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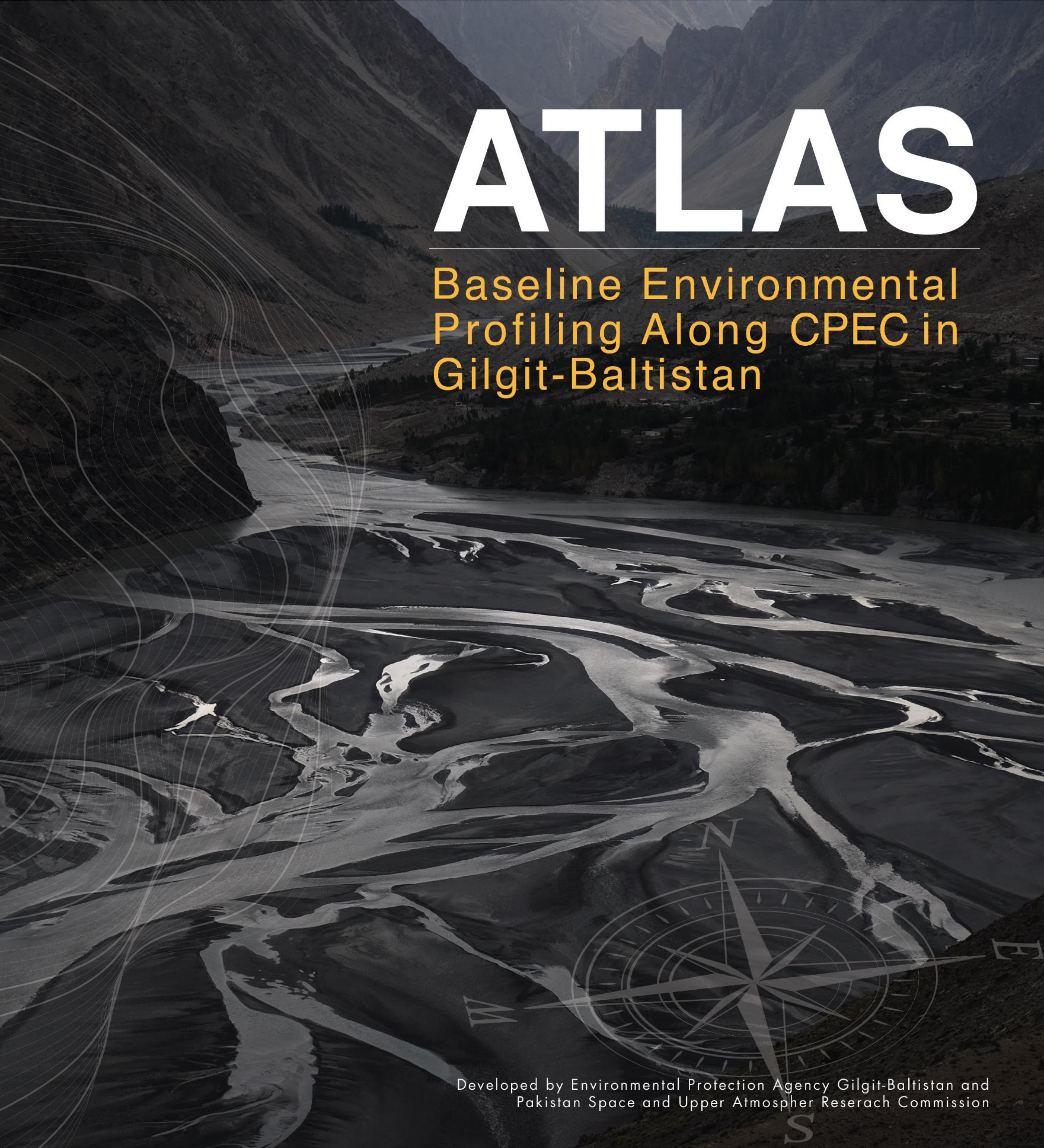
ATLAS

Baseline Environmental Profiling Along CPEC in Gilgit-Baltistan



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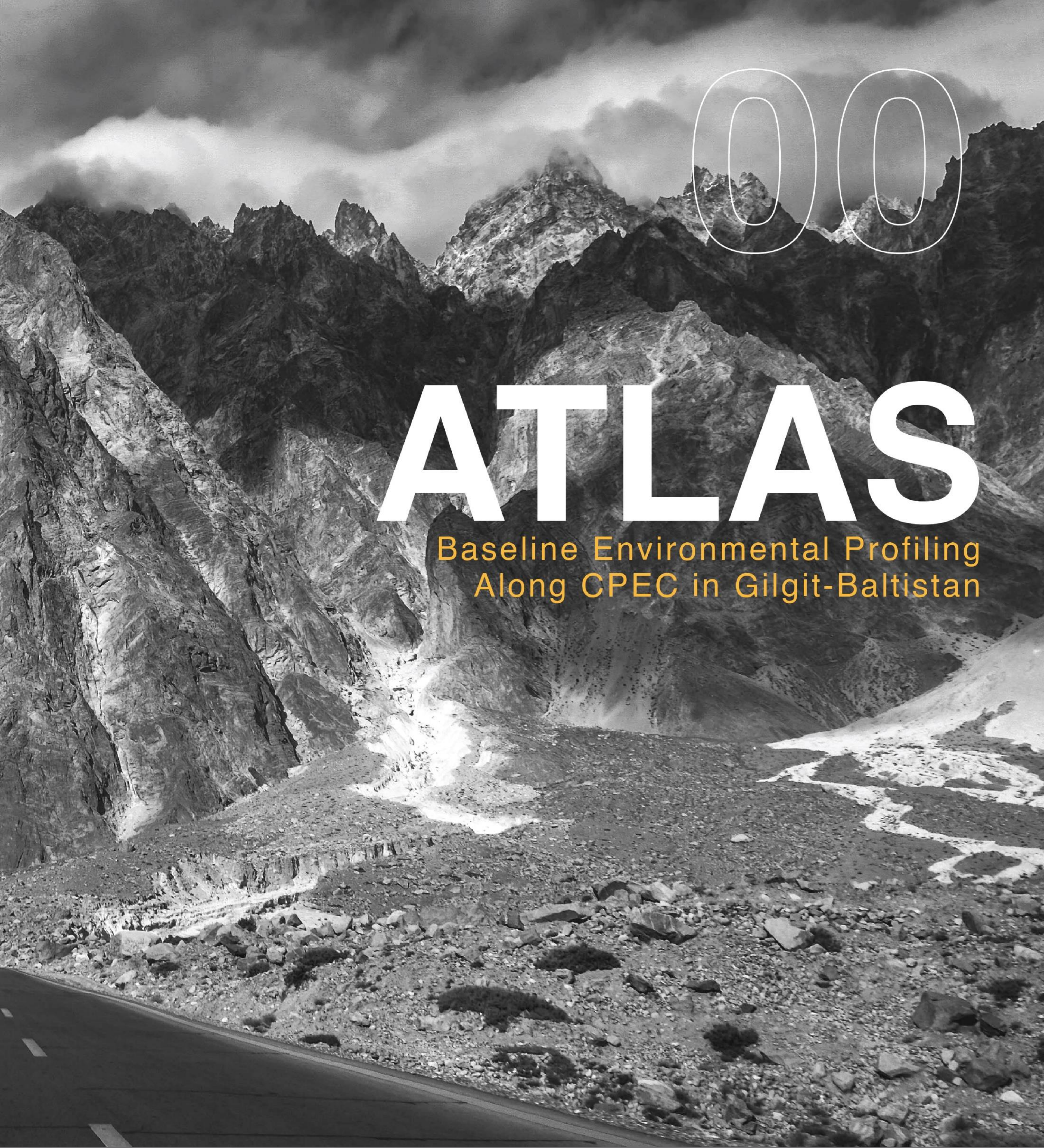

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ATLAS

Baseline Environmental Profiling Along CPEC in Gilgit-Baltistan

List of Acronyms

asl	Above Sea Level
BC	Black Carbon
CNES	Centre National D'études Spatiales
CO	Carbon monoxide
CPEC	China Pakistan Economic Corridor
dBA	Decibel ‘A’ scale (Sound intensity with ‘A’ contour filter)
E.Coli	Escherichia Coliform
EPA	Environmental Protection Agency
GB	Gilgit-Baltistan
HKH	Hindukush, Karakoram, Himalaya
km	kilometer
Leq	Equivalent Continuous Noise Level
mg	Milligram
mg/l	milligram per liter
µg	Microgram
MPN	Most Probable Number
MS	Multispectral
NEQS	National Environmental Quality Standards
ng	Nanogram
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of Nitrogen
NSDWQ	National Standards for Drinking Water Quality
NTU	Nephelometric Turbidity Unit
O_3	Ozone
PAN	Panchromatic
pH	Power of Hydrogen Ions
PM	Particulate Matter
ppm	parts per million
SEL	SUPARCO Environmental Laboratory
SO_2	Sulfur dioxide
SPOT	Pour l’Observation de la Terre
SUPARCO	Pakistan Space & Upper Atmosphere Research Commission
T.Coli	Total Coliform
TDS	Total Dissolved Solids
WHO	World Health Organization

Foreword

Environmental degradation such as air pollution, fresh water contamination; destruction of natural ecosystems e.g., glacier melting, deforestation; land disturbance; and extinction of biodiversity has become a common concern for humankind over the past few decades. The distinctive nature of the present environmental problems is that these are caused more by anthropogenic rather than natural phenomena. Mindless consumerism and craze for economic growth have started to generate pernicious effects for 'Mother Nature'. The modern technological progress, we are so proud of, is actually the root cause of the environmental deterioration. Despite this, the pace and desire for economic development has never ceased; and the jargon of 'sustainable development' has become a buzzword.

Nature has bestowed Gilgit-Baltistan (GB), the land of beauty, with unique attributes such as eye-catching landscapes, lush green environment, clear sky, crystal-clear waters, and massive glaciers which are water towers of Indus River. It is a well-known fact that cumulative human intrusions and developmental activities coupled with global warming have already begun to contribute to deteriorating the natural ecosystem of GB in the form of glacier melting, avalanches, glacial lakes outburst floods, contamination of drinking water among other environmental issues. In fact, these issues are now far beyond the scientific matter, rather they have become the national security threats. If they are ignored and unaddressed, these challenges may trigger negative socioeconomic and environmental impacts in the region by undermining the potential of the game-changing China Pakistan Economic Corridor (CPEC) project.

To cope with this critical situation, we need to make optimum use of natural resources, adopt environment-friendly practices, develop mechanism for environmental information management, and formation of coordinated environmental institutions as well as the formation of new laws and policies. In order to turn these ambitions into the actions, we need reliable data and comprehensive information on the subject.

The Atlas of Baseline Environmental Profiling along CPEC in Gilgit-Baltistan is a major landmark in this regard. I must congratulate Gilgit-Baltistan Environmental Protection Agency (GB-EPA) and Pakistan Space & Upper Atmosphere Research Commission (SUPARCO) for pooling their tremendous efforts in collecting & compiling environmental and land cover data and its transformation into the Atlas form. I am pleased to see that the new knowledge on these topics has been generated and visualized through this Atlas, in which high quality scientific knowledge has been made available in simple tabular / graphical form and language for policy makers, researchers, and general public. The baseline data presented in the Atlas provides comprehensive information of present trends, and would serve as the reference point to examine future changes in environment and ecosystem of Gilgit-Baltistan.

I look forward to more joint scientific endeavors by SUPARCO and other government departments.

Sumair Ahmed Syed
Secretary
Forest, Wildlife & Environment,
Government of Gilgit-Baltistan

Acknowledgement

The first edition of Atlas of Baseline Environmental Profiling along CPEC in Gilgit-Baltistan has been prepared through a partnership of Gilgit Baltistan Environmental Protection Agency (GB-EPA) and Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) under Memorandum of Understanding (MoU) for scientific research between the two institutions. This Atlas is the product of a combination of Remote Sensing and Geographical Information System (RS/GIS) technologies, in-situ monitoring, and laboratory analysis of environmental samples. The baseline data presented here will help to identify priority areas to conserve natural resources; track air, water and noise pollution and environmental hazards; detect changes in land use, and discern likely impacts of climate change and anthropogenic activities on natural resources in the region.

Despite being most disaster-prone and ecologically fragile region, our knowledge of present state of environment and impacts of climate change on the ecosystem of Gilgit-Baltistan (GB) is limited. Over the last few decades, there have been many environmental studies carried out in GB, but these studies were confined to limited areas or their findings had not been reached to decision-makers. Therefore, perseverance for gathering and integrating the baseline information about key environmental indicators including air, water, noise pollution and land cover changes in GB was need of the hour, especially along CPEC that could provide a concrete ground for a comprehensive environmental legislation on certain issues to protect natural resources and ensure sustainable development in the region. The Atlas is designed to give an analytical assessment of the environmental and different features of land cover so that the policy makers could infer their timely actions to secure the state of natural resources and devise environmental management programs in the region.

The present Atlas is an initial step towards collection of information about different environmental indicators alongside the CPEC in GB. The next step would be to expand the spatial coverage of environmental assessments throughout GB with inclusion of more disciplines including climate change, soil quality, biodiversity, cryosphere, glacial lakes, hydrology and others. I hope that this endeavor will not only make good use of updated knowledge, but will be invaluable in informing researchers and policy makers to build social and ecological resilience in the region.

I am thankful to GB Government for its support in terms of providing financial resources to conduct the baseline study. I hereby acknowledge the invaluable technical support of SUPARCO, especially the Project Director, Dr. Jawad Nasir and his whole team. Last but not the least, I would like to express my sincere gratitude to Chairman SUPARCO and Member, Space & Application Research Wing, SUPARCO because the completion of this project would not be possible without their patronage.

Shehzad Hasan Shigri
Director, GB-EPA
Gilgit-Baltistan

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Executive Summary

The China-Pakistan Economic Corridor (CPEC) intends to provide breakthrough in the provision of infrastructure including energy, communication, special economic zones and development of Gwadar city and port in Pakistan. These projects will definitely boost country's economy by generating numerous business and employment opportunities for local citizens as well as international outreach to Pakistani markets. However, for sustainable development, equal attention must be paid towards environmental implications of the project.

The anticipated impacts of the project may be air pollution, contamination of fresh water resources, rise in regional temperature, glacier melt, deforestation, and biodiversity loss etc. Gilgit-Baltistan (GB) holds a pivotal position in this project as it is the 'Gateway to CPEC' in Pakistan, yet there is a scarcity of baseline data to ascertain the present state of the environment, and to assess potential future changes in it. To overcome this knowledge gap, Gilgit-Baltistan Environmental Protection Agency (GB-EPA) joined hands with SUPARCO to conduct "Baseline Environmental Profiling along CPEC in Gilgit-Baltistan" under a development project of GB Government.

In this regard, initially following four environmental indicators were monitored / mapped to assess their present state, covering the area along CPEC from Khunjerab Top to Basari;

1. Quality of freshwater resources
2. Ambient air quality with meteorological conditions
3. Noise levels
4. Present extent of different types of land covers by mapping through high resolution satellite imagery including glaciers.

In order to monitor the water, air and noise levels (S.No. 1 to 3), SUPARCO teams conducted field surveys in GB during winter (25 Nov to 20 Dec 2019) and summer (16 Aug to 09 Sep 2020). In each season, water samples were collected from 28 locations including rivers, glacial streams and springs from Indus main stream, Hunza sub-basin and Gilgit sub-basin. The collected samples were tested for physical, chemical and biological parameters in SUPARCO Environmental Laboratory (SEL). The results were evaluated against National Standards for Drinking Water Quality (NSDWQ) of Pakistan. Some parameters, for which the permissible limits are not defined by NSDWQ, were assessed against World Health Organization (WHO) guidelines. Among physical parameters of water quality, electrical conductivity levels of all selected water bodies except Danyor Spring met recommended limits of WHO. The concentration of Total Dissolved Solids (TDS) in all water samples were within permissible limits of NSDWQ whereas turbidity of some water samples in Hunza, Danyor and Chilas exceeded the NSDWQ.

Among chemical parameters, pH of all water samples in summer season were detected within the range of NSDWQ (6.5 – 8.5), whereas during winter, pH of few water samples from Hunza sub-basin, Gilgit sub-basin and Indus main stream were found slightly higher (up to 9.3) than NSDWQ. Level of dissolved oxygen in all water samples were within the recommended range by WHO. Total hardness of all water bodies in both seasons met permissible limit of NSDWQ except two sites i.e., near Chilas and Diamer-Basha Dam. Concentration of anions (i.e., chloride, fluoride, nitrate & sulphates) and cations (i.e., calcium, magnesium & sodium) during both summer and winter seasons were found within permissible limits of NSDWQ. Among heavy metals, lead and arsenic were detected in more than 50% of total water samples (including Hunza river basin, Gilgit river basin and Indus main stream) whereas cadmium and mercury were detected in less than 15% of total water samples collected from three basins. However, except mercury, the concentrations of cadmium, lead and arsenic were found as per recommended limits by NSDWQ.

Regarding the biological parameters, the bacterial contamination (including Total Coliforms and Escherichia Coliform) was found in 82% of water samples collected during summer and 48% of water samples collected during winter. The positive correlation between the growing rate of human interference in watershed areas and degradation in water quality parameters is well recognized. Therefore, in context of increasing anthropogenic activities during the operational phase of CPEC, it is recommended that basin-wise watershed management studies may proactively be initiated in GB.

Ambient air quality and noise level monitoring was carried out in five cities of GB including Sost, Hunza, Gilgit, Jaglot and Chilas in summer and winter seasons. Continuous air monitoring was conducted for gaseous pollutants including Carbon Monoxide (CO), Sulfur Dioxide (SO_2), Oxides of Nitrogen (NO + NO_2) and Ozone (O_3); as well as aerosol pollutants including Black Carbon (BC) & Particulate Matter of diameter less than or equal to 2.5 micrometer ($PM_{2.5}$). The average atmospheric levels of gaseous pollutants (CO, SO_2, NO, NO_2 & O_3) in all cities were observed within National Environmental Quality Standards (NEQS) of Pakistan during summer and winter seasons. On the other hand, the average 24 hours atmospheric levels of $PM_{2.5}$ in Gilgit and Chilas were beyond the recommended NEQS levels in winter season. The general trend of air pollutants in selected cities were in the order of Gilgit > Chilas > Hunza > Jaglot > Sost in both seasons.

Average day & night time noise levels in commercial areas like Sost Check Post, Karimabad & Aliabad (Hunza), Danyor & near Gilgit Airport (Gilgit), Jaglot, and Chilas met permissible limits of NEQS for commercial area in winter season. Same trend was also observed in summer season for these sites except near Gilgit Airport where day time noise levels were beyond the safe limit for commercial areas. In both seasons, the average day time noise levels in aforementioned sites were found exceeding the NEQS for residential areas except in Jaglot during winter. In Gircha & Khudabad (Sost), the average day / night time noise levels were found within the NEQS for residential & commercial areas in both seasons.

In order to reduce or control the anthropogenic emissions in GB during operational phase of CPEC, it is recommended to establish permanent air quality monitoring stations at critical locations along CPEC for year-round monitoring of gaseous and aerosol pollutants. In addition, strict measures are required to restrict the extensive use of Non-Custom Paid (NCP) vehicles by introducing mass transit system for local commuting; and also discourage the burning of solid waste (plastic material, tires etc.) for heating purpose by seeking the potential for renewable energy resources. Government of GB may set & adopt its own air emission standards keeping in view the local situation and sensitivity of natural ecosystem.

For land cover classification and mapping, SPOT satellite data was acquired along CPEC in GB region for the year 2017-2018. Mostly, the post-monsoon scenes were selected to map the land cover, keeping in view minimum cloud cover and temporary snow cover. A total of 26 satellite images were acquired to digitize/ classify the CPEC region with 20 Km buffer, covering an area of 7578.814 Km^2 encompassing five districts of GB i.e., Hunza, Nagar, Gilgit, Astore and Diamer. Although, CPEC does not include Astore district however due to 20 Km buffer alongside Karakoram Highway, a minor fragment of Astore district also included in the study area. Overall, thirteen land cover classes are mapped including agriculture, forest, rangelands, glaciers, snow cover, lakes, rivers, natural vegetation in wetlands, settlements among others. Hunza & Nagar districts are found with largest area of glaciers and permanent snow cover whereas Diamer district hosts larger area of rangelands and forest cover as compare to other districts in the study. Gilgit district contains largest built-up area as compare to other districts in study. In addition to district-wise land cover classification & mapping, the study area alongside CPEC was also distributed in 62 zones for in-depth land cover classification.

This atlas is comprised of four chapters. Chapter 1 (Introduction) covers background of the project; Chapter 2 describes findings on fresh water quality monitoring whereas Chapter 3 reports the outcomes of air quality, meteorology and noise levels monitoring. Chapter 4 contains land cover classification / mapping along CPEC in GB. The hourly data of air pollutants & noise levels in five GB cities and their diurnal graphs for all study sites are given in Annexures I to IV. All photographs and satellite images presented in the Atlas were acquired / processed by SUPARCO.

