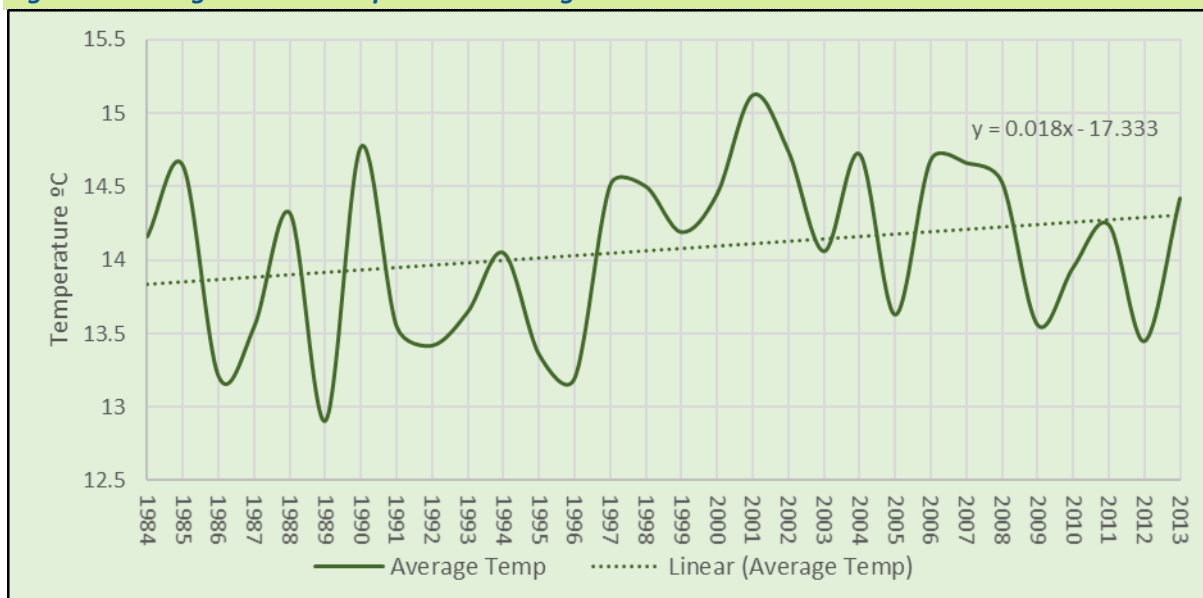
a) Trends in Temperature Levels

Figure 5: Average Annual Temperature of Five Weather Stations in Gilgit-Baltistan



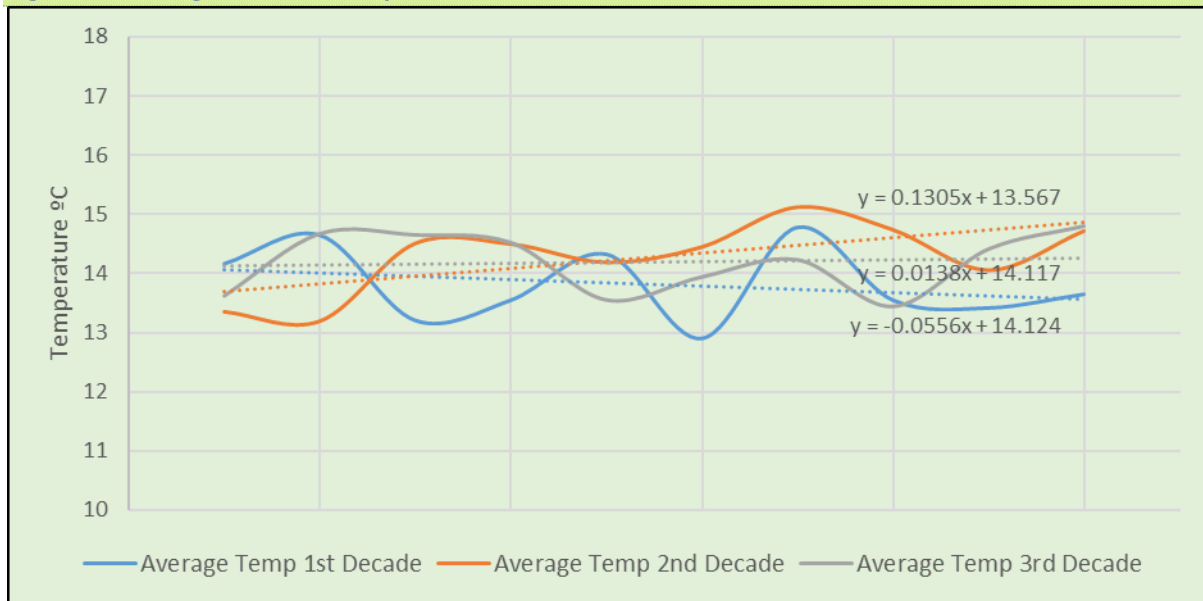
An annual increase in average temperatures for five weather stations can be found in all temperature records except of Skardu, mean temperatures for Gilgit, Gupis, Chilas and Astore for the period of 1984 to 2013 showed an overall annual increasing trend of +0.85, +0.84, +0.25 and +1.197 °C one to one. Whereas, Skardu showed a decreasing trend of -0.45 °C.