01

INTRODUCTION

Chapter One

1. Introduction

1.1 Project Background

The China-Pakistan Economic Corridor (CPEC) constitutes a network of roads, railway tracks, oil and gas pipelines, and economic zones linking the Western part of China to the Gwadar Port in Pakistan running some 3000 km from Xinjiang to Gwadar via Khunjerab Pass in GB region of Pakistan (Figure 1.1). GB region is uniquely situated at the confluence of the world's three great mountain ranges: Himalaya, Karakoram and Hindukush (HKH).

The HKH glaciers are headwaters of Indus River, which is aptly termed as "The lifeline of Pakistan". The melt water from these glaciers contributes more than 50% to the total annual runoff in the Indus River system for human consumption, agriculture, industries, and hydropower generation in Pakistan.

It is a well-known fact that man-made activities had posed devastating impacts on glaciers stability, snow cover and hydrological cycles in Tibetan Plateau, Himalayas and Polar Regions as well. Since, more than 400 km of the CPEC route passes through Gilgit-Baltistan, therefore, it is envisaged that human interventions coupled with changing patterns of global climate could have devastating impacts on glaciers stability, snow melt patterns and hydrological cycles. This could lead to disturbance in downstream water supplies, resulting in distressing effects on country's economy.

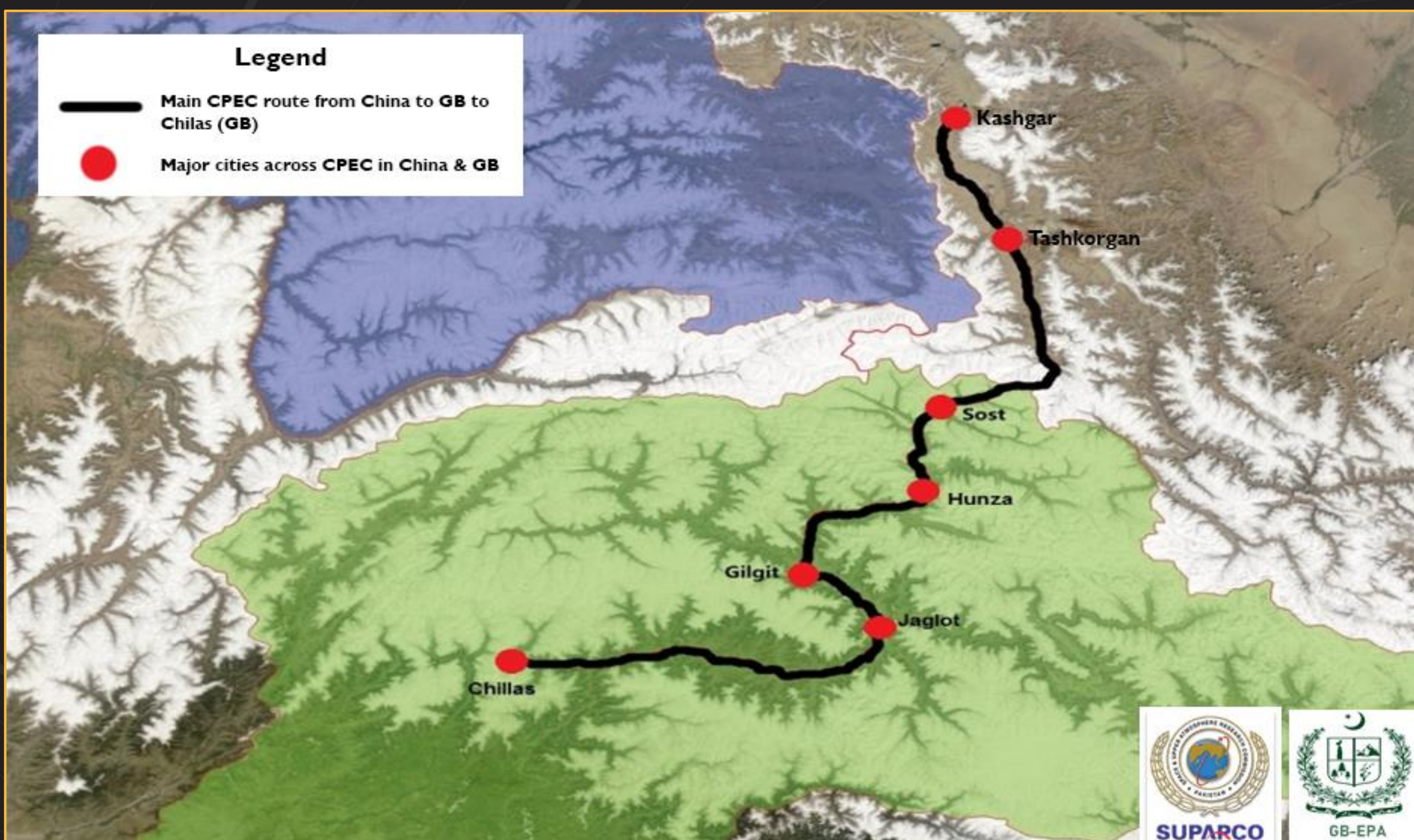


Figure 1.1: CPEC route in GB and area covered under the study (From Sost to Chilas)

SUPARCO & GB-EPA Officials during Air Monitoring in Gilgit


Water sampling from Hunza River by SUPARCO Officials

There is pressing demand of environmental enforcement in GB due to increasing pressure on natural resources, environmental pollution by development activities, transportation of goods via heavy vehicles, solid waste generation due to tourism and others. Under these circumstances, there is a pivotal role of GB-EPA to ensure the sustainability of the project in terms of ecological conservation, which requires reliable and comprehensive information on changes in the quality of ecosystem, and on the causes of those changes for efficient surveillance and control measures. However, there is no officially updated database exists reflecting the current state of the environment and health of glaciers alongside CPEC.

GB region with total area of 72,496 sq. km and population of 1.5 million is administratively divided into three divisions naming Gilgit, Baltistan and Diamer-Astore. As CPEC starts near the China border at Khunjerab up to Chilas, it covers only Gilgit and Diamer-Astore Divisions. Therefore, the baseline environmental profiling is limited to these two divisions.

1.2 Objective

The objective of the project is "to gather baseline information about key environmental indicators (including air, water, noise, and land cover changes) along CPEC in GB. The data will be used to compare the state of environment during development and post-operation phases of CPEC in order to ensure the protection of natural resources and sustainable development in the region".

Following activities were performed to achieve the objective:

1. Monitoring the quality of freshwater resources
2. Ambient air quality and meteorological monitoring
3. Noise level monitoring
4. Land cover classification and mapping by using high resolution satellite imagery

1.3 Project Kick-off Meeting

GB-EPA awarded the contract to SUPARCO on 17 Oct 2019. The kick-off meeting of the project was held between the officials of SUPARCO and GB-EPA at GB-EPA office, Gilgit on 25 Nov 2019 (Figures 1.2 & 1.3). Following officials participated in the meeting:

Table 1.1: Official Project Team

Organization	Officials	Designation
GB-EPA	Mr. Shehzad Hasan Shigri	Director GB-EPA
	Mr. Khadim Hussain	Deputy Director GB-EPA
	Ms. Samreen Liaqat	Scientific Officer
SUPARCO	Dr. Jawad Nasir	General Manager (Project Director)

Figure 1.2: Kick-off meeting between SUPARCO and GB-EPA officials (Date: 25 Nov 2019)

Figure 1.3: Group photo of SUPARCO and GB-EPA officials (Date: 25 Nov 2019)

Project Director, SUPARCO briefed GB-EPA officials about the sampling / monitoring plan during field survey in GB. Director GB-EPA assured SUPARCO team for complete local support and assistance in sites selection for water and air quality sampling / monitoring. The field survey teams were comprised of following SUPARCO & GB-EPA officials:

Table 1.2: Environmental Monitoring Team Winter Season (25 Nov to 20 Dec 2019)

Organization	Officials	Responsibility
SUPARCO	Dr. Jawad Nasir (General Manager)	Project Director / Field Survey Planning
	Mr. Maqbool Ahmed (Manager)	Water Sampling / in-situ water testing
	Mr. Zahid Hussain (Sub Engr)	Air & Noise Monitoring
	Mr. Muhammad Zain (Sub Engr)	
GB-EPA	Mr. Aesar Hussain (Field Tech)	Local Coordination

Table 1.3: Environmental Monitoring Team Summer Season (16 Aug to 09 Sep 2020)

Organization	Officials	Responsibility
SUPARCO	Mr. Usama Rehmat (Assistant Manager)	Team Leader
	Mr. Saddam Hussain (Assistant Manager)	Water Sampling / in-situ water testing
	Mr. Abdul Hayat (Sub Engr)	Air & Noise Monitoring
	Mr. Muhammad Zain (Sub Engr)	
GB-EPA	Mr. Aesar Hussain (Field Tech)	Local Coordination

In addition, SUPARCO team for Land Cover Classification & Mapping (LCCM) was comprised of following Remote Sensing (RS) & Geographical Information System (GIS) experts:

Table 1.4: Remote Sensing (RS) & Geographical Information System (GIS) Team

Sr. No.	Name	Expertise
1	Dr. Muhammad Shafiq	Incharge, LCCM Team
2	Mr. Adnan Aziz	RS Expert
3	Mr. Mudassar Umar	GIS Expert
4	Mr. Abdul Azeem Siddiqui	GIS Expert

02

FRESHWATER QUALITY MONITORING

Chapter Two

2. Freshwater Quality Monitoring

2.1 Background

Water is central to the survival of human beings as it is needed in all aspects of life. Freshwater including rivers, lakes and streams is important resource for domestic, industrial and irrigation purposes[1]. In recent years, water quality has deteriorated in many regions of the world with high pollution threats identified across Europe, South Asia, China, South America and parts of Africa. This deterioration is expected to intensify the threat to human health, environment and sustainable development[2].

According to World Health Organization (WHO), diarrheal disease is responsible for the deaths of 1.8 million people every year[3]. Recent studies, focusing Himalaya[4] and Tibetan Plateau[5] water bodies, have found significant deterioration in water quality due to sediment load and human interference i.e. deforestation, cultivation, construction of dams and urbanization which is a matter of serious concern for billions of people inhabiting in downstream regions. In fact, in Asia, the available freshwater resources are getting depleted and being adversely affected both qualitatively and quantitatively.

Nature has gifted Pakistan with enough water resources which are originated from glaciers and seasonal snow deposits in Northern areas i.e., GB region and KPK province. GB is the home of more than 6500 glaciers covering an area of ~13,214 sq.km[6] and constitute a main reservoir of freshwater not only for GB but melt water originating from snow and glaciers in the region constitutes more than 80%[7] of Indus River which is a life line of the country (Figure 2.1). It is hard to overstate the importance of the Indus Basin system to the 237 million people who live within it. The basin's water is essential for drinking, food security, power sector and, fishing-based economies in Pakistan. Hence any change (quality or quantity wise) in freshwater resources through climate change or socio-economic factors could have serious implications for food security, health and economy of Pakistan.

Like other regions of world, Pakistan is not the exception. Due to alarming increase in population and rapid industrialization, drinking water quality is getting deteriorated in the country. About 20% of total population of Pakistan has access to safe drinking water while remaining 80% is forced to use unsafe drinking water due to the scarcity of safe and healthy drinking water sources.

The primary source of contamination is sewerage (fecal) which is extensively discharged into drinking water system supplies. Secondary source of pollution is the disposal of toxic chemicals from industrial effluents, pesticides, and fertilizers from agricultural fields into the water bodies. About 50% of diseases and 40% of deaths occur in the country due to poor drinking water quality[8]. Thus, there is an immediate need to take protective measures and treatment technologies to overcome unhygienic condition of drinking water supplies throughout the country.

[1] Ali Muhammad Yousafzai, Abdur Rehman Khan and Abdul Rauf Shakoori, 2010. "Pollution of Large, Subtropical Rivers-River Kabul, Khyber-PakhtunKhwa Province, Pakistan): Physico-Chemical Indicators" Pakistan J. Zool., vol. 42(6), pp. 795-808

[2] Evans, A.E., Mateo-Sagasta, J., Qadir, M., Boelee, E., and Ippolito, A., 2019. Agricultural water pollution: key knowledge gaps and research needs: Current opinion in environmental sustainability, v. 36, p. 20-27.

[3] https://www.iwapublishing.com/news/water-based-diseases

[4] Zhang, Y., M. Sillanpää, et al., 2015. "River water quality across the Himalayan regions: elemental concentrations in headwaters of Yarlung Tsangbo, Indus and Ganges River." Environmental Earth Sciences 73(8): 4151-4163

[5] Huang, X., M. Sillanpää, et al. 2008. "Water quality in the Tibetan Plateau: Metal contents of four selected rivers." Environmental Pollution156(2): 270-277

[6] Glacier Inventory of Pakistan 2017. A joint publication of SUPARCO and ITP-CAS, ISBN: 978-92-9115-4715

[7] Arfan, M., Makhdum, A., and Nabi, G., 2017. Assessment of temporal flow variability of the Kabul River: Journal of Mountain Area Research, vol. 2, p. 1-8.

[8] Daud, M.K., Nafees, M., Ali, S., Rizwan, M., et al., 2017. Drinking Water Quality Status and Contamination in Pakistan: BioMed research international, v. 2017, p. 7908183-7908183

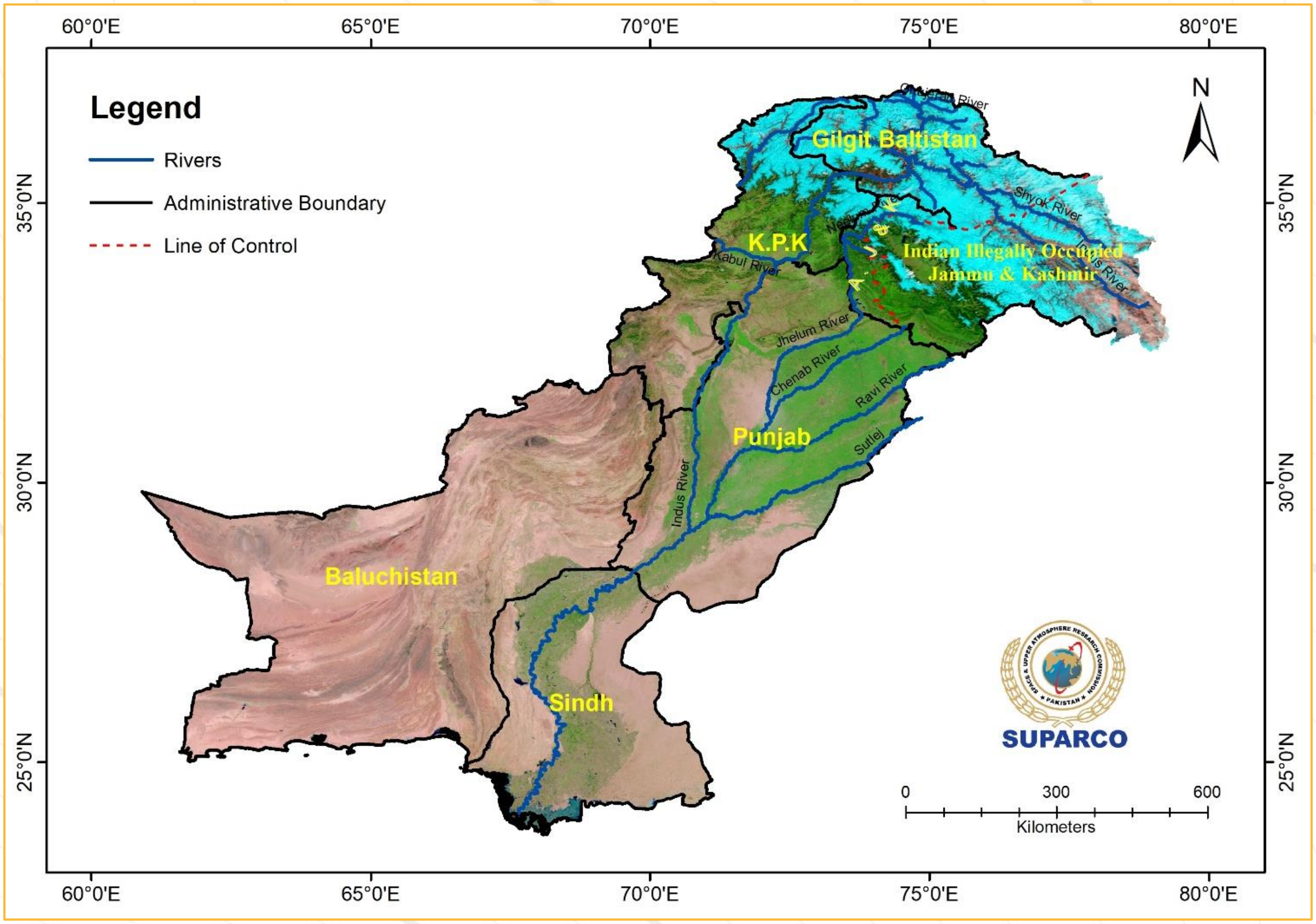


Figure 2.1: The flow network of Indus River System (Source: SUPARCO, adopted from Survey of Pakistan, http://surveyofpakistan.gov.pk)

In Gilgit Baltistan (GB), local people depend mainly on water streams for drinking and irrigation purposes. These water bodies / channels are open and prone to contamination with faeces (human / animal) and wastewater from residential areas. In addition, clothes and domestic utensils are also washed in the same channels. To overcome uncertain and scare availability of water, tanks are used for storage of water. The storage in tanks facilitates removal of turbidity, but poor maintenance and cleaning of these tanks seems promoting bacterial contamination and is the major cause of unsafe water in the region[9].

The development activities in Gilgit-Baltistan especially in CPEC zone and increasing tourism are positive signs for the economy and well-being of locals. On the other hand, these activities may cause pollution issues like contamination of fresh water bodies by waste disposal, and increase in sediment loads due

[9] Ali, S., and Rubina, S.H., 2018, Assessment of Freshwater Springs, Associated Diseases and Indigenous Perception in Ghizer, Gilgit-Baltistan, Pakistan: Pakistan journal of medical sciences, v. 34, p. 121.

to cutting of mountains and erosion of slopes for infrastructure development[10].

The fundamental principle of water quality management for sustainable development embraces the concept of its effective use while concurrently protecting and conserving water quality and quantity. It is envisaged that the findings of present study would not only be useful to develop a baseline data of selected water pollutants but also designing awareness programs for community regarding quality of fresh water bodies and associated diseases.

The objective of water quality study in selected districts of GB alongside CPEC was to establish a baseline of water quality information about temporal and spatial variability of physical, chemical & biological parameters.

The physical, chemical and biological parameters are as follow:

1. **Physical Parameters:** Temperature, conductivity, turbidity and total dissolved solids (TDS)
2. **Chemical Parameters:** pH, dissolved oxygen (DO), Fluoride (Fl^-), Chloride (Cl^-), Nitrate (NO_3^{-1}), Sulphate (SO_4^{-2}), Sodium (Na), Calcium (Ca), Magnesium (Mg), Cadmium (Cd), Mercury (Hg), Lead (Pb) and Arsenic (As)
3. **Biological Parameters:** Escherichia Coliform (E. Coli.) and Total Coliform (T Col.)

2.2 Study Region and Water Sampling Locations

The Indus River is a transboundary international river with headwater tributaries located in China (Tibetan Plateau), India, Pakistan, and Afghanistan. The river originates north of the Himalayas in Tibetan Plateau, with the main stem flowing initially through the Ladakh district of Jammu and Kashmir, and then through the northern mountainous areas of Pakistan (Gilgit-Baltistan) between the western Himalayas and the Karakoram range. Although, there is no definite boundary among the three mountain ranges but it is generally assumed that the Indus River bisects the Himalayan range from Hindukush and Karakoram. The eastern boundary of Shyok basin limits the Karakoram Range in the east, while the boundary between Gilgit and Hunza basins separates it from the Hindukush range. The Indus then turns to the south from Nanga Parbat (8,126 m asl), and flows along the entire length of Pakistan, through the provinces of KPK, Punjab, and finally Sindh, where it drains into Arabian Sea.

From hydrology viewpoint, in northern region of Pakistan, researchers divide Indus basin into 10 high-altitude catchments / sub-basins covering an area of 114,019 sq km i.e., Hunza, Gilgit, Shyok, Shigar, Shingo, Astore, Chitral, Swat, Jhelum and Indus main stream[11] (Figure 2.2). Since the present study focuses on surface water bodies existing alongside CPEC therefore water sampling from selected points, as identified by GB-EPA, was carried out in the sub-basins of Hunza and Gilgit as well as west part of Indus main stream flowing across Diamer district. Name and location of water sampling site in each sub-basin are given in Table 2.1.

Figure 2.2: Sub-basins of Indus River and mountain ranges of HKH (Source: SUPARCO)

[10] Malik, M.A., Azam, M., and Saboor, A., 2010, Water quality status of upper KPK and northern areas of Pakistan, Pakistan Council of Research in Water Resources: ISBN 978-969-8469-35-1

[11] Glacier Inventory of Pakistan 2017, A joint publication of SUPARCO and ITP-CAS, ISBN: 978-92-9115-4715

Table 2.1: Water sampling locations across selected sub-basins in GB

River Basin	Description of sampling site	Sample ID	Latitude	Longitude
Hunza Sub-basin	Spring, Khudabad Village, Sost	HN-1	36.687810	74.816310
	Brongtar Nallah, Khudabad Village, Sost	HN-2	36.688134	74.816133
	Daya Spring Near Misger	HN-3	36.747670	74.830260
	Gircha Spring, Sost	HN-4	36.648504	74.848219
	Khyber Nallah	HN-5	36.577201	74.799777
	Batura Nallah	HN-6	36.509071	74.868277
	Passu Nallah	HN-7	36.461429	74.892771
	Shishkat Nallah	HN-8	36.361956	74.861787
	Attabad Lake	HN-9	36.320812	74.873404
	Multan Chaah Spring / Nallah, Hunza	HN-10	36.320712	74.875168
	Ultar Nallah, Hunza	HN-11	36.325880	74.668780
	Ultar Nallah, Hunza (after filtration unit)	HN-12	36.316111	74.667222
	Spring of Hyderabad, Hunza	HN-13	36.318028	74.633878
	Chill Ganish Hunza	HN-14	36.316837	74.655304
	Gamun Ganish Hunza	HN-15	36.314555	74.665770
	Hasanabad Nallah	HN-16	36.300631	74.586626
	Spring of Jaglotgah	HN-17	36.183947	74.295091
	Danyor Water Supply System	HN-18	35.929956	74.396763
Gilgit Sub-basin	Danyor Spring	GL-1	35.902761	74.394139
	Jutial Nallah, Gilgit	GL-2	35.888179	74.344285
	Kargah Nallah, Gilgit	GL-3	35.914684	74.257101
	Bamba Barmus Spring, Gilgit	GL-4	35.915316	74.300574
Indus Main Stream	Gilgit River	IN-1	35.925157	74.318469
	Jaglot Spring	IN-2	35.678870	74.616680
	Jaglot Nallah	IN-3	35.678662	74.616962
	Indus River near Chilas	IN-4	35.431136	74.107228
	Indus River near Diamer-Basha Dam	IN-5	35.517171	73.743963
	Sumer Nallah	IN-6	35.508678	73.387449

(a) Hunza River Basin

The Hunza River basin is the northernmost region of GB. It is situated in high-altitudes of Central Karakorum having drainage area of 13,535 sq.km. The basin hosts highest number of glaciers (more than 1250) than other basins of Indus River in Pakistan.

The Hunza River is formed by the confluence of the Kilik and Khunjerab nallahs (gorges) and flows from north to south, fed by many glaciers such as Pasu, Hispar, Shimshal, and Chipursan Glaciers, and connects the Gilgit River before merging to the main Indus River. Surface water samples were collected from 18 sites in Hunza River basin (Figure 2.3).

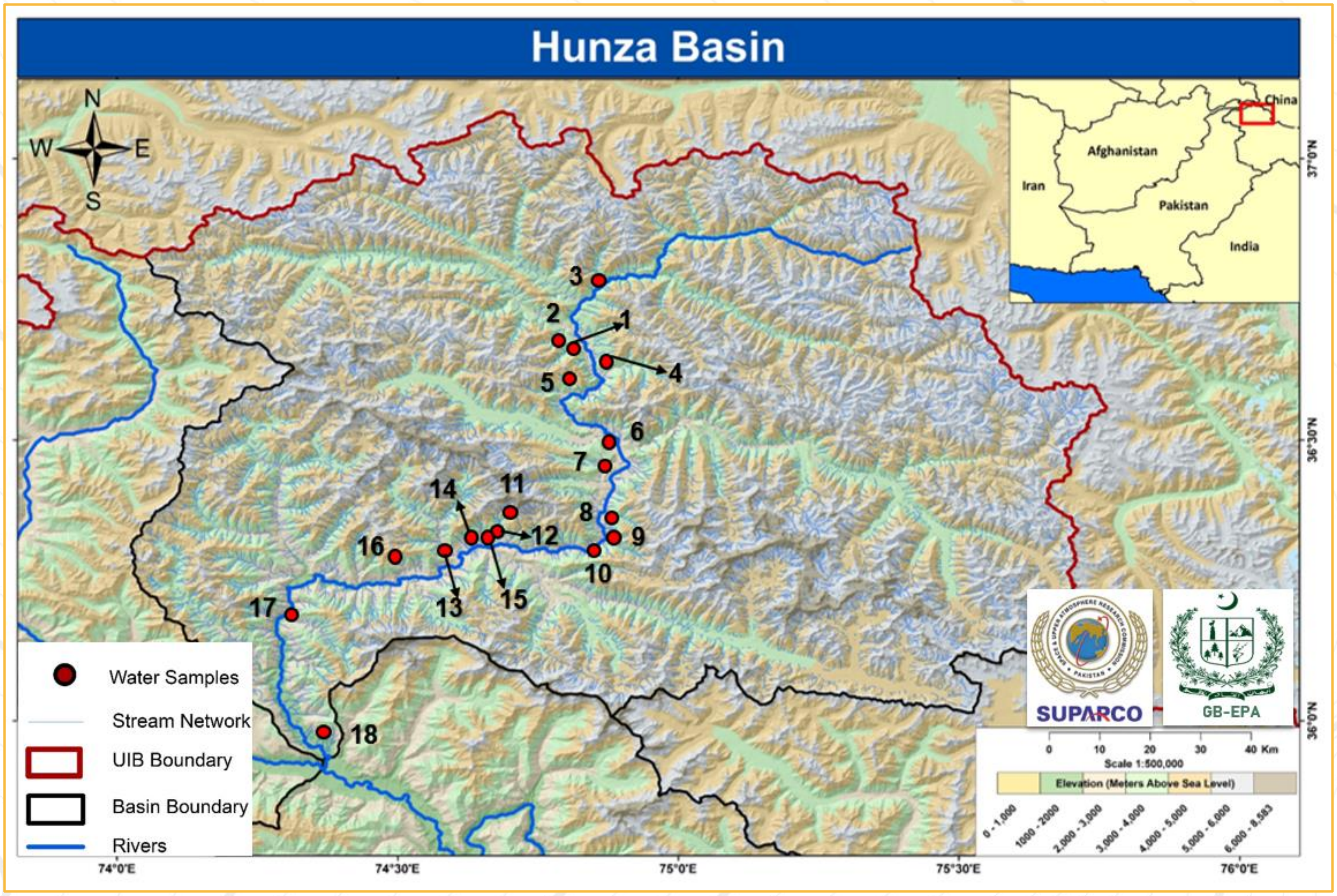


Figure 2.3: Water sampling locations alongside Hunza River (The numbers denote samples ID with prefix 'HN')

(b) Gilgit River Basin

The Gilgit River, a tributary of the Indus River, originates in Hindukush region and its network comprises of Ghizar, Yasin and Ishkuman Rivers and joins Indus River at junction point of three mountain ranges near town of Jaglot.

The upper reaches of basin are mostly glaciated and covered with permanent snow. The basin has drainage area of 6722 sq.km with more than 950 glaciers.13 In Gilgit basin, the surface water sampling was conducted from 04 sites which are main sources of water supply in Gilgit city and proximity areas (Figure 2.4).

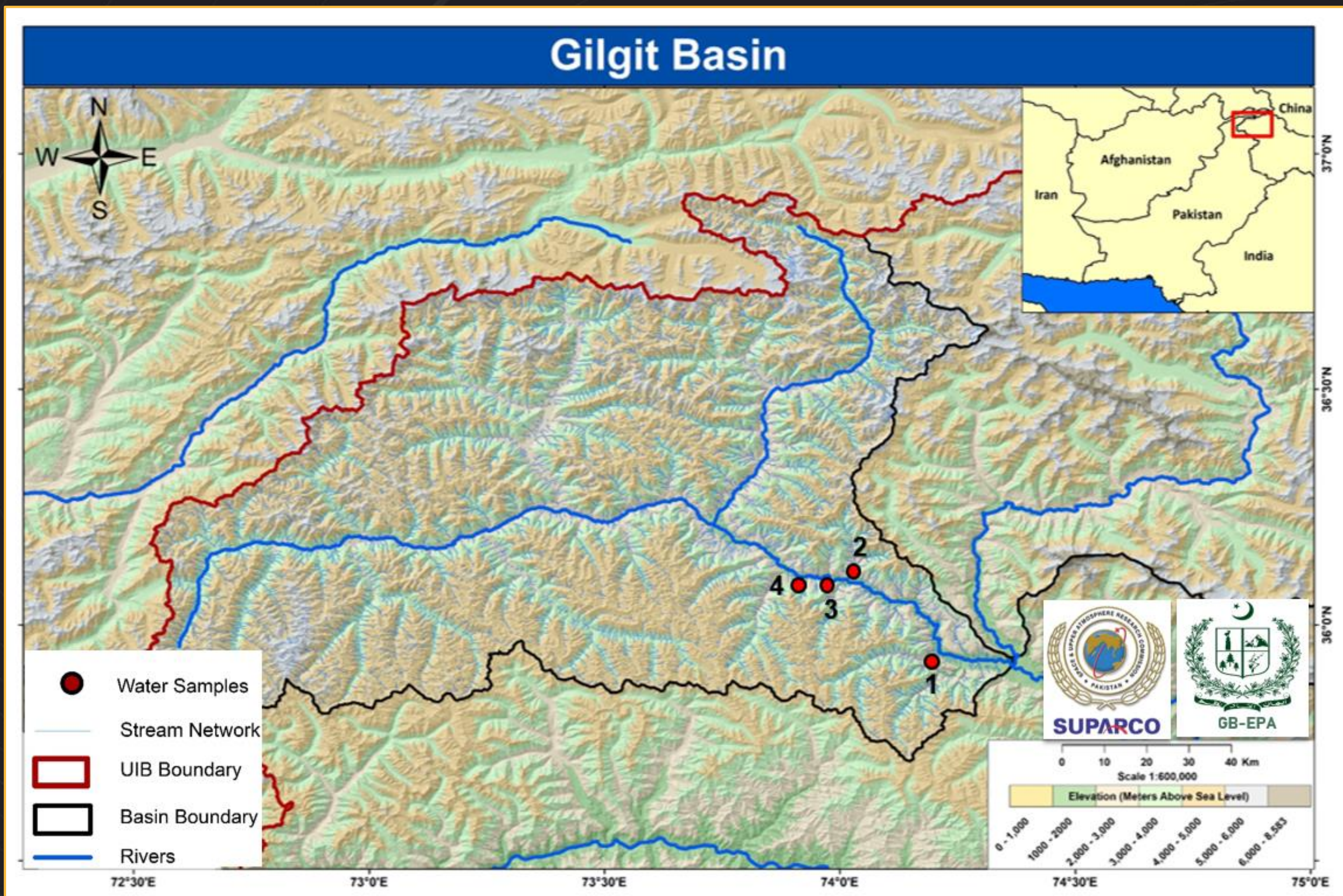


Figure 2.4: Water sampling locations alongside Gilgit River (The numbers denote samples ID with prefix 'GL')

(c) Indus Main Stream

The Indus main stream constitutes the largest catchment in GB with an area of 32736 sq.km.13 The Indus stream after entering from Indian Himalayas to the Shyok basin (the eastern border basin of GB) receives additional water from the Shyok, Shigar, Hunza, and Gilgit rivers in the adjacent catchments in the Karakoram Mountains, and from the Astore River in the western Himalayas. Since only western part of Indus stream lies under CPEC zone, therefore water sampling was carried from 06 locations between Jaglot to Chilas (Figure 2.5).

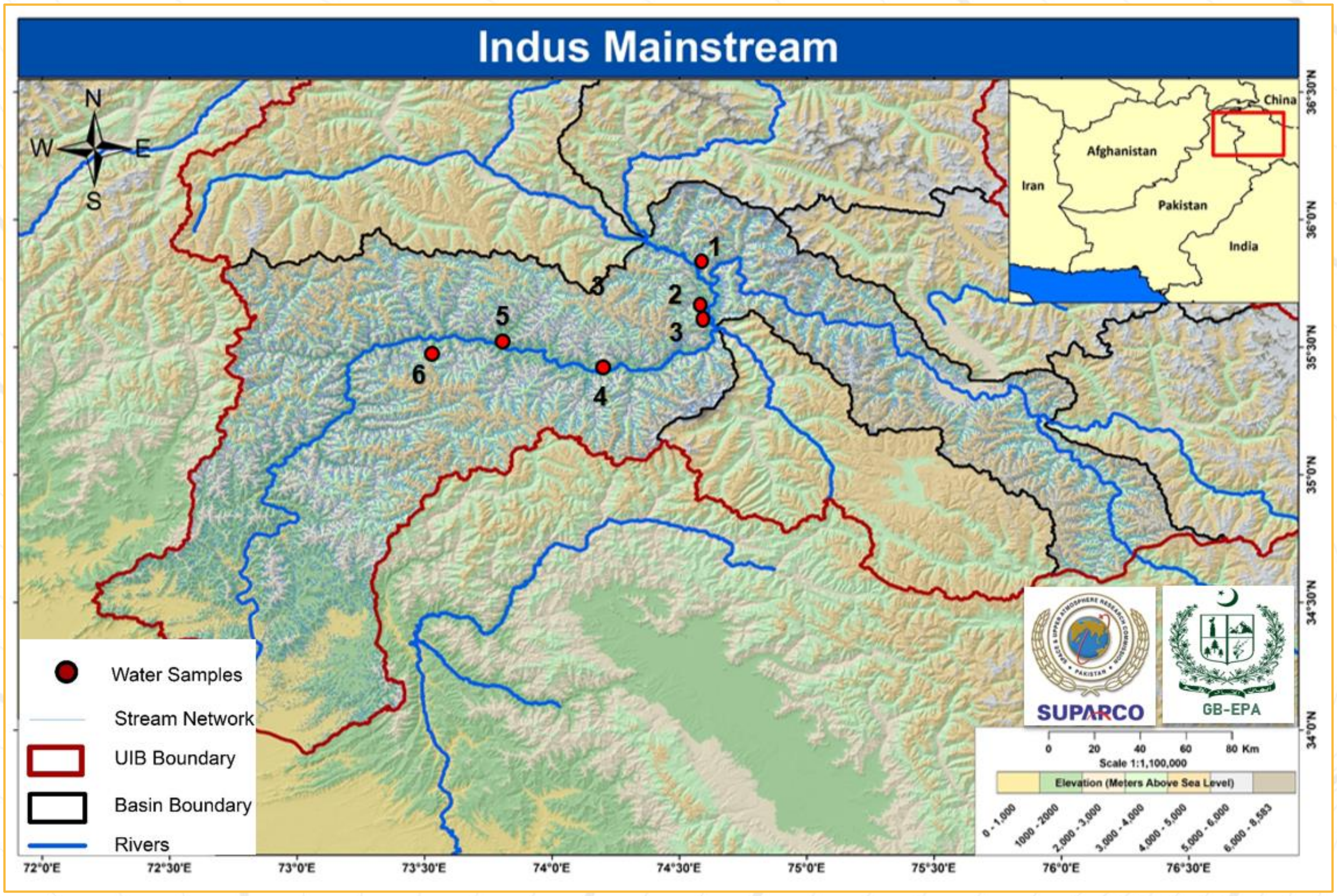


Figure 2.5: Water sampling locations alongside Indus Mainstream (The numbers denote samples ID with prefix 'IN')

2.3 Methodology

2.3.1 Water Sampling

Sampling of freshwater was conducted in winter season (Nov-Dec 2019) and summer season (Aug-Sep 2020) from selected locations (Figure 2.6 to 2.11). Sampling points were chosen preferably those under regular public use i.e., streams, springs and river bodies. Sample ID for monitoring purpose was marked according to name of sub-basin and sequence of collection (Table 2.1). Sampling of surface water, their preservation and transport were done according to the current standard procedures and methods, ISO 5667–6:2014 (Guidance on sampling of rivers and streams), ISO 19458:2006 (Sampling for microbiological analysis), Surface water sampling methods and analysis, Govt of Australia[12], and ISO 5667-3:2018 (Preservation and handling of water samples).

Figure 2.6: In-Situ Monitoring of drinking water at Khudabad, Sost

Briefly, the grab sampling of surface water was conducted from streams, springs and rivers for physical, chemical and bacteriological testing. From each location, two sets of water samples were collected in duplicate; one set in 1 Liter sterilized high-density polyethylene (HDPE) bottles for chemical analyses and the other in 500 ml sterilized HDPE sample for biological analyses. Samples collected for chemical analyses were immediately filtered with 0.45 µm pore cellulose acetate membrane filter and split in two sets of samples using 500 ml sterilized HDPE bottles. One set was acidified with 10% concentrated nitric acid (HNO_3) to pH<2 for analysis of soluble metals. All water samples were stored in ice boxes to maintain temperature between 1–4°C till shipment to laboratory. The sampling locations were recorded with a handheld global positioning system (GPS) (GARMIN, eTrex 30, Germany).

Figure 2.7: Water sampling in Hunza

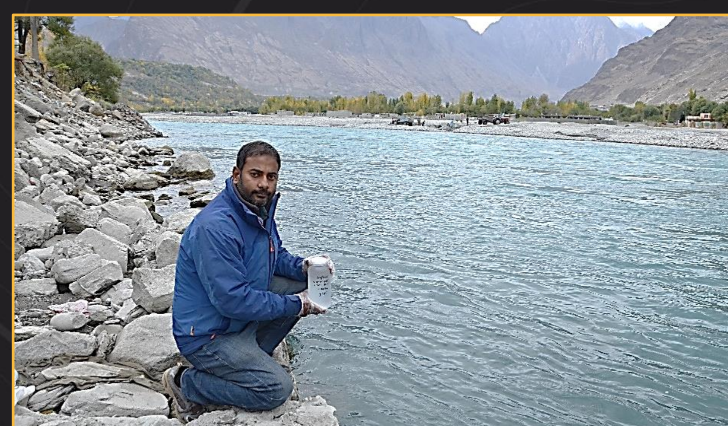


Figure 2.8: Water sampling of Gilgit River

[12] Heald, D., Looij, E., Bunting, T., and Patten, J., 2007, Surface water sampling methods and analysis. Technical Appendices: Standard Operating Procedures for Water Sampling Methods and Analysis. Government of Western Australia, Department of Water.

2.3.2 Water Testing

In-situ measurements for temperature, conductivity, pH, dissolved oxygen (DO) were carried out by using calibrated portable multi-parameter meter (ExTECH, Model DO700), while turbidity was noted by using portable Turbidimeter (HACH P2100). Bacteriological analysis (E. coli and total coliform) was also performed on field by membrane filtration technique (HACH 8074). All chemical analyses of water samples were performed at SUPARCO Environmental Laboratory (SEL), SUPARCO HQs, Karachi using standard methods and protocol (Table 2.2).

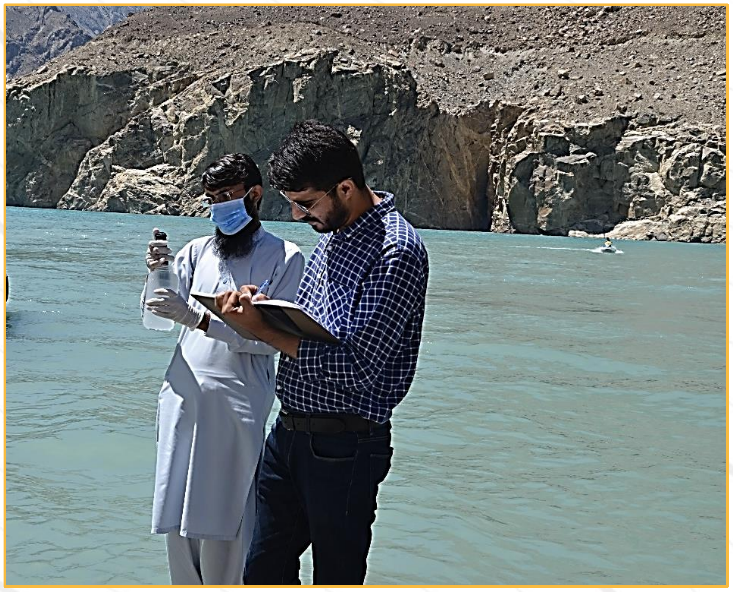


Figure 2.9: In-situ monitoring at Attabad Lake, Hunza

2.3.3 Quality Assurance / Quality Control

To ensure the quality of the data, standard procedures were followed for testing of the samples. All instruments used in testing were calibrated with standard and known concentrations. The multi-parameter meter was calibrated with three pH standard solutions (pH 4.0, 7.0, and 10.0) and two conductivity standards (84 μS/cm, 1413 μS/cm) before taking the measurements. The value of each sample was taken after submerging the probe in the water sample and holding for a couple of minutes to achieve a stabilized reading. After the measurement of each sample, the probe was rinsed with deionized water to avoid cross contamination among different samples. Similarly, 3-point calibration of turbidity meter was performed using StablCal Primary Standards in sealed vials, one each of <0.1 NTU, 20 NTU, 100 NTU. Quality control samples (three field and three travel blanks, one set for each sub-basin) were also taken in to account during field surveys. Field blanks were consisted of de-ionized water taken from SEL, exposed to the sampling environment at the sampling site and handled / stored / shipped / analyzed in same manner as the collected surface water samples.