Figure 6: Average Annual Temperatures in Gilgit-Baltistan



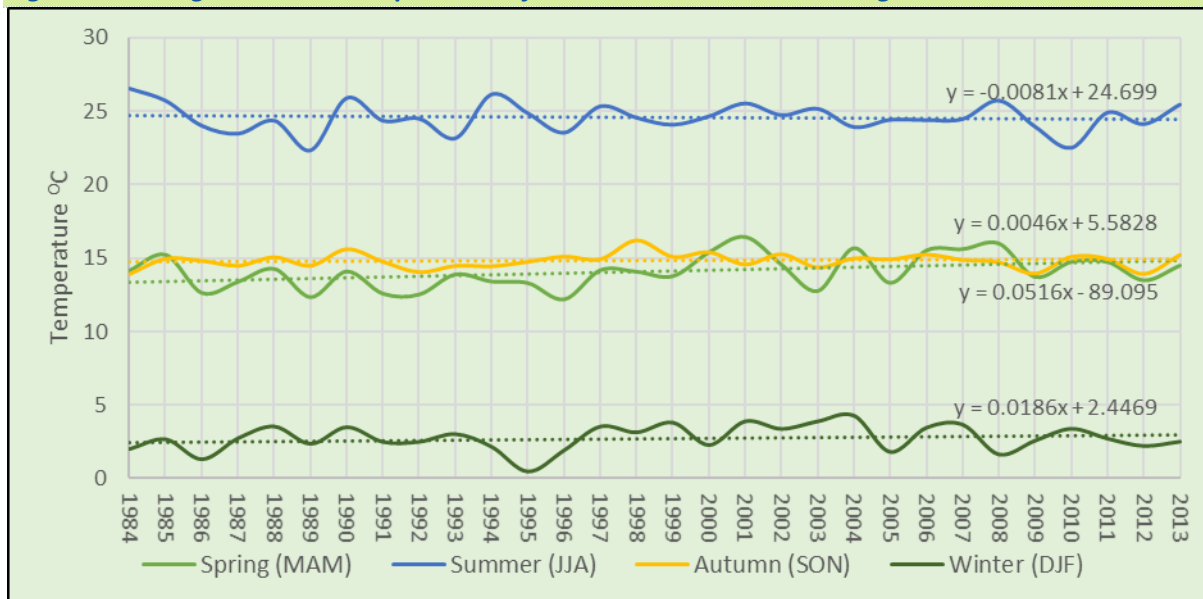
Average annual temperature of three Decades (30 years) from five weather stations installed at Astore, Gilgit, Chilas, Gupis and Skardu showed an increase of + 0.18 °C per decade.

Figure 7: Average Decadal Temperatures



A decrease of - 0.5 °C was recorded during 1st decade (1984-1993) followed by an upsurge of 1.2 °C in the course of 2nd decade (1994-2003) and a decline of -0.5 °C for 3rd decade (2004-2013). Decade 1st and 3rd showed an equal decreasing trend but a shift of +0.68 °C can be seen among these two decades.