Figure 2.10: Water sampling at Kargah Nallah

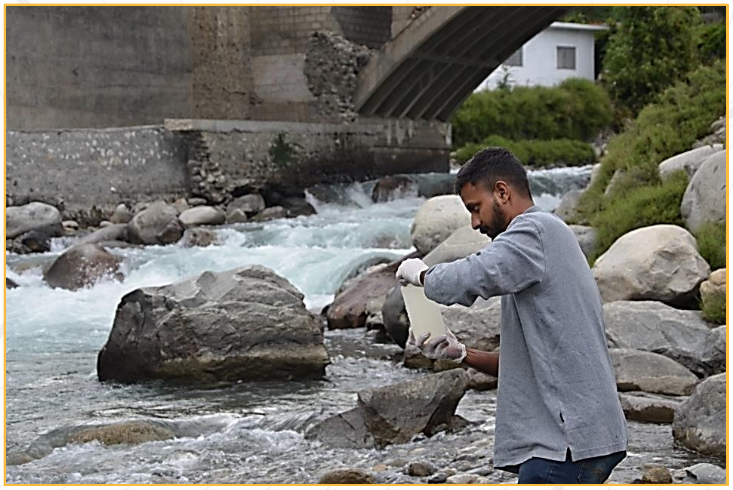


Figure 2.11: Water sampling at Jaglot Nullah

Table 2.2: Analytical methods for water testing

Parameter	Technique	Reference Method
Escherichia Coliform (MPN)	Membrane Filtration Technique	HACH 8074
Total Coliform (MPN)	Membrane Filtration Technique	HACH 8074
Temperature (oC)	Thermometry	-
pH	Multiparameter Meter (DO700, EXTECH)	US-EPA 150.2
Conductivity (µS/cm)	Multiparameter Meter (DO700, EXTECH)	US-EPA 120.1
TDS (mg/l)	Multiparameter Meter (DO700, EXTECH)	US-EPA 160.1
Dissolve Oxygen (mg/l)	Multiparameter	US-EPA 360.1
Turbidity (NTU)	Turbidity Meter (2100P, HACH)	US-EPA 180.1
Total Hardness (mg/l)	EDTA Titration	US-EPA 310.1
Fluoride (mg/l)	SPADNS Method by Spectrophotometer	US-EPA 300.1
Chloride (mg/l)	Titration (Silver Nitrate)	US-EPA 300.1
Nitrate (mg/l)	Cd. Reduction by Spectrophotometer	US-EPA 300.1
Sulphate (mg/l)	SulfaVer4 by Spectrophotometer	US-EPA 300.1
Calcium (mg/l)	Atomic Absorption Spectrophotometer (AAS)	US-EPA 7000B
Magnesium (mg/l)	Atomic Absorption Spectrophotometer (AAS)	US-EPA 7000B
Sodium (mg/l)	Atomic Absorption Spectrophotometer (AAS)	US-EPA 7000B
Cadmium (mg/l)	Atomic Absorption Spectrophotometer (AAS)	US-EPA 7000B
Lead (mg/l)	Atomic Absorption Spectrophotometer (AAS)	US-EPA 7000B
Arsenic (mg/l)	Atomic Absorption Spectrophotometer (AAS)	US-EPA 206.3
Mercury (mg/l)	Atomic Absorption Spectrophotometer (AAS	US-EPA 245.1

These blanks are used to detect potential sample contamination during sample collection, handling, shipping and analysis. Travel blanks were also comrised of de-ionized water taken from SEL and brought to sampling sites but were not exposed to the sampling environment. These travel blanks were then stored / shipped / analyzed in same manner as the surface water samples. These blanks are used to detect potential sample contamination during shipping, handling, and analysis of samples without the influence of direct exposure to the sampling environment. Furthermore, at each site, samples were taken in duplicate and the average of their results is reported in this report.

2.4 Results and Discussion

Testing results (physical, chemical and biological parameters) of all water samples collected during winter and summer seasons alongside CPEC starting from Sost to Chilas are given in Table 2.3 to 2.5 along with standard permissible limits of National Standards for Drinking Water Quality (NSDWQ) of Pakistan, where applicable.

Table 2.3: Physical results of GB water samples

	Winter Season				Summer Season			
Sample ID	**Temp (°C)**	**Cond (µS/cm)**	**TDS (ppm)**	**Turbidity (NTU)**	**Temp (°C)**	**Cond (µS/cm)**	**TDS (ppm)**	**Turbidity (NTU)**
Std Limit	**NS ***	**NS ***	**< 1000 ‡**	**< 5 NTU ‡**	**NS ***	**NS ***	**< 1000 ‡**	**< 5 NTU ‡**
HN-1	6.4	515	254	0.17	15.6	610	290	2.18
HN-2	2.6	350	170	0.14	22.9	423	210	4.94
HN-3	2.2	740	370	0.72	18	380	190	4.91
HN-4	10.3	600	300	0.24	10.3	689	404	4.32
HN-5	2.9	270	136	0.12	12.3	319	200	1.56
HN-6	2.3	318	160	12.2	6.4	290	110	16.3
HN-7	2.6	180	94	10.7	7.2	251	274	13.7
HN-8	2.8	305	157	2.2	9.6	297	140	10.8
HN-9	3.8	320	165	0.51	10.4	352	179	8.78
HN-10	2.9	460	230	0.24	7.9	380	148	3.30
HN-11	3.6	470	240	11.8	13	433	290	15.4
HN-12	5.5	450	220	1.04	20	390	254	4.87
HN-13	7.2	500	250	0.27	16	435	290	8.6
HN-14	4.1	490	247	11.4	16	538	324	12.8
HN-15	4.2	460	230	5.27	13.2	497	300	7.6
HN-16	6.2	320	160	9.21	7.5	380	207	11.7
HN-17	4.8	510	260	0.24	12.7	490	290	5.75
HN-18	5.1	595	300	6.67	14.2	537	290	4.29
GL-1	6.4	1140	580	1.32	18	1210	654	12.54
GL-2	4.6	217	110	0.38	20	540	111	4.20
GL-3	5.0	232	119	0.23	18.6	410	165	4.60
GL-4	4.1	201	98	0.22	19.2	358	243	3.78
IN-1	3.7	291	150	1.93	12	551	215	3.45
IN-2	4.0	534	270	0.22	19.5	618	316	4.63
IN-3	3.1	261	130	0.83	8.3	407	174	4.88
IN-4	6.4	576	281	3.58	15	654	589	11.25
IN-5	5.9	492	245	4.51	17	770	379	10.82
IN-6	2.7	190	92	0.45	10.6	280	324	8.23

* NS: Not Set, ND: Not Detected
‡ National Standards for Drinking Water Quality (NSDWQ), S.R.O 1062 (I)/2010

Table 2.4(a): Chemical results of GB water samples (Winter Season)

Sample ID	PH	DO (mg/L)	Hardness (mg/L)	Fl^- (mg/L)	Cl^- (mg/L)	NO_3^{-1} (mg/L)	SO_4^{-2} (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	Cd (mg/L)	Hg (mg/L)	Pb (mg/L)	As (mg/L)
Std Limit	*6.5 – 8.5 ‡*	*NS **	*< 500 ‡*	*< 1.5 ‡*	*< 250 ‡*	*< 50 ‡*	*NS **	*NS **	*NS **	*NS **	*0.01 ‡*	*<0.001 ‡*	*<0.05‡*	*<0.05‡*
HN-1	9.34	8.0	240	0.17	14.25	19.4	40.1	26.6	7.75	4.96	ND	ND	0.004	0.007
HN-2	9.17	7.9	163	0.48	16.19	9.2	45.3	36.2	8.76	3.20	ND	ND	ND	ND
HN-3	7.78	8.5	284	0.43	15.27	6	67.6	39.7	9.62	3.47	ND	ND	0.008	0.009
HN-4	7.80	8.2	257	0.98	18.24	9.3	20.0	24.9	7.62	6.65	ND	ND	0.025	ND
HN-5	8.09	7.6	98	0.22	2.98	6.8	16.7	17.2	6.38	1.43	ND	ND	0.029	0.016
HN-6	8.23	9.7	139	0.19	0.94	1.2	12.2	11.6	7.14	1.37	ND	ND	ND	0.003
HN-7	8.17	9.1	59	0.20	1.56	0.7	8.5	13.4	6.95	0.28	ND	ND	ND	ND
HN-8	8.25	9.3	144	0.15	1.82	6.1	10.4	10.2	6.67	1.19	0.005	ND	0.016	0.002
HN-9	8.10	8.2	85	0.18	1.35	1.8	9.6	18.6	7.45	1.58	ND	ND	0.006	0.004
HN-10	8.90	7.7	170	0.32	7.12	1.1	43.4	30.2	6.47	4.76	ND	ND	ND	ND
HN-11	8.41	9.0	210	0.20	8.22	1.8	26.1	21.8	7.47	3.51	ND	ND	0.007	0.012
HN-12	8.16	9.0	182	0.16	7.26	0.8	26.9	22.7	7.49	2.4	ND	ND	ND	0.008
HN-13	8.23	8.2	222	0.11	13.98	0.8	53.5	25.5	6.91	5.74	ND	ND	0.02	ND
HN-14	8.26	8.6	208	0.39	9.11	15.1	34.7	28.8	6.72	6.57	ND	0.003	0.008	0.014
HN-15	7.96	8.5	191	0.34	12.39	6.7	30.5	29.7	7.54	7.50	ND	ND	ND	0.009
HN-16	7.68	8.5	159	0.66	4.60	0.9	26.7	18.4	6.5	1.46	ND	ND	ND	0.004
HN-17	8.30	9.4	213	0.10	3.35	1.1	33.9	16.6	7.68	1.98	ND	ND	0.006	ND
HN-18	8.06	7.6	249	0.44	15.24	5.30	61.0	28.3	8.45	7.01	ND	ND	0.008	0.005
GL-1	7.83	6.4	325	0.26	29.27	0.6	73.5	48.6	10.69	14.5	ND	ND	ND	0.021
GL-2	8.29	8.1	78	0.08	0.64	0.9	7.3	11.7	5.86	1.21	ND	ND	ND	ND
GL-3	8.41	8.6	87	0.20	3.27	1.0	9.8	14.5	5.93	1.98	ND	ND	ND	0.007
GL-4	8.73	7.2	65	0.19	8.00	1.8	22.8	27.4	7.73	3.25	ND	ND	0.01	0.006
IN-1	8.02	8.5	108	0.05	1.19	1.8	11.3	13.2	6.94	1.67	ND	ND	0.01	0.008
IN-2	8.86	8.2	248	0.37	6.82	10.5	44.8	31.7	9.04	4.53	ND	ND	ND	ND
IN-3	8.15	9.1	105	0.09	2.51	6.2	14.6	15.6	6.63	1.74	ND	ND	0.01	0.007
IN-4	8.91	7.9	235	0.19	7.20	3.3	35.0	36.9	8.87	6.20	0.007	ND	0.04	0.007
IN-5	8.57	8.1	219	0.24	5.40	4.8	27.2	29.5	7.07	4.80	ND	0.002	0.02	0.014
IN-6	7.96	7.9	76	0.15	0.28	2.5	4.4	5.8	5.36	0.11	ND	ND	ND	ND
Avg	**8.30**	**8.32**	**172**	**0.27**	**7.80**	**4.6**	**29.2**	**23.4**	**7.41**	**3.75**	**0.006**	**0.003**	**0.014**	**0.009**

* NS: Not Set, ND: Not Detected

‡ National Standards for Drinking Water Quality (NSDWQ), S.R.O 1062 (I)/2010

Table 2.4(b): Chemical results of GB water samples (Summer Season)

Sample ID	PH	DO (mg/L)	Hardness (mg/L)	Fl^- (mg/L)	Cl^- (mg/L)	NO_3^{-1} (mg/L)	SO_4^{-2} (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	Cd (mg/L)	Hg (mg/L)	Pb (mg/L)	As (mg/L)
Std Limit	*6.5 – 8.5 ‡*	*NS **	*< 500 ‡*	*< 1.5 ‡*	*< 250 ‡*	*< 50 ‡*	*NS **	*NS **	*NS **	*NS **	*0.01 ‡*	*<0.001 ‡*	*<0.05‡*	*<0.05‡*
HN-1	7.46	7.5	358	0.38	12.21	24.8	52.7	32.2	12.71	8.5	ND	ND	0.005	0.02
HN-2	6.9	6.5	248	0.70	14.32	16.3	46.4	43.6	11.47	6.33	ND	ND	ND	ND
HN-3	7.4	7.1	355	0.62	13.22	8.6	74.6	49.6	13.03	5.4	ND	ND	0.008	ND
HN-4	7.5	6.3	312	1.12	18.56	12.6	34.4	32.5	13.46	8.35	ND	ND	0.009	ND
HN-5	8.50	7.8	140	0.88	8.25	7.32	35.0	29.0	13.99	4.34	ND	ND	ND	0.01
HN-6	7.57	8.2	198	0.54	7.53	2.90	38.7	25.3	10.07	5.11	0.004	ND	ND	0.008
HN-7	7.57	7.1	110	0.47	8.24	1.20	29.3	22.7	11.2	3.81	ND	ND	0.007	ND
HN-8	7.04	7.5	138	0.62	6.21	8.68	38.8	20.2	10.54	3.45	ND	ND	ND	0.02
HN-9	8.48	6	128	0.43	46.80	2.96	34.3	26.5	11.52	4.31	ND	ND	ND	0.01
HN-10	7.57	8.2	263	0.89	26.34	2.34	58.2	41.6	11.1	4.32	ND	ND	ND	0.008
HN-11	7.34	7.2	310	0.87	14.38	3.11	35.5	53.5	11.87	6.45	ND	ND	ND	ND
HN-12	7.53	8.5	265	0.64	10.20	2.59	24.7	48.8	10.55	5.25	ND	ND	ND	ND
HN-13	7.04	6.9	303	0.50	17.45	2.88	62.6	40.2	9.48	9.28	ND	ND	0.009	ND
HN-14	6.9	7.5	219	0.78	14.89	10.16	51.2	34.3	10.24	6.1	ND	0.002	0.01	0.03
HN-15	6.9	8.2	218	0.65	20.98	9.27	39.8	37.2	10.2	6.92	ND	0.003	0.02	0.01
HN-16	7.14	6.8	192	1.21	36.12	5.20	33.3	25.6	10.21	4.84	ND	ND	ND	0.007
HN-17	7.45	6.5	178	0.77	23.43	2.32	45.2	21.9	12.66	5.94	ND	ND	0.03	0.008
HN-18	7.62	7	202	1.15	32.10	6.34	78.8	31.1	11.5	7.54	ND	ND	0.03	0.01
GL-1	6.96	6.8	478	1.30	36.98	5.92	84.0	56.2	15.34	11.12	0.007	ND	0.008	0.03
GL-2	7.47	7.2	110	0.95	15.92	3.55	39.6	25.4	9.90	5.25	ND	ND	ND	0.009
GL-3	7.5	6.8	137	0.75	10.36	4.58	32.8	22.3	12.5	5.36	ND	ND	ND	ND
GL-4	7.65	7.3	97	0.97	17.76	2.80	36.5	45.4	14.47	6.75	ND	ND	0.009	ND
IN-1	7.18	6.6	118	0.88	10.49	5.24	27.1	30.3	12.12	4.17	ND	ND	0.02	0.01
IN-2	7.72	7	210	0.65	12.34	9.06	56.7	28.5	13.78	5.4	ND	ND	ND	0.01
IN-3	7.3	8.1	221	0.42	9.10	11.2	45.4	36.3	11.4	4.23	ND	ND	0.02	0.009
IN-4	7.36	6.1	518	1.38	46.31	4.0	48.2	58.3	15.82	9.42	0.008	0.004	0.05	0.02
IN-5	6.8	6.1	554	1.40	53.40	5.60	53.5	65.3	17.58	10.77	0.009	0.005	0.04	0.03
IN-6	7.05	8.3	120	0.30	8.54	6.76	26.0	18.2	11.9	8.21	ND	ND	ND	0.04
Avg	**7.39**	**7.2**	**239**	**0.79**	**19.73**	**6.72**	**45.1**	**35.8**	**12.16**	**6.32**	**0.007**	**0.004**	**0.018**	**0.016**

* NS: Not Set, ND: Not Detected
‡ National Standards for Drinking Water Quality (NSDWQ), S.R.O 1062 (I)/2010

Table 2.5: Biological results of GB water samples

	Winter Season		Summer Season	
Sample ID	**Escherichia Coli (MPN)**	**Total Coliform (MPN)**	**Escherichia Coli (MPN)**	**Total Coliform (MPN)**
Standard Limit	**0 ‡**	**0 ‡**	**0 ‡**	**0 ‡**
HN-1	3	12	7	17
HN-2	0	0	9	20
HN-3	0	0	0	0
HN-4	0	0	0	0
HN-5	0	0	2	10
HN-6	0	0	0	0
HN-7	0	0	0	0
HN-8	0	0	0	2
HN-9	0	0	1	3
HN-10	0	0	0	0
HN-11	5	22	8	21
HN-12	0	5	3	8
HN-13	0	0	0	0
HN-14	7	25	6	18
HN-15	8	30	18	32
HN-16	5	16	19	37
HN-17	0	7	1	5
HN-18	0	0	3	11
GL-1	0	8	0	4
GL-2	0	0	0	0
GL-3	2	11	4	17
GL-4	0	14	0	8
IN-1	3	10	8	12
IN-2	0	0	0	0
IN-3	2	9	10	18
IN-4	4	17	15	28
IN-5	0	0	0	0
IN-6	0	0	0	0

‡ National Standards for Drinking Water Quality (NSDWQ), S.R.O 1062 (I)/2010
* WHO Guidelines for Drinking-water Quality, 4TH Edition, 2017; ISBN 978-92-4-154995-0
** World Health Organization 2018, A global overview of national regulations and standards for drinking-water quality. ISBN 978-92-4- 151376-0

2.4.1 Physical Parameters

a. Temperature

As temperature has an influence on many aquatic variables and processes, it is important always to include it in a sampling regime, and to take and record it at the time of collecting water samples. The temperature of surface waters is influenced by latitude, altitude, season, time of day, air circulation, cloud cover, flow, and depth of the water body.

Figure 2.12 represents temperature of selected water bodies in Hunza sub basin, Gilgit sub basin and Indus main stream in winter and summer seasons. Table 2.6 shows minimum and maximum temperatures of these water bodies. Overall temperature of these water bodies in winter and summer seasons was found between 2.2 to 22.3°C.

Table 2.6: Range of temperature of selected water bodies in GB

S. No.	Study Basins	Water Temp Range (°C) (Winter Season)	Water Temp Range (°C) (Summer Season)
1	Hunza Sub-Basin	2.2 – 10.3	6.4 – 22.9
2	Gilgit Sub-Basin	4.1 – 6.4	18 – 20
3	Indus Main Stream	2.7 – 6.4	8.3 – 19.5

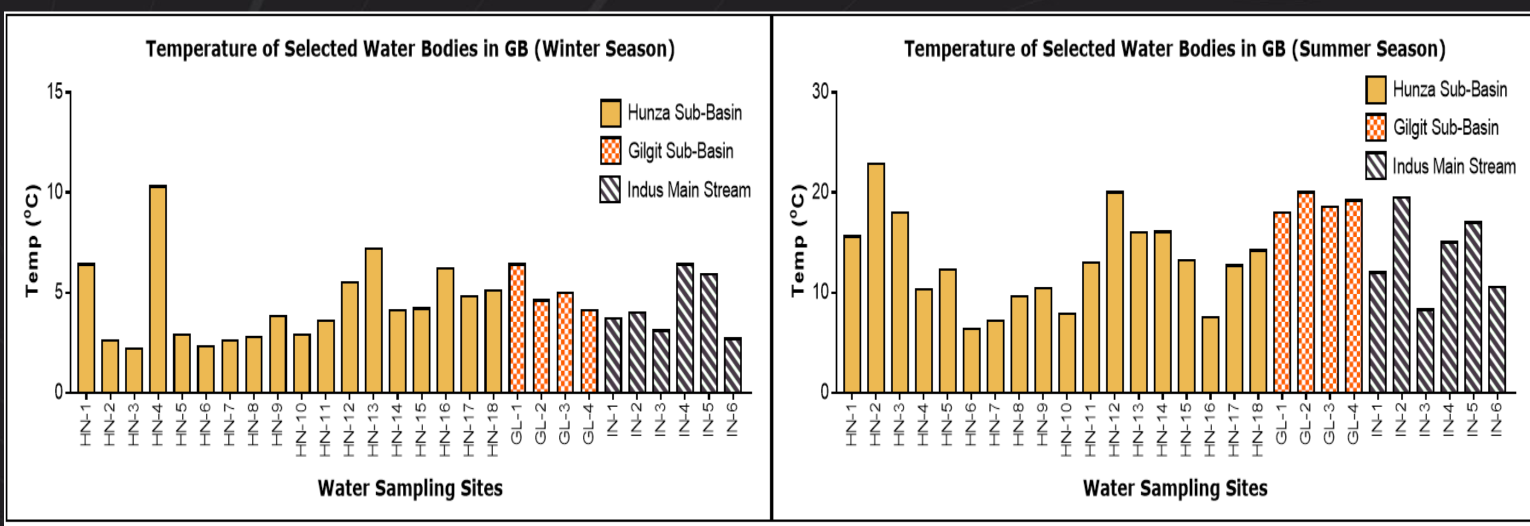


Figure 2.12: Spatial variation in temperature of selected water bodies in GB (Winter & Summer Seasons)

b. Electrical Conductivity (EC)

The Electrical Conductivity (EC) is a measure of the ability of water to conduct an electric current. It is sensitive to variations in dissolved solids, mostly mineral salts e.g., calcium, chloride, and magnesium. The EC increases as the concentration of dissolved solids increases. As such, NSDWQ has not specified the standard for freshwater EC however EC in the range of 10 to 1,000 µS/cm is considered suitable by World Health Organization (WHO)[13]. Figure 2.13 depicts the EC of water bodies in winter and summer seasons whereas Table 2.7 represents the range of EC. Overall conductivity values in both seasons ranged from 180 to 1210 µS/cm. Highest conductivity was observed only for Danyor spring in both seasons ranging from 1140 to 1210 µS/cm which is beyond the recommended levels of WHO.

Table 2.7: Range of EC in selected water bodies in GB

S. No.	Study Basins	Range of EC (µS/cm) (Winter Season)	Range of EC (µS/cm) (Summer Season)
1	Hunza Sub-Basin	180 - 740	251 - 689
2	Gilgit Sub-Basin	201 - 1140	358 - 1210
3	Indus Main Stream	190 - 576	280 - 770

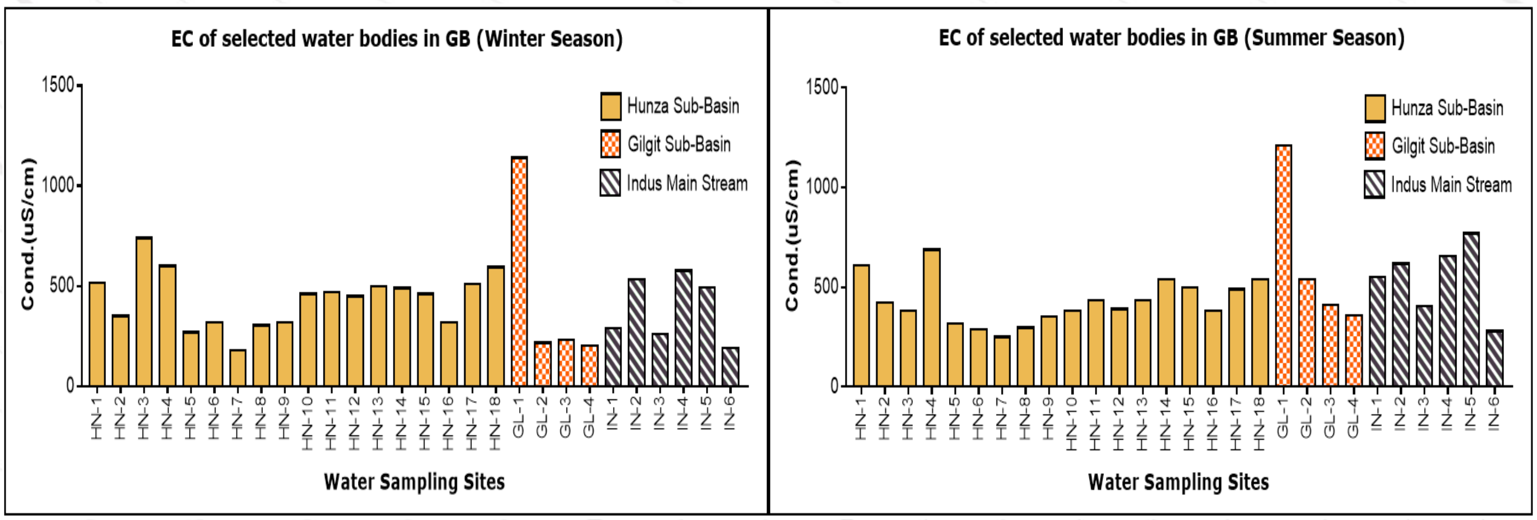


Figure 2.13: Spatial variation in conductivity of selected water bodies in Gilgit-Baltistan (Winter & Summer Seasons)

[13] World Health Organization 2018, A global overview of national regulations and standards for drinking-water quality. ISBN 978-92-4- 151376-0

c. Total Dissolved Solids (TDS)

TDS in water comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulphates) and small amounts of organic matter that are dissolved in water. TDS in drinking-water originates from natural sources, sewage, and industrial wastewater. Concentrations of TDS in water vary considerably in different geological regions owing to differences in the solubility of minerals. The palatability of water with TDS level of 600 mg/l is generally considered to be good; drinking-water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 ppm[14]. Concentration of TDS in all water samples across study regions in GB were found within permissible limit of NSDWQ i.e., 1000 mg/L (Figure 2.14). Overall TDS in all water samples ranged between 92 - 654 ppm during winter and summer seasons (Table 2.8). Overall, TDS levels were found higher for all water bodies in summer season as compare to winter season. Highest TDS was observed in Danyor spring in both seasons ranging from 580 – 654 ppm.

Table 2.8: Range of TDS in selected water bodies in GB

S. No.	Study Basins	Range of TDS (ppm) (Winter Season)	Range of TDS (ppm) (Summer Season)
1	Hunza Sub-Basin	94 - 370	110 - 404
2	Gilgit Sub-Basin	98 - 580	111 - 654
3	Indus Main Stream	92 - 281	174 - 589

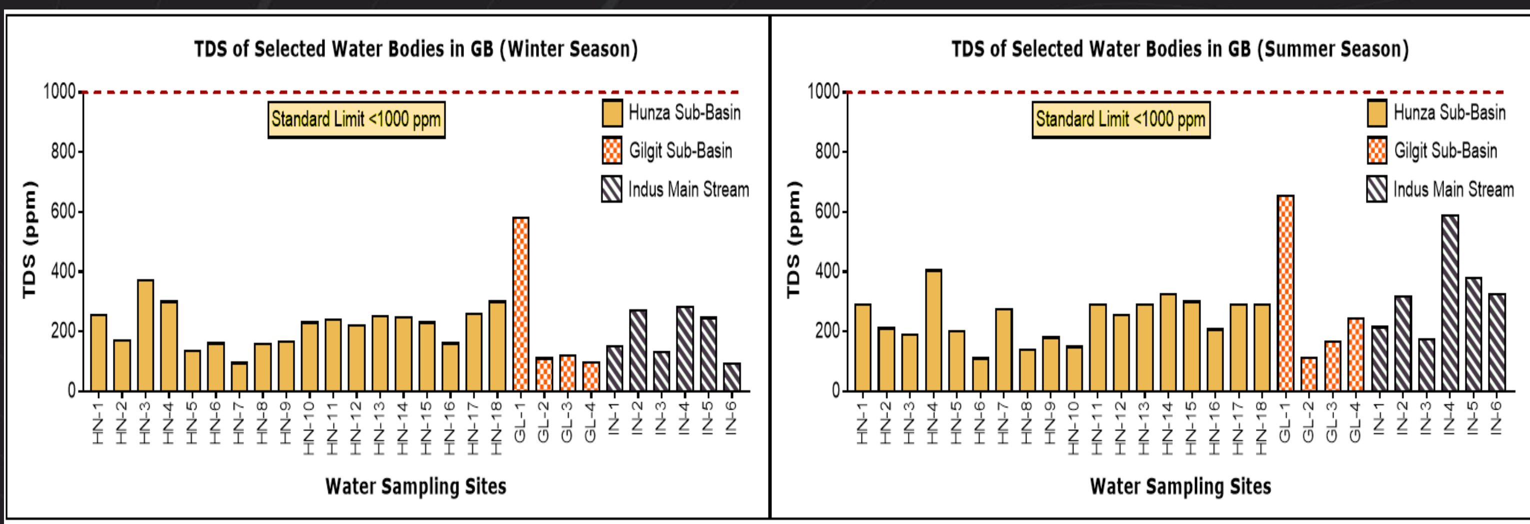


Figure 2.14: Spatial variation in TDS of selected water bodies in Gilgit-Baltistan (Winter & Summer Seasons)

[14] WHO Guidelines for Drinking-water Quality, 4TH Edition, 2017; ISBN 978-92-4-154995-0

d. Turbidity

Turbidity, typically expressed as nephelometric turbidity units (NTU), describes the cloudiness of water caused by suspended particles (e.g., clay and silts), chemical precipitates (e.g., manganese and iron), organic particles (e.g., plant debris) and organisms. Turbidity can be caused by poor source of water quality and disturbance of sediments.16 Visible turbidity reduces the acceptability of drinking-water.

During winter season, about 25% samples from selected basins were found with turbidity value exceeding NSDWQ (<5 NTU). In summer season, 50% samples from selected water bodies were found with turbidity exceeding the NSDWQ. Overall, turbidity in all water samples of three sub basins ranged from 0.12 to 16.3 NTU during both seasons (Figure 2.15, Table 2.9).

Table 2.9: Range of turbidity in selected water bodies in GB

S. No.	Study Basins	Range of Turbidity (NTU) (Winter Season)	Range of Turbidity (NTU) (Summer Season)
1	Hunza Sub-Basin	0.12 - 12.2	1.56 – 16.3
2	Gilgit Sub-Basin	0.22 - 1.32	3.78 – 12.54
3	Indus Main Stream	0.22 - 4.51	3.45–11.25

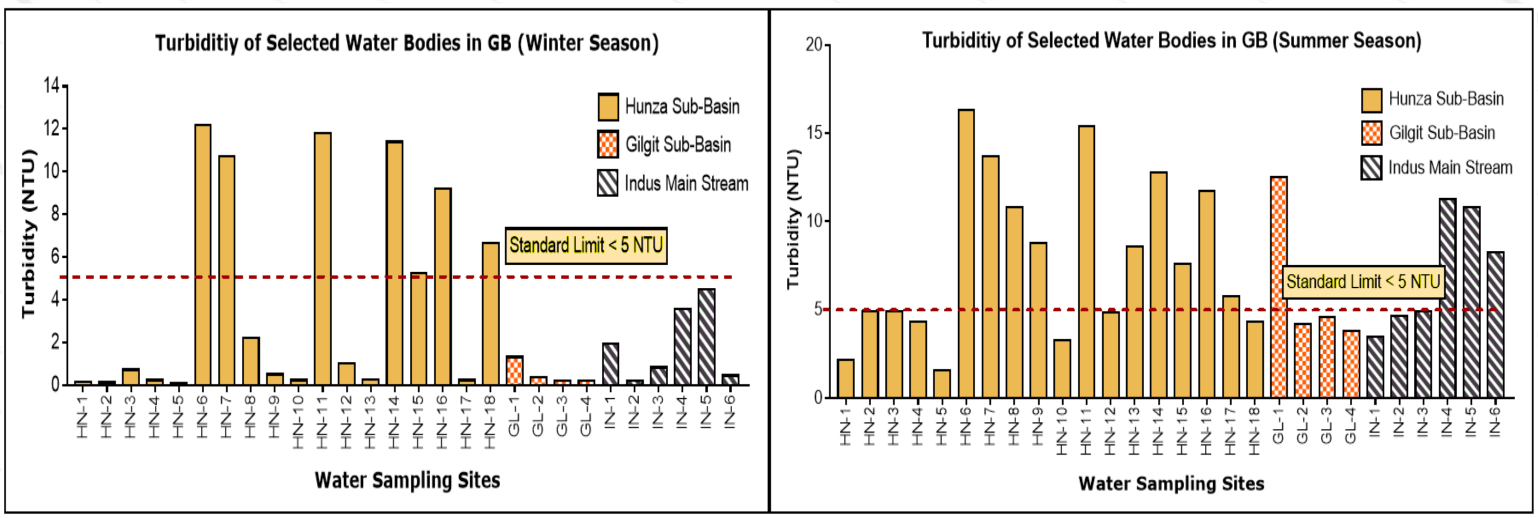


Figure 2.15: Spatial variation in Turbidity of selected water bodies in Gilgit-Baltistan (Winter & Summer Seasons)

2.4.2 Chemical Parameters

a. pH

The pH is a measure of the acid balance of a solution and is defined as the negative of the logarithm to the base 10 of the hydrogen ion concentration. The pH scale runs from 0 to 14 (i.e., very acidic to very alkaline), with pH 7 representing a neutral condition. The pH is an important variable in water quality assessment as it influences many biological and chemical processes within a water body. NSDWQ recommends the pH value between 6.5 and 8.5 is safe for drinking water. During winter season, pH values of selected water bodies ranged from 7.68 to 9.34 while in summer season, it was found between the range of 6.80 to 8.50 (Table 2.10). In winter season, pH of three samples from Hunza basin, one from Gilgit basin and two from Indus main stream were found slightly higher than NSDWQ limits (6.5 – 8.5) whereas during summer season, pH of all samples lied within NSDWQ limits (Figure 2.16). The higher values of pH as noted in winter season is a point of concern and calls for continuous study of these water bodies to detect the source of disturbing pH.

Table 2.10: Range of pH in selected water bodies in GB

S. No.	Study Basins	Range of pH (Winter Season)	Range of pH (Summer Season)
1	Hunza Sub-Basin	7.68 - 9.34	6.90 – 8.50
2	Gilgit Sub-Basin	7.83 – 8.73	6.96 – 7.65
3	Indus Main Stream	7.96 – 8.91	6.80 – 7.72

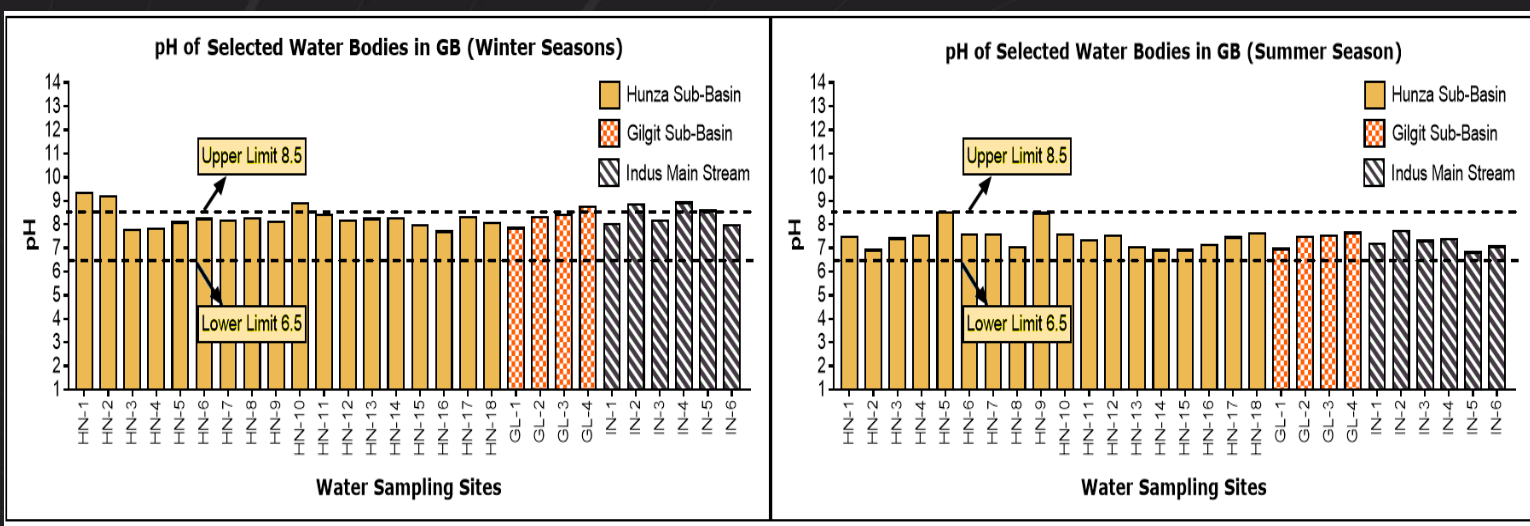


Figure 2.16: Spatial variation in pH of selected water bodies in GB (Winter & Summer Seasons)

b. Dissolved Oxygen (DO)

Dissolved oxygen (DO) is considered to be one of the most important parameters of water quality in streams, rivers, and lakes. It is a key test of water pollution. The higher the concentration of dissolved oxygen, the better is the water quality. The solubility of oxygen decreases as temperature and salinity increase. DO has no direct effect on public health, but drinking water with very little or no oxygen may taste unpalatable to people and unsuitable for aquatic life[15]. No health-based guideline value is recommended however in fresh-waters DO ranges from 15 mg/l at 0°C to 8 mg/l at 25°C[16]. Levels of dissolved oxygen in all water samples during winter and summer seasons ranged from 6.0 to 9.7 mg/l with an average value of 8.3 mg/l (Table 2.11). All water bodies in Hunza basin were found with higher levels of DO than Gilgit basin and Indus main stream (Figure 2.17).

Table 2.11: Range of DO in selected water bodies in GB

S. No.	Study Basins	Range of DO (mg/l) (Winter Season)	Range of DO (mg/l) (Summer Season)
1	Hunza Sub-Basin	7.6 – 9.7	6.0 – 8.5
2	Gilgit Sub-Basin	6.4 – 8.6	6.8 – 7.3
3	Indus Main Stream	7.9 – 9.1	6.1 – 8.3

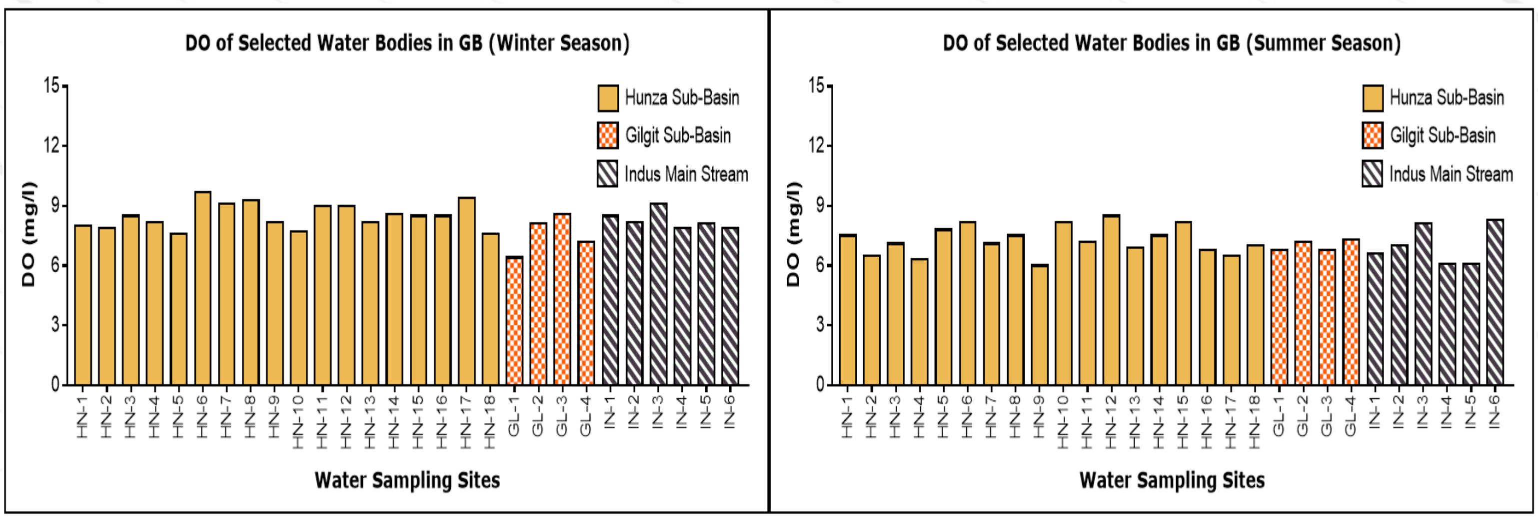


Figure 2.17: Spatial variation in DO of selected water bodies in Gilgit-Baltistan (Winter & Summer Seasons)

[15] Omer, N.H., 2019, Water Quality Parameters, Water Quality-Science, Assessments and Policy, Intech Open.

[16] Chapman, D.V., 1996, Water quality assessments: a guide to the use of biota, sediments, and water in environmental monitoring, published on behalf of WHO by F & FN Spon London

c. Total Hardness (as $CaCO_3$)

Hardness is a term used to express the properties of highly mineralized waters. The dissolved minerals in water cause problems such as scale deposits in hot water pipes and difficulty in producing lather with soap. Calcium (Ca^{2+}) and Magnesium (Mg^{2+}) ions cause the greatest portion of hardness in naturally occurring waters. They enter water mainly from contact with soil and rock, particularly limestone deposits. From health viewpoint, hardness up to 500 mg/L is safe, but more than that may cause a laxative effect. Concentration of hardness in all water samples during winter and summer seasons ranged between 59 to 554 mg/l (Table 2.12). During summer season, only in two water samples from Indus Main stream i.e., near Chilas and Diamer-Basha Dam, the values of hardness were noted slightly higher than the acceptable limit of NSDWQ i.e., < 500 mg/l whereas in all other samples, values of hardness in both seasons were within acceptable limit (Figure 2.18).