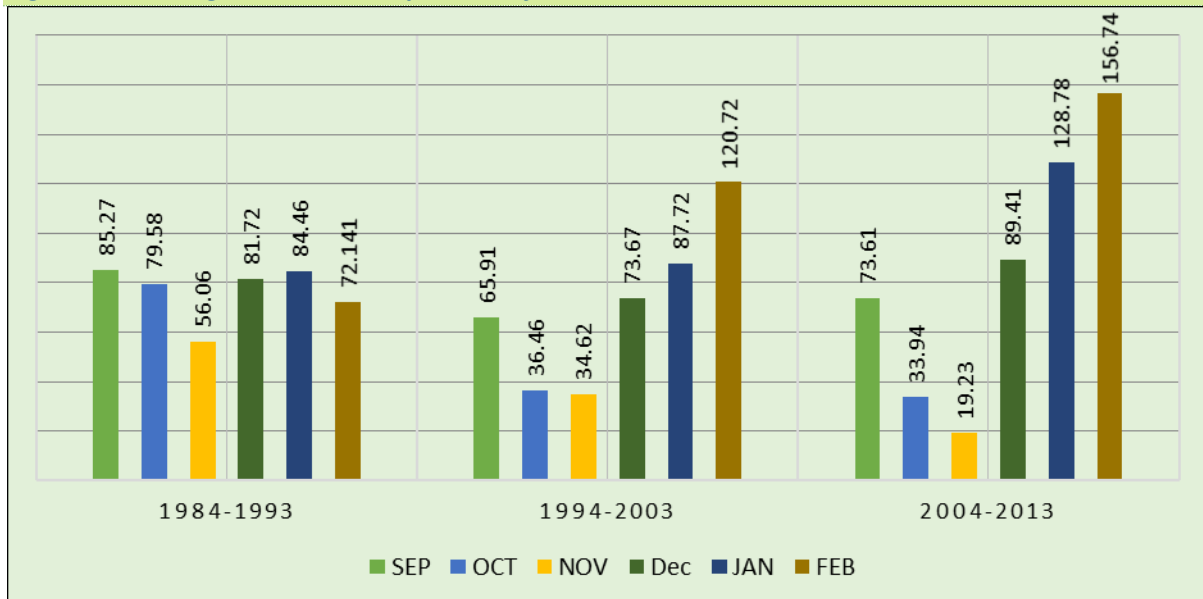
Figure 8: Average Seasonal Temperature of Five Weather Stations in Gilgit-Baltistan



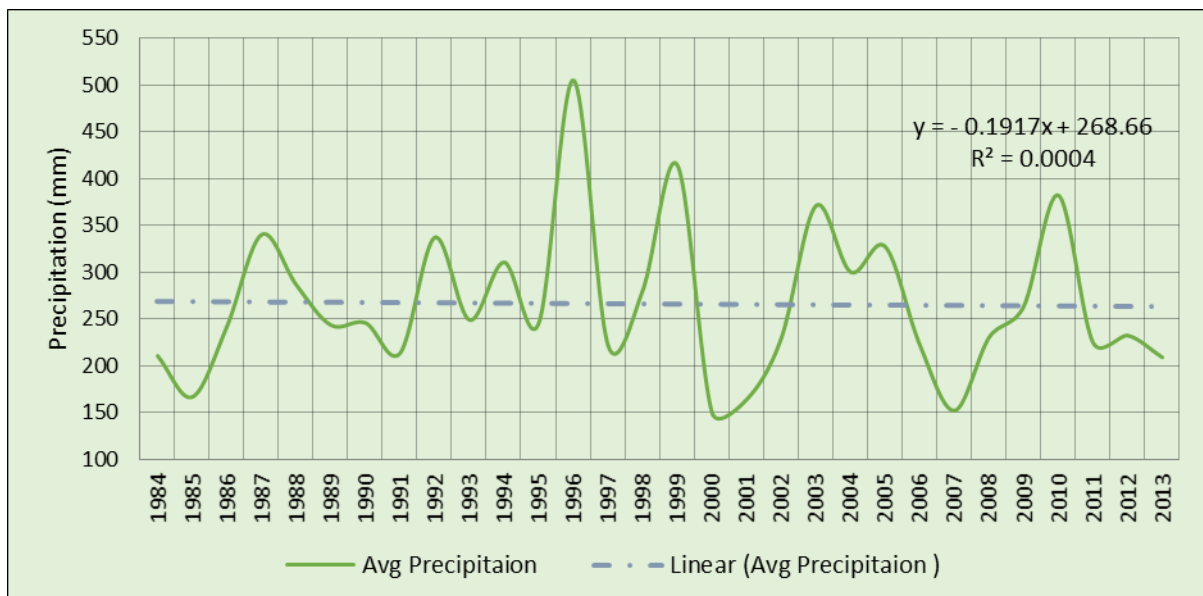
A seasonal increase in annual mean temperature of five weather stations during winter (DJF), autumn (SON) and spring (MAM), and a decrease in summer can be shown in all-time series. An upsurge of +0.5, +0.138 and + 1.548 °C for winter, autumn and spring was recorded respectively while summers showed a decreasing trend of -0.243 °C. This reflects warming in winters, spring and autumn and cooling in summer temperature.

b) Trends in Precipitation Levels

Figure 95: Average Decadal Precipitation of Five Weather Stations in GB



During 1st decade the total annual precipitation was increased by 60 mm, followed by a decrease of 76 and 40 mm during second and third decade. A decreasing trend in precipitation of September, October and November and increasing in January and February from 1984 to 2013 can be observed in the above exhibit. The exhibit below shows an average decrease of 5.7 mm in precipitation for a recorded period of thirty years. Figure 60: Average Precipitation of Five Weather Stations





Gilgit-Baltistan Environmental Protection Agency (GB-EPA)

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