Table 2.12: Range of Hardness in selected water bodies in GB

S. No.	Study Basins	Range of Hardness (mg/l) (Winter Season)	Range of Hardness (mg/l) (Summer Season)
1	Hunza Sub-Basin	59 - 284	110 - 358
2	Gilgit Sub-Basin	65 - 325	97 - 478
3	Indus Main Stream	76 - 248	118 - 554

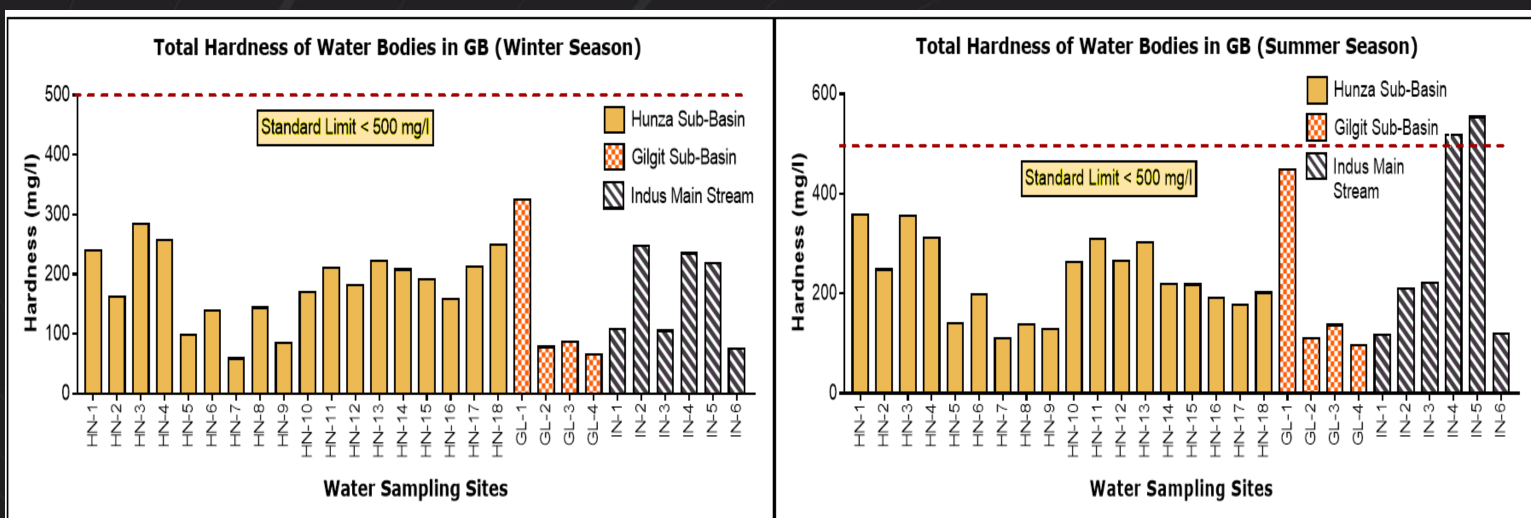


Figure 2.18: Spatial variation in Hardness of selected water bodies in GB (Winter & Summer Seasons)

d. Fluoride (F)

Fluoride originates from the weathering of fluoride-containing minerals and enters surface waters with run-off and ground waters through direct contact. Fluoride mobility in water depends, to a large extent, on the Ca^{2+} ion content, since fluoride forms low solubility compounds with divalent cations. Fluoride concentrations in natural waters vary from 0.05 to 100 mg/l, although in most situations they are less than 0.1 mg/l. Measurement of fluoride content is especially important when a water body is used for drinking water supply. At high concentrations, fluoride is toxic to humans and animals and can cause bone diseases. However, a slight increase in natural concentrations can help prevent dental caries although, at higher concentrations (above 1.5 - 2.0 mg/l).

Overall concentration of fluoride in all water samples collected from different sources in winter and summer seasons ranged from 0.08 to 1.40 mg/L (Table 2.13) which was within permissible the limit of NSDWQ i.e., <1.5 mg/l (Figure 2.19).

Table 2.13: Range of Fluoride in selected water bodies in GB

S. No.	Study Basins	Range of Fluoride (mg/l) (Winter Season)	Range of Fluoride (mg/l) (Summer Season)
1	Hunza Sub-Basin	0.10 – 0.98	0.38 – 1.21
2	Gilgit Sub-Basin	0.08 – 0.26	0.75 – 1.30
3	Indus Main Stream	0.05 – 0.37	0.30 – 1.40

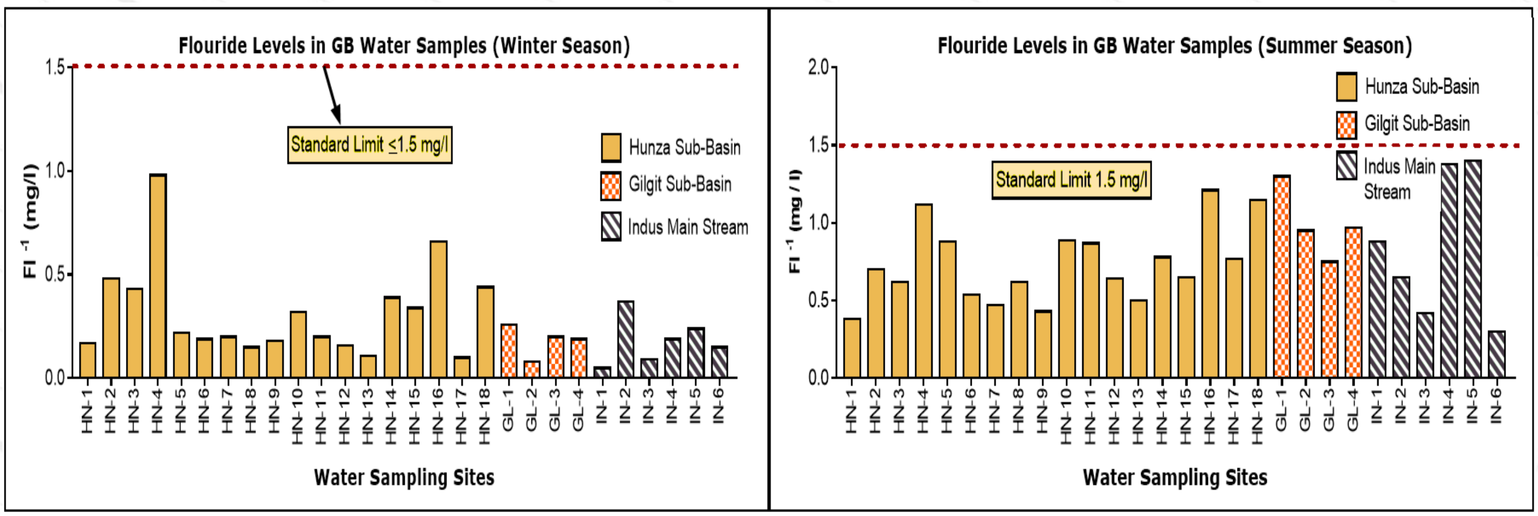


Figure 2.19: Spatial variation in Fluoride of selected water bodies in Gilgit-Baltistan (Winter & Summer Seasons)

e. Chloride

Most chlorine occurs as chloride (Cl^-) in solution. It enters surface waters with the atmospheric deposition of oceanic aerosols, with the weathering of some sedimentary rocks (mostly rock salt deposits) and from industrial and sewage effluents, as well as agricultural run-off. High concentrations of chloride can make water unpalatable and, therefore, unfit for drinking purpose.

Seasonal fluctuations of chloride concentrations in surface waters can occur where roads are salted in the winter.19 Concentration of chloride in water samples in winter and summer seasons ranged from 0.28 to 29.56 mg/l i.e., within acceptable limit of NSDWQ (< 250 mg/l) (Figure 2.20, Table 2.14).

Table 2.14: Range of Chloride levels in selected water bodies in GB

S. No.	Study Basins	Range of Chloride (mg/l) (Winter Season)	Range of Chloride (mg/l) (Summer Season)
1	Hunza Sub-Basin	0.94 – 18.24	6.2 – 46.8
2	Gilgit Sub-Basin	0.64 – 29.27	10.4 – 37.0
3	Indus Main Stream	0.28 – 7.20	8.54 – 53.4

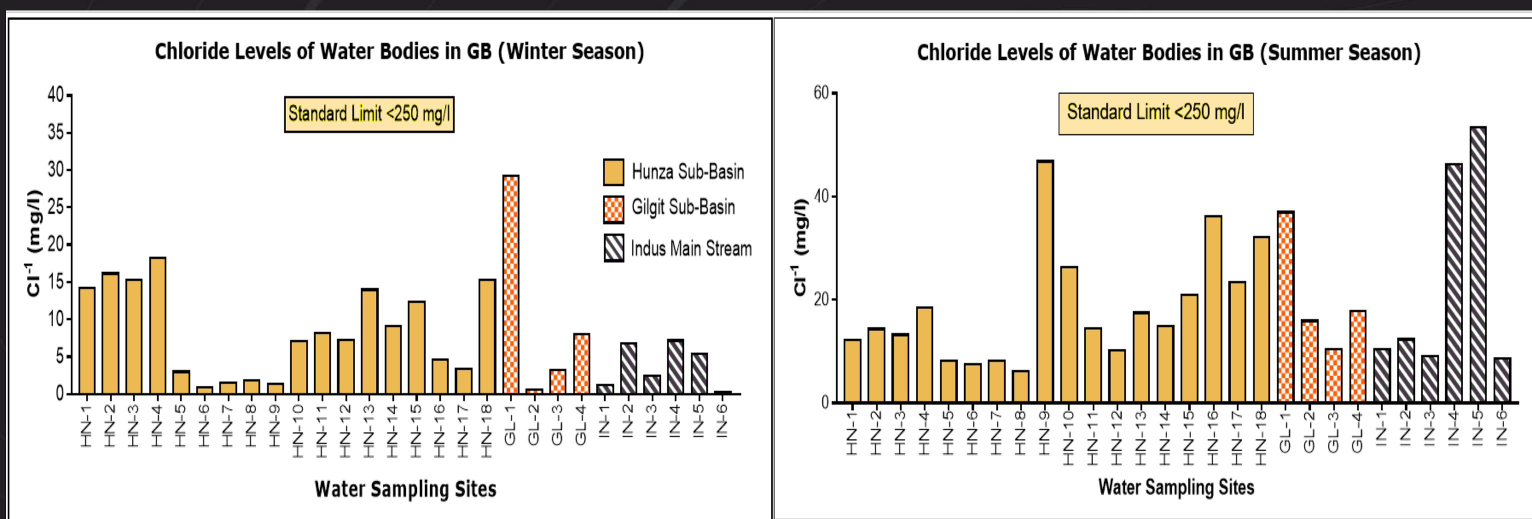


Figure 2.20: Spatial variation in Chloride levels of selected water bodies in GB (Winter & Summer Seasons)

f. Nitrate (NO_3-)

Nitrate can reach both surface water and groundwater as a consequence of agricultural activity (including excess application of inorganic nitrogenous fertilizers and manures), from wastewater disposal and from oxidation of nitrogenous waste products in human and other animal excreta, including septic tanks. No adverse health effects have been reported in humans in areas where drinking water consistently contained nitrate at concentrations below 50 mg/l. Although studies found that exposure to nitrate concentrations above 50 mg/l are weakly associated with altered thyroid function but the evidence is limited.

Overall nitrate concentration in winter and summer seasons ranged from 0.6 to 24.8 mg/l (Table 2.15). Concentration of nitrate in all water samples from GB were found within NSDWQ limits i.e., <50 mg/l (Figure 2.21).

Table 2.15: Range of Nitrate levels in selected water bodies in GB

S. No.	Study Basins	Range of Nitrate (mg/l) (Winter Season)	Range of Nitrate (mg/l) (Summer Season)
1	Hunza Sub-Basin	0.7 - 19.4	1.2 – 24.8
2	Gilgit Sub-Basin	0.6 – 1.8	2.8 – 5.9
3	Indus Main Stream	1.8 – 10.5	4.0 – 11.2

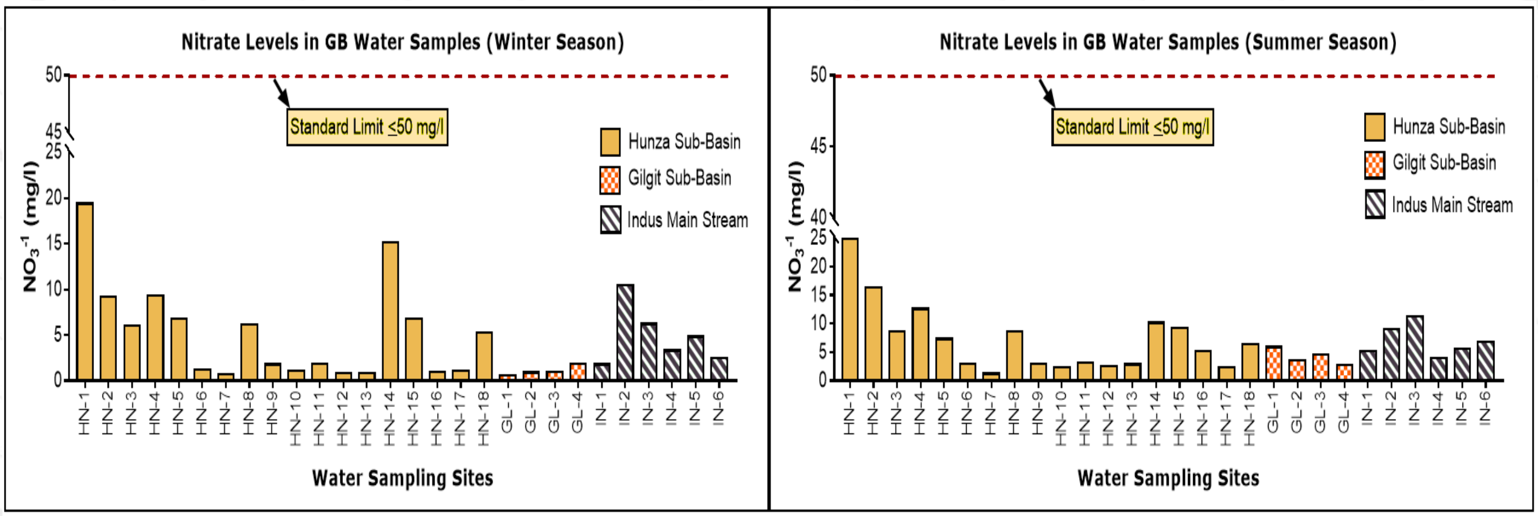


Figure 2.21: Spatial variation in Nitrate levels of selected water bodies in GB (Winter & Summer Seasons)

g. Sulphate (SO_4^{-2})

Sulphates occur naturally in numerous minerals and are used commercially in chemical industries. Sulphates are discharged into water through industrial wastes, and atmospheric deposition; however, the highest levels usually occur in groundwater and are from natural sources. In general, the average daily intake of sulphate from drinking-water, air and food is approximately 500 mg, food being the major source. However, in areas with drinking-water supplies containing high levels of sulphate, drinking-water may constitute the principal source of intake. The data from tap water studies with human volunteers indicate a laxative effect at concentrations of 1000–1200 mg/l, but no increase in diarrhea, dehydration or weight loss. No health-based guideline is proposed for sulphate, however, because of the gastrointestinal effects resulting from ingestion of drinking-water containing high sulphate levels, WHO recommends that health authorities be notified of sources of drinking water that contain sulphate concentrations in excess of 500 mg/l[17]. NSDWQ has not specified any specific limit for sulphate levels in freshwater. Overall concentration of sulphate in all drinking water samples were found between 4.4 to 84.0 mg/l (Table 2.16) in winter and summer seasons (Figure 2.22).

Table 2.16: Range of Sulphate levels in selected water bodies in GB

S. No.	Study Basins	Range of Sulphate (mg/l) (Winter Season)	Range of Sulphate (mg/l) (Summer Season)
1	Hunza Sub-Basin	8.5 – 67.6	24.7 – 78.8
2	Gilgit Sub-Basin	7.3 - 73.5	32.8 – 84.0
3	Indus Main Stream	4.4 – 44.8	26.0 – 56.7

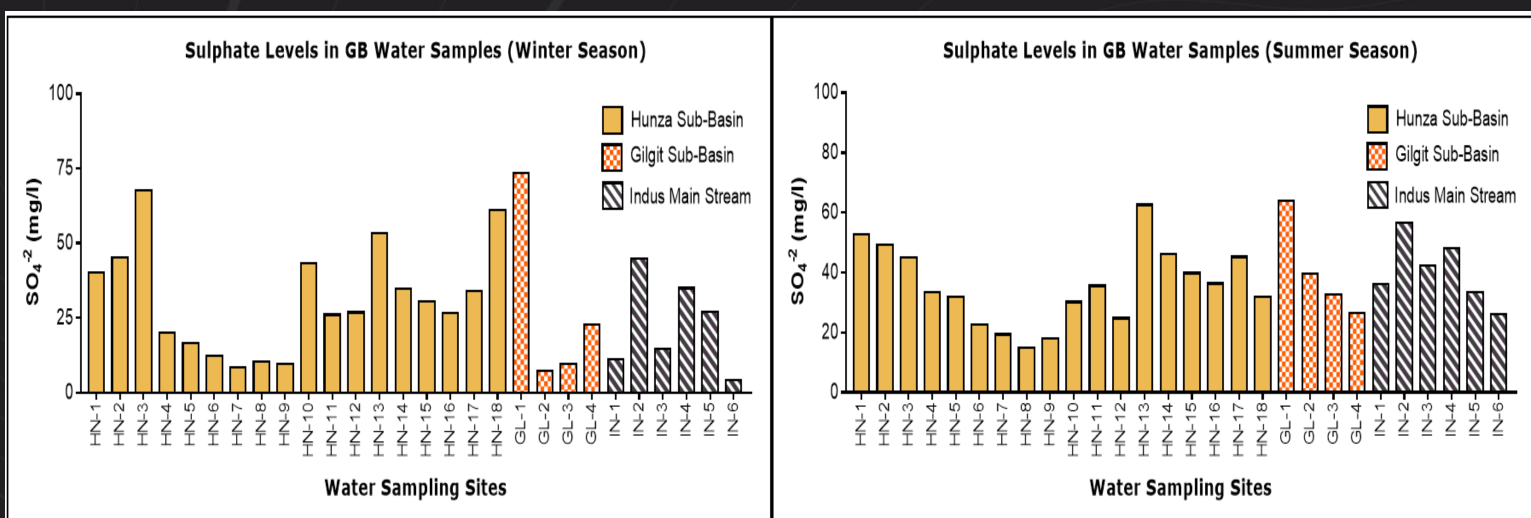


Figure 2.22: Spatial variation in Sulphate levels of selected water bodies in GB (Winter & Summer Seasons)

[17] WHO Guidelines for Drinking-water Quality, 4TH Edition, 2017; ISBN 978-92-4-154995-0

h. Calcium (Ca)

Calcium is present in water bodies as Ca^{2+} and is readily dissolved from rocks rich in calcium minerals, especially limestone and gypsum. The cation is abundant in surface and ground waters. The salts of calcium, together with those of magnesium, are responsible for the hardness of water. Acidic rainwater can increase the leaching of calcium from soils.

According to WHO, calcium concentration in natural waters is typically <15 mg/l. For waters associated with carbonate-rich rocks, concentrations may reach 30-100 mg/l[18]. NSDWQ has not specified any permissible limit for Ca contents in freshwater. Overall concentration of Ca in all drinking water samples collected from GB in winter and summer seasons ranged from 5.8 to 65.3 mg/l (Table 2.17, Figure 2.23).

Table 2.17: Range of Calcium levels in selected water bodies in GB

S. No.	Study Basins	Range of Calcium (mg/l) (Winter Season)	Range of Calcium (mg/l) (Summer Season)
1	Hunza Sub-Basin	10.2 – 39.7	20.2 – 53.5
2	Gilgit Sub-Basin	11.7 – 48.6	22.3 – 56.2
3	Indus Main Stream	5.8 – 36.9	18.2 – 65.3

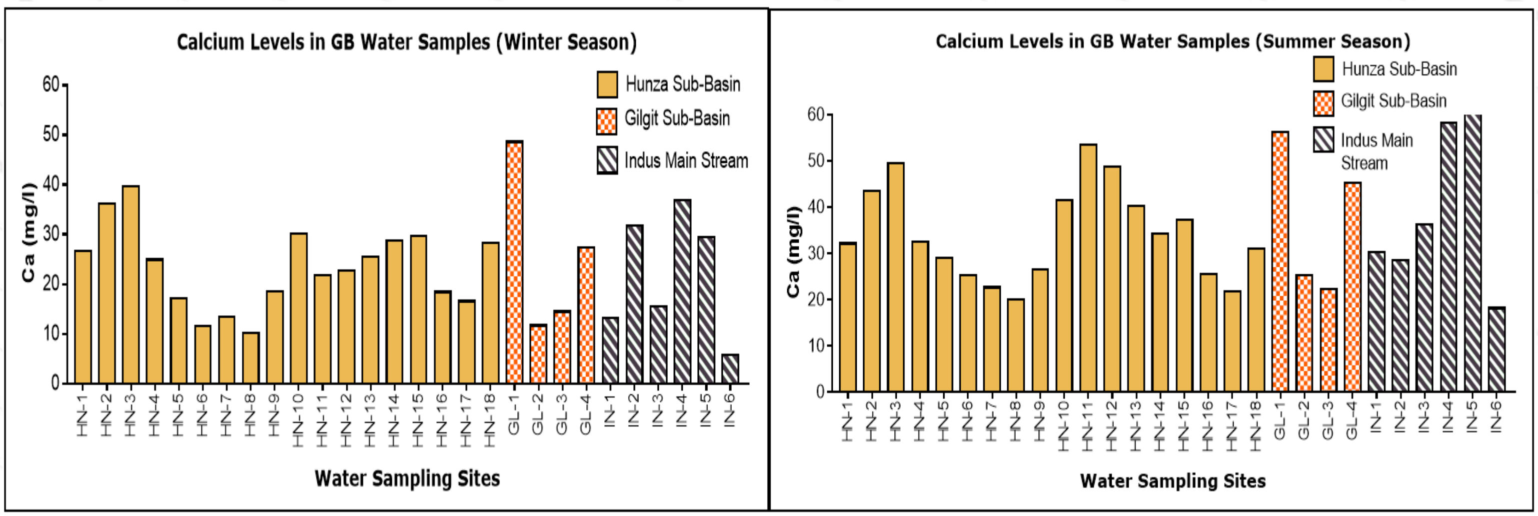


Figure 2.23: Spatial variation in Calcium levels of selected water bodies in Gilgit-Baltistan (Winter & Summer Seasons)

[18] Chapman, D.V., 1996, Water quality assessments: a guide to the use of biota, sediments, and water in environmental monitoring, published on behalf of WHO by F & FN Spon London

i. Magnesium (Mg)

Magnesium is common in natural waters as Mg^{2+}, and along with calcium, is a main contributor to water hardness. Magnesium arises principally from the weathering of rocks containing ferro-magnesium minerals and from some carbonate rocks.

According to WHO, natural concentration of magnesium in fresh waters may range from 1 to > 100 mg/l, depending on the rock types within the catchment[19]. NSDWQ has not specified any permissible limit for Mg contents in freshwater however overall concentration of magnesium in winter and summer seasons ranged from 5.36 to 17.58 mg/l (Table 2.18, Figure 2.24).

Table 2.18: Range of Magnesium levels in selected water bodies in Gilgit-Baltistan

S. No.	Study Basins	Range of Magnesium (mg/l) (Winter Season)	Range of Magnesium (mg/l) (Summer Season)
1	Hunza Sub-Basin	6.38 - 9.62	9.48 – 13.99
2	Gilgit Sub-Basin	5.86 – 10.69	9.90 – 15.34
3	Indus Main Stream	5.36 – 9.04	11.40 – 17.58

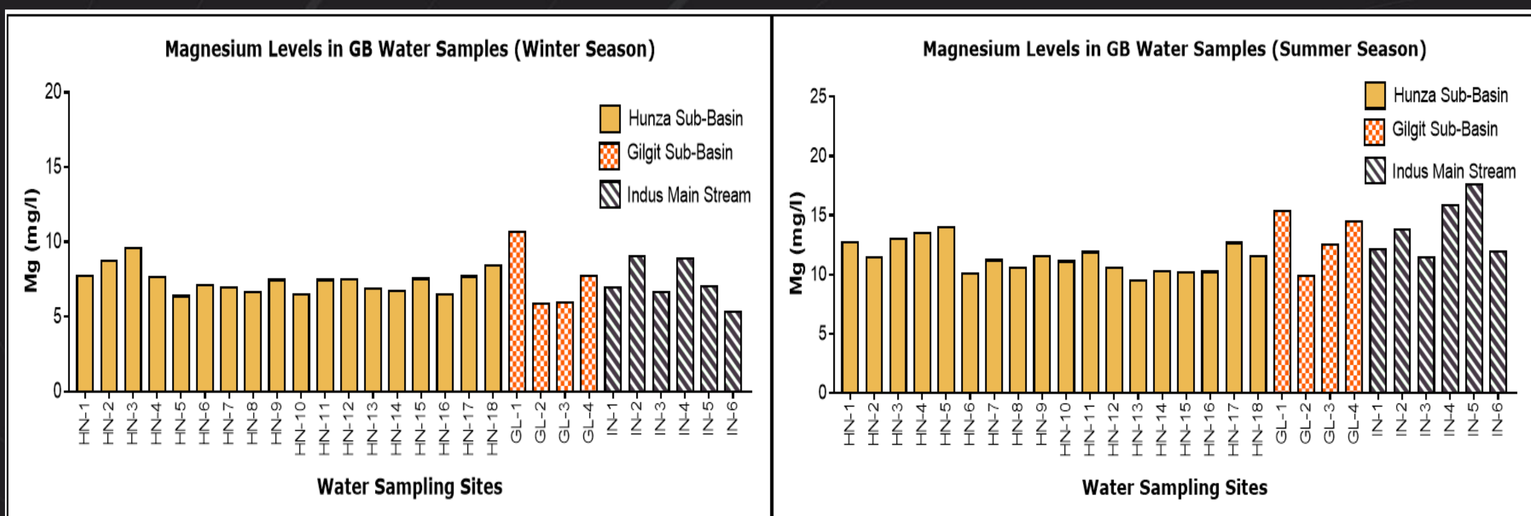


Figure 2.24: Spatial variation in Magnesium levels of selected water bodies in GB (Winter & Summer Seasons)

[19] WHO Guidelines for Drinking-water Quality, 4TH Edition, 2017; ISBN 978-92-4-154995-0

j. Sodium (Na)

Natural water bodies contain some sodium and it is one of the most abundant elements on earth. Increased concentrations in surface waters may arise from sewage and industrial effluents and from the use of salts on roads to control snow and ice, the latter source can also contribute to increased sodium in groundwater concentrations of sodium in natural surface waters vary considerably depending on local geological conditions, wastewater discharges and seasonal use of road salt. Though NSDWQ has not set standard limit of sodium in drinking water how according to WHO, the values may range from 1 to 105 mg/l[20].

Overall concentrations of sodium in all drinking water samples in winter and summer seasons varied from 0.11 to 11.12 mg/l (Table 2.19) which are well below the WHO's permissible limit (Figure 2.25).

Table 2.19: Range of Sodium levels in selected water bodies in GB

S. No.	Study Basins	Range of Sodium (mg/l) (Winter Season)	Range of Sodium (mg/l) (Summer Season)
1	Hunza Sub-Basin	0.28 – 7.5	3.45 – 9.28
2	Gilgit Sub-Basin	1.21 – 14.5	5.25 – 11.12
3	Indus Main Stream	0.11 – 6.2	4.17 – 10.77

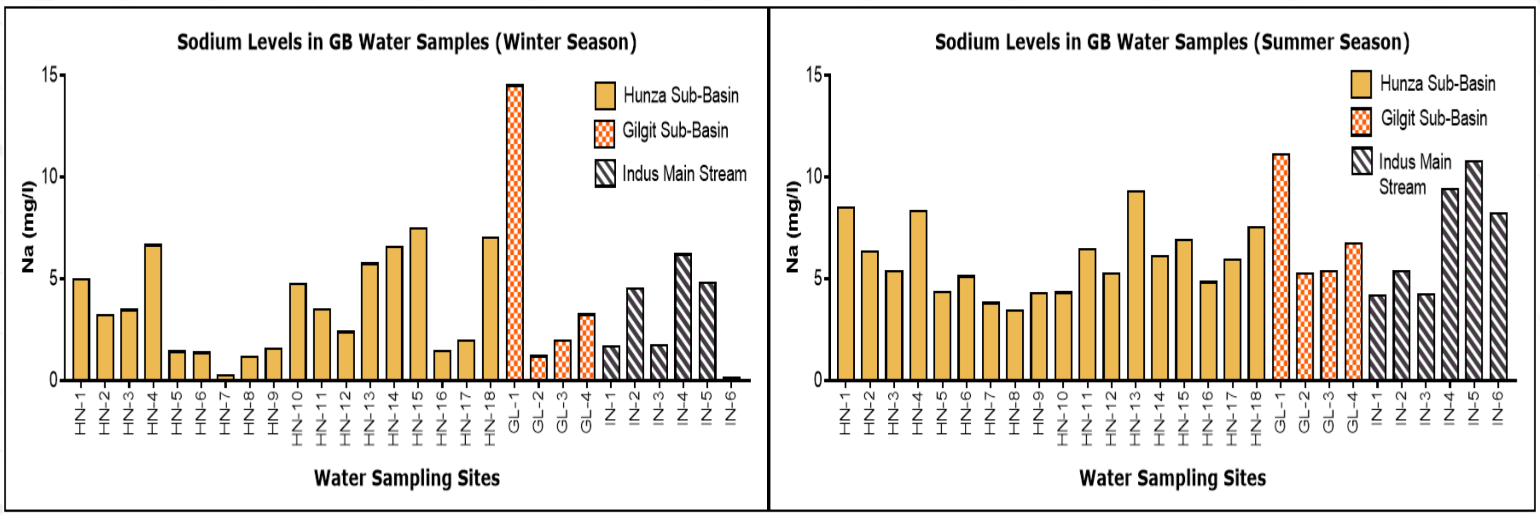


Figure 2.25: Spatial variation in Sodium levels of selected water bodies in Gilgit-Baltistan (Winter & Summer Seasons)

[20] WHO Guidelines for Drinking-water Quality, 4TH Edition, 2017; ISBN 978-92-4-154995-0

k. Cadmium (Cd)

Cadmium occurs naturally in zinc, lead and copper ores and can be released to ground and surface waters, when in contact natural water bodies. It enters the food chain from uptake by plants from contaminated soil or water. Cadmium has the chronic potential to cause kidney, liver, bone and blood damage from long-term exposure however there is inadequate evidence to state whether or not cadmium has the potential to cause cancer from lifetime exposures in drinking water[21].

The guideline value for cadmium as set by NSDWQ is 0.01 mg/l. Concentration of cadmium in all water samples ranged from ND (not detected) to 0.009 mg/l in winter and summer seasons (Table 2.20).

Table 2.20: Range of Cadmium levels in selected water bodies in GB

S. No.	Study Basins	Range of Cadmium (mg/l) (Winter Season)	Range of Cadmium (mg/l) (Summer Season)
1	Hunza Sub-Basin	ND - 0.005	ND - 0.004
2	Gilgit Sub-Basin	ND	ND – 0.007
3	Indus Main Stream	ND – 0.007	ND – 0.009

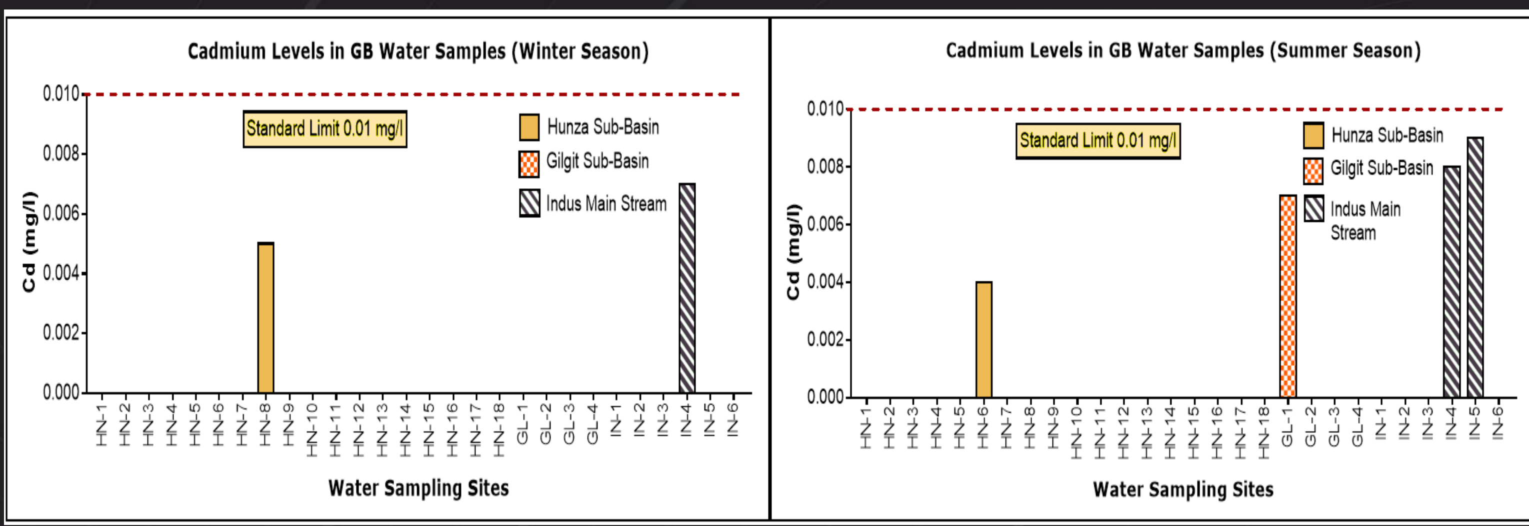


Figure 2.26: Spatial variation in Cadmium levels of selected water bodies in Gilgit-Baltistan (Winter & Summer Seasons)

[21] Water Quality Association, USA [https://www.wqa.org/learn-about-water/common-contaminants/cadmium]

I. Mercury (Hg)

Mercury (Hg) is a naturally occurring metal found primarily in a mineral called cinnabar (a toxic mercury sulfide mineral), which can contain up to 86 percent mercury. Mercury is released from these ores through the natural weathering of rock and volcanic activity. Another source of mercury in the environment is from human activity through coal-combustion electrical power generation and industrial waste disposal. Once mercury is released to the environment, it can be converted to a biologically toxic form of methyl mercury (MeHg) by microorganisms found in soil and in the aquatic environment. Mercury has the potential to cause kidney damage from long-term exposure however there is insufficient evidence to state whether mercury in drinking water has the potential to cause cancer over a lifetime.

NSDWQ has set permissible limit of mercury in drinking water as less than 0.001 mg/l. Concentration of mercury in water samples collected from GB ranged between ND to 0.005 mg/l (Table 2.21). During summer season, mercury was detected in two water samples from Hunza Basin i.e., from Chill Ganish (0.002 mg/l) and Gamun Ganish (0.003 mg/l) as well as in two samples from Indus main stream i.e., near Chilas (0.004 mg/l) and Diamer-Basha Dam (0.005 mg/l) exceeding the standard limit of NSDWQ (<0.001 mg/l). During winter season, it was detected only in two samples i.e., from Chill Ganish, Hunza (0.003 mg/l) and near Diamer-Basha Dam (0.002 mg/l) which were also exceeding the NSDWQ limit (Figure 2.27).

Table 2.21: Range of Mercury levels in selected water bodies in GB

S. No.	Study Basins	Range of Mercury (mg/l) (Winter Season)	Range of Mercury (mg/l) (Summer Season)
1	Hunza Sub-Basin	ND – 0.003	ND – 0.003
2	Gilgit Sub-Basin	ND	ND
3	Indus Main Stream	ND – 0.002	ND – 0.005

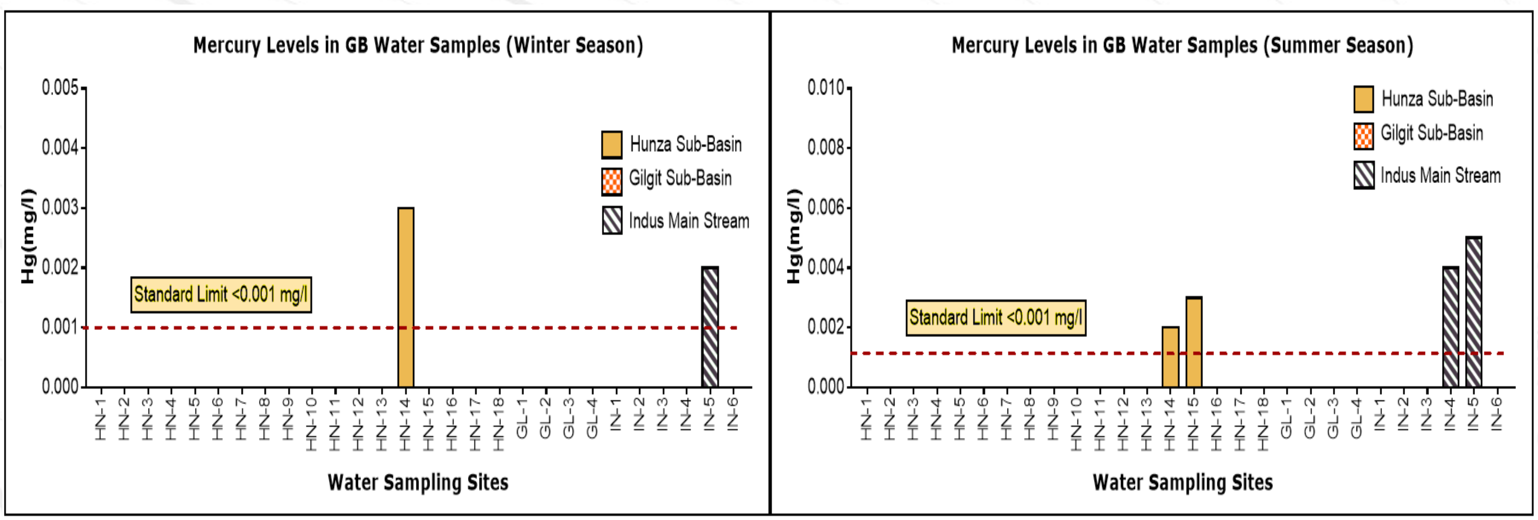


Figure 2.27: Spatial variation in Mercury levels of selected water bodies in GB (Winter & Summer Seasons)

m. Lead (Pb)

Lead (Pb) naturally occurs in earth crust in the form of lead sulfide therefore the main source of lead in surface and ground waters could be the weathering/ leaching of sulfide deposits. Another source of Pb could be the mining of Pb ores located in river basins[22]. Exposure to lead through drinking water is associated with a wide range of effects, including various neuro-developmental effects, mortality (mainly due to cardiovascular diseases), impaired renal function, hypertension, impaired fertility and adverse pregnancy outcomes[23]. Pb was found in various samples collected from Hunza, Gilgit and Indus main stream samples. Overall concentration of Pb in drinking water samples ranged from ND to 0.05 mg/l in winter and summer seasons (Table 2.22). Highest level of lead was observed during summer season in water samples from Indus main stream near dam construction sites followed by Chilas (Figure 2.28). Regardless of the fact that Pb levels were below or coinciding the NSDWQ limit (<0.05 mg/l) however the presence of lead in surface water is alarming which needs an extensive investigative study by continuous water sampling to detect the source of lead in study region.

Table 2.22: Range of Pb levels in selected water bodies in GB

S. No.	Study Basins	Range of Lead (mg/l) (Winter Season)	Range of Lead (mg/l) (Summer Season)
1	Hunza Sub-Basin	0.004 – 0.03	ND – 0.03
2	Gilgit Sub-Basin	ND – 0.01	ND – 0.009
3	Indus Main Stream	ND – 0.04	ND – 0.05

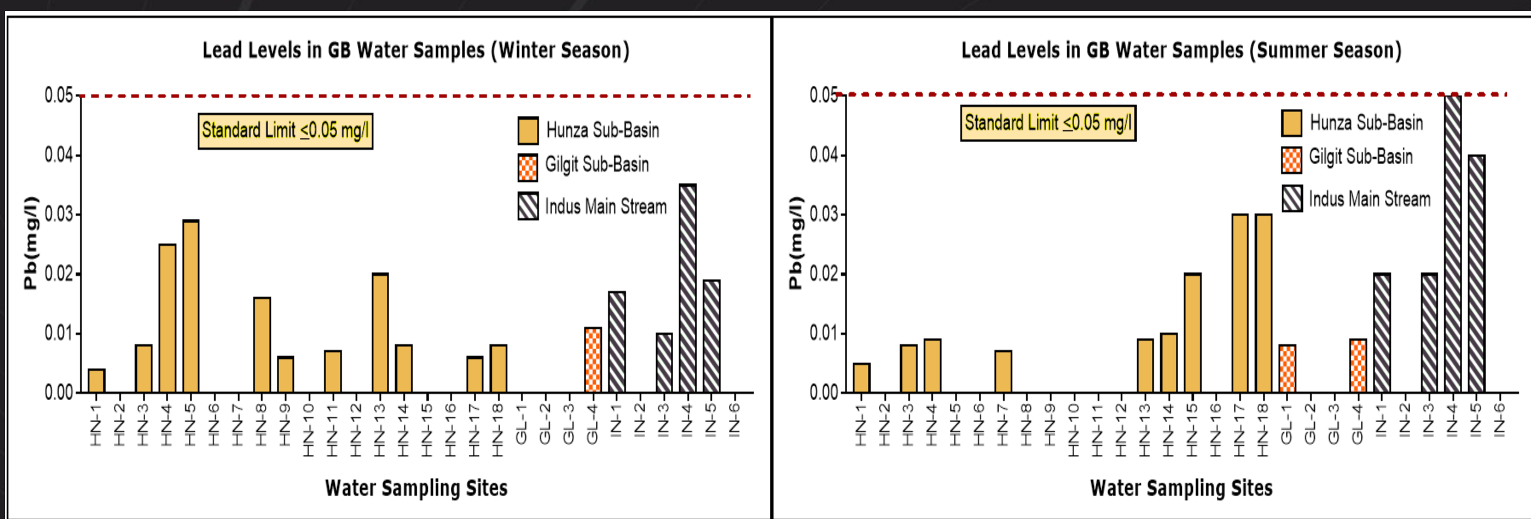


Figure 2.28: Spatial variation in Lead levels of selected water bodies in GB (Winter & Summer Seasons)

[22] Sanja M. Sakan, Gordana J. Devic, Dubravka J. Relic, Ivan B. Andelkovic, Environmental Assessment of Heavy Metal Pollution in Freshwater Sediment, Serbia, Clean - Soil Air Water , November 2014, DOI: 10.1002/clen.201400275

[23] WHO Guidelines for Drinking-water Quality, 4TH Edition, 2017; ISBN 978-92-4-154995-0

n. Arsenic (As)

Arsenic (As) is found widely in Earth's crust. It is released into the aquatic environment from both natural and anthropogenic sources. Anthropogenic inputs such as mining and smelting activities, combustion of fossil fuels, and the use of 'As' pesticides, herbicides and additives to livestock feed have been reported to contribute significantly to the elevation of 'As' levels in freshwater ecosystems such as rivers and lakes around the world[24]. In natural waters, 'As' can be accumulated by aquatic biota, especially by fish and can reach terrestrial animals and humans, resulting in adverse effects of varying extents. High levels of 'As' in water may lead to health problems such as melanosis, lung disease, liver disease and even cancers of skin[25].

The 'As' in drinking water has been legally regulated as <0.05 mg/l by NSDWQ. The concentration of arsenic in GB water samples ranged from ND to 0.04 mg/l (Table 2.23) which shows that the detected levels of 'As' were within the standard limits by NSDWQ (Figure 2.29).

Table 2.23: Range of Arsenic levels in selected water bodies in GB

S. No.	Study Basins	Range of Arsenic (mg/l) (Winter Season)	Range of Arsenic (mg/l) (Summer Season)
1	Hunza Sub-Basin	ND - 0.016	ND - 0.03
2	Gilgit Sub-Basin	ND – 0.021	ND - 0.03
3	Indus Main Stream	ND – 0.014	ND - 0.04

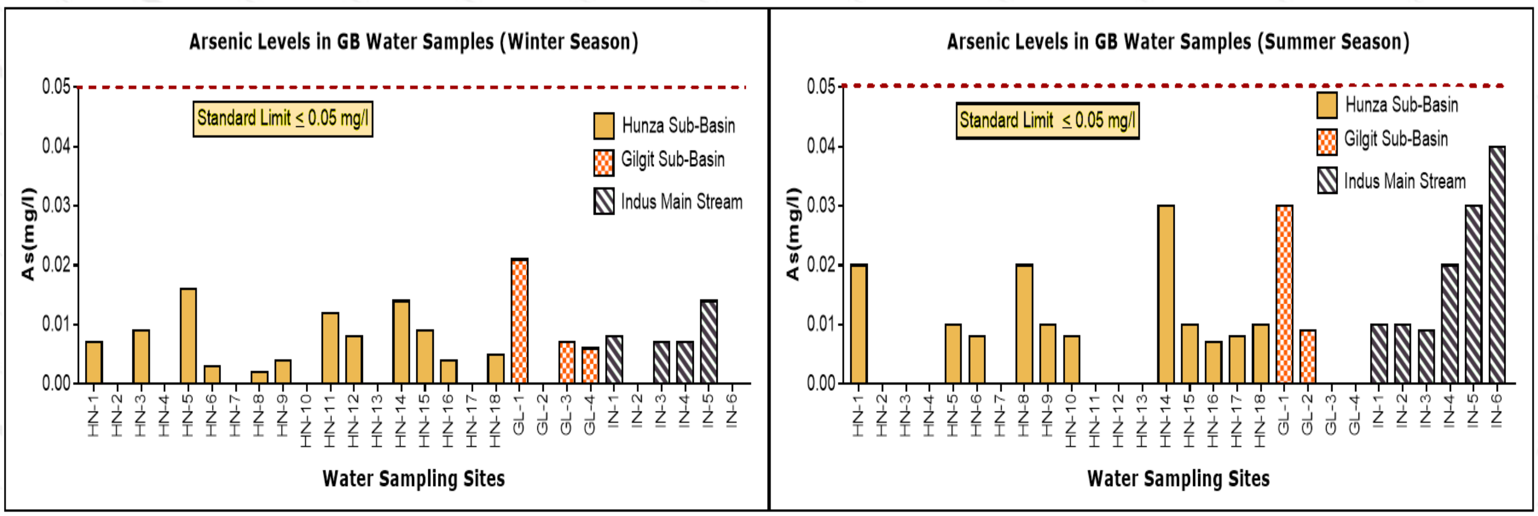


Figure 2.29: Spatial variation in Arsenic levels of selected water bodies in Gilgit-Baltistan (Winter & Summer Seasons)

[24] P.L. Smedley, D.G. Kinniburgh, A review of the source, behaviour and distribution of arsenic in natural waters, Appl. Geochem. 17 (2002) 517–568
[25] M.B. Arain, T.G. Kazi, J.A. Baig, M.K. Jamali, H.I. Afridi, A.Q. Shah, N. Jalbani, R.A.Sarfraz, Determination of arsenic levels in lake water, sediment, and foodstuff from selected area of Sindh, Pakistan: estimation of daily dietary intake, Food Chem. Toxicol. 47 (2009) 242–248

2.4.3 Biological Parameters

Water pollution caused by fecal contamination is a serious problem due to the potential for contracting diseases from pathogens (disease causing organisms). The presence of pathogens is determined by testing for an "indicator" organism such as coliform bacteria. Coliform bacteria are present in the environment and feces of all warm-blooded animals and humans. There are three groups of coliform bacteria. Each is an indicator of drinking water quality and each has a different level of risk. Total coliform is a large collection of different kinds of bacteria. Initially, the drinking water samples are tested for total coliform. If total coliform is present, the samples are further tested for Escherichia coliform (E. coli) which is a subgroup of the fecal coliform group. The presence of E. coli in a drinking water sample usually indicates recent fecal contamination which indicates toward the high risk of presence of pathogens. Two categories of bacterial coliform were tested in GB water samples i.e., Total Coliform[26] & E. Coliform[27].

a. Total Coliform

For Total coliform, NSDWQ recommends zero MPN (Most Probable Number) or must not be detected in 100 ml of drinking water[28]. Drinking water samples collected from different sources in GB were analyzed for bacteriological analysis and the number of detected total coliform ranged from 0 to 37 MPN in winter and summer seasons (Table 2.24). In winter season, T.Coli bacteria were detected in 39%, 75% and 50% water bodies in Hunza basin, Gilgit basin and Indus main stream respectively. In summer season, T.Coli bacteria were detected in 67%, 75% and 50% water bodies in Hunza basin, Gilgit basin and Indus main stream respectively. Highest levels of total coliforms were detected in Hunza sub-basin followed by Indus main stream and Gilgit sub-basin (Figure 2.30).

Table 2.24: Range of Total Coliform bacteria in selected water bodies in GB

S. No.	Study Basins	Range of Total Coliform (MPN) (Winter Season)	Range of Total Coliform (MPN) (Summer Season)
1	Hunza Sub-Basin	0 - 30	0 - 37
2	Gilgit Sub-Basin	0 – 14	0 - 17
3	Indus Main Stream	0 - 17	0 - 28

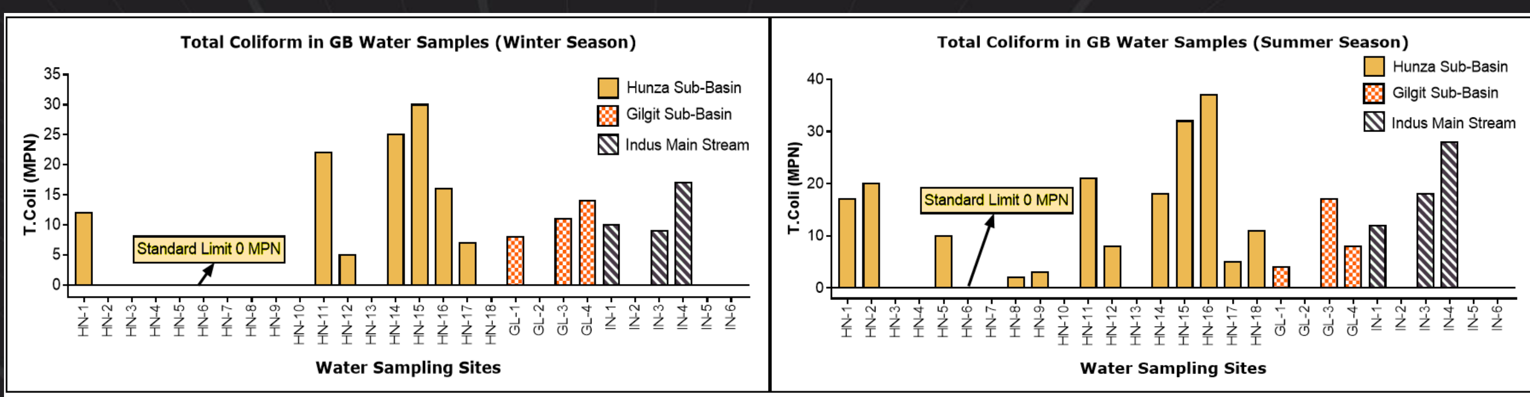


Figure 2.30: Spatial variation in Total Coliform of selected water bodies in Gilgit-Baltistan (Winter & Summer Seasons)

b. Escherichia Coliform

[26] Coliform Bacteria and Drinking Water (NYDOH) https://www.doh.wa.gov/Portals/1/Documents/Pubs/331-181.pdf
[27] Coliform Bacteria in Drinking Water Supplies (NYDOH) health.ny.gov/environmental/water/drinking/coliform_bacteria.htm
[28] National Standards for Drinking Water Quality (NSDWQ), S.R.O. 1062 (I)/2010, The Gazette of Pakistan, Extra., November 26, 2010

For E. coli, NSDWQ recommends zero MPN (Most Probable Number) or must not be detected in 100 ml of drinking water. The number of detected E. coli ranged from 0 to 19 MPN in winter and summer seasons (Table 2.25). In winter season, E. coli bacteria were detected in 28%, 25% and 50% water bodies in Hunza basin, Gilgit basin and Indus main stream respectively. In summer season, E. coli bacteria were detected in 83%, 25% and 66% water bodies in Hunza basin, Gilgit basin and Indus main stream respectively. Highest levels of E. coli were detected in Hunza sub-basin followed by Indus main stream (Figure 2.31).

Table 2.25: Range of Escherichia Coliform bacteria in selected water bodies in GB

S. No.	Study Basins	Range of E. Coliform (MPN) (Winter Season)	Range of E. Coliform (MPN) (Summer Season)
1	Hunza Sub-Basin	0 - 8	0 - 19
2	Gilgit Sub-Basin	0 - 2	0 - 4
3	Indus Main Stream	0 - 4	0 - 15

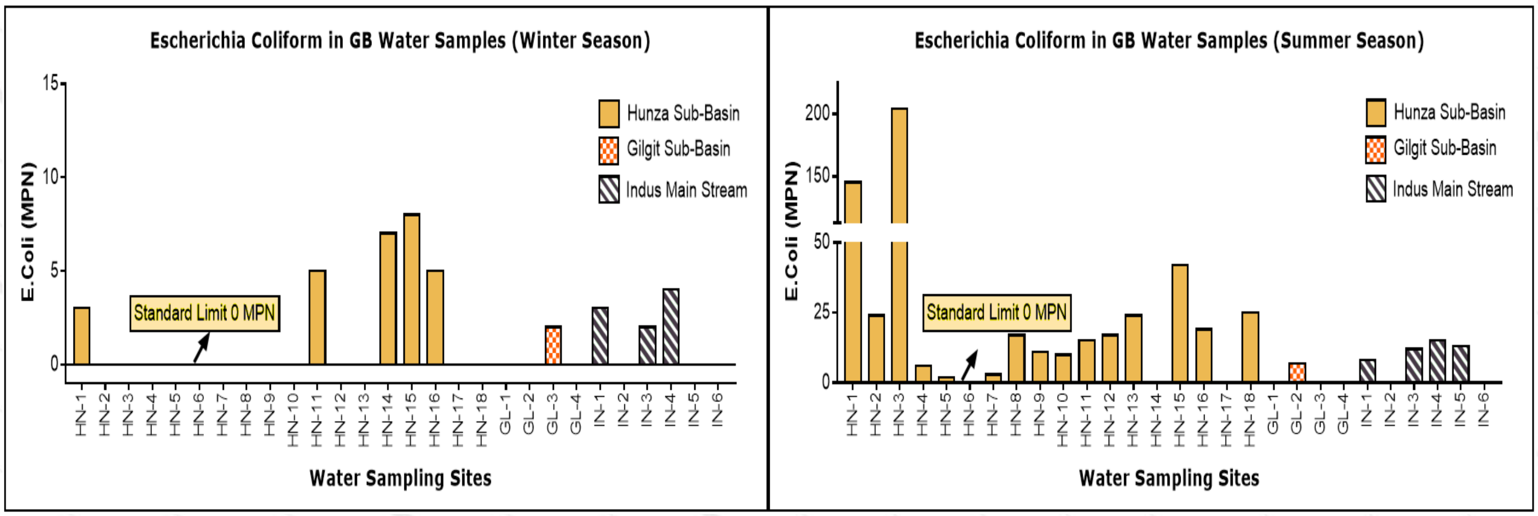


Figure 2.31: Spatial variation in Escherichia Coliform bacteria in selected water bodies in Gilgit-Baltistan (Winter & Summer Seasons)

2.5 Conclusion

Field surveys in GB were carried out for sampling of streams (nallahs), springs, rivers and pipeline supplies of drinking water. Total 28 sites were sampled including Hunza sub-basin (18 sites), Gilgit sub-basin (04 sites) and Indus main stream (06 sites) in winter season 2019 and summer season 2020. All water samples were tested for physical, chemical and biological parameters. The in-situ and laboratory results were evaluated according to the drinking water quality criteria specified by National Standards for Drinking Water Quality (NSDWQ) set by Government of Pakistan.

Regarding the physical parameters of water quality, in winter & summer seasons, all water samples met standard limit (<1000 ppm) of total dissolved solids (TDS) as defined by NSDWQ. The highest TDS was observed in water samples collected in summer season from Danyor (654 ppm) followed by those collected nearby Diamer-Basha Dam (589 ppm). Turbidity of 25% of water samples in winter season was found exceeding the NSDWQ (<5 NTU) whereas in summer season, 50% of water samples were found with turbidity beyond the NSDWQ. In Hunza basin, higher turbidity levels were noted in water samples from Batura, Passu, Shiskat, Hasanabad & Ultar Nallahs especially in summer season. In Gilgit river basin, highest turbidity was observed in Danyor spring whereas water bodies of Indus main stream nearby Diamer-Basha Dam and Chilas were also exceeded the permissible limits. For electrical conductivity, NSDWQ has not specified the standard limit however World Health Organization (WHO) recommends conductivity in the range of 10 to 1000 µS/cm suitable for drinking purpose. Overall electrical conductivities of all water bodies in summer and winter seasons were found within the recommended range of WHO except Danyor water spring in Gilgit where higher conductivity levels were observed in both seasons ranging from 1140 to 1210 µS/cm.

Chemical analysis of water bodies is a sensitive indicator in assessing potential contamination of an ecosystem. In this context, water samples collected from selected river basins were analyzed for pH, hardness, dissolved oxygen, minerals (sodium, calcium, magnesium, chloride, fluoride, sulphate, & nitrate) and toxic metals (cadmium, mercury, lead & arsenic).

In summer season, pH of all selected water bodies lied within the range of NSDWQ (6.5 – 8.5) whereas in winter season, pH of three water samples from Hunza sub-basin, one from Gilgit sub-basin and two from Indus main stream were found slightly higher (exceeded up to 9.34) than NSDWQ. Levels of dissolved oxygen in all water samples during both seasons ranged from 6.0 to 9.7 mg/l which were within the recommended range by WHO i.e., 8 to 15 mg/l. Total hardness of all water bodies in both seasons met permissible limit of NSDWQ (i.e., < 500 mg/l) except two sites i.e., near Chilas and Diamer-Basha Dam. The values of hardness at these sites were noted slightly higher (up to 554 mg/l) in summer season. As far as mineral components are concerned, levels of anions (i.e., chloride, fluoride, nitrate & sulphates) and cations (i.e., calcium, magnesium & sodium) during both summer and winter seasons were found within permissible limits of NSDWQ (where applicable). Overall, the average levels of anions were found in the order of SO_4>Cl >NO_3>F whereas cations had concentration in the order of Ca>Mg>Na.

Among heavy metals, lead and arsenic were detected in more than 50% of water samples (including Hunza river basin, Gilgit river basin and Indus main stream) whereas cadmium and mercury were detected in less than 15% water samples in both seasons. In winter season, concentrations of cadmium, mercury, lead and arsenic were found below the permissible limits of NSDWQ. In summer season, concentration of mercury exceeded the NSDWQ whereas concentrations of cadmium, lead and arsenic were found as per recommended limits by NSDWQ.

The bacterial contamination (including Total Coliforms and E. coli) was found in 82% of samples in summer and 48% of water samples in winter which shows contamination of fresh water bodies with animal or human faeces.

According to US EPA, a water body is 'impaired' if it does not attain the water quality criteria associated with its designated use(s). The 'threatened' waters are those that meet standards but exhibit a declining trend in water quality such that they will likely exceed standards in the near future[29]. In this perspective, it is concluded that selected river basins in GB fall in the category of "threatened" regarding the physical and chemical parameters whereas in context of biological parameters, most water sites can be termed as "impaired". Therefore, it is recommended that basin-wise watershed management studies may be initiated in GB to control / mitigate degradation of water quality during operational phase of CPEC.

[29] United States Environmental Protection Agency, A Quick Guide to Developing Watershed Plans to Restore and Protect Our Waters, Washington, DC 20460, EPA 841-R-13-003, May 2013

03

AIR QUALITY, METEROLOGY AND NOISE MONITORING

Chapter Three

3. Ambient Air quality, Meteorology & Noise Level Monitoring

3.1 Background

The issue of air pollution (including short-lived gases and aerosols) and emissions of greenhouse gases (GHGs) due to anthropogenic activities has drawn much attention of scientists worldwide due to their considerable role in climatic perturbations as well as adverse impacts on health and ecosystem. These emissions have severely affected the atmospheric composition resulting in changes in rain fall patterns & hydrological cycles, glaciers stability by reducing snow albedo, and crops yield by disturbing energy-balance of the earth-atmosphere system. Therefore, the issue of climate change and improvement of air quality has moved to the top of the political and scientific agenda in many parts of the world[1].[2]

The glaciated regions in Asia including Hindukush-Karakoram-Himalaya (HKH) region and Tibetan Plateau (TP) have long been considered as pristine region which is not or relatively less influenced by emissions from human activities. However, in recent years, scientific studies[3],[4] in these regions revealed high concentration of anthropogenic pollutants either in air or deposited on snow. These pollutants include black carbon (BC), ozone (O3), Sulfur Dioxide (SO2), Oxides of Nitrogen (NO & NO2), Carbon Monoxide (CO), Particulate Matter (PM), and others. The consensus theory of the scientific community is that atmospheric burden of light absorbing pollutants i.e., BC and PM is a principal cause of the increase in atmospheric temperature, and accelerated melting of glaciers. Furthermore, air pollutants e.g., CO, SO_2, NO_X, O_3, PM also have profound health effects including aggravated cardiovascular and respiratory illness. Long-term exposure to air pollutants may have severe health effects such as accelerated aging of the lungs, development of diseases such as asthma, bronchitis, emphysema, and possibly cancer. According to WHO, air pollution results in death of over 3 million people worldwide in a year[5]. In fact, observation of atmospheric composition variables has become an important area of atmospheric research studies.

One of the dominant origins of anthropogenic pollutants in glaciated regions of HKH / TP is South Asian haze, also known as Atmospheric Brown Clouds (ABCs) which is the regional scale air pollution that persists throughout the year over South Asia, Bay of Bengal and Arabian Sea. This brownish haze is composed of a 3-km thick mixture of black carbon (BC), GHGs, organic pollutants, dust, and toxins e.g., mercury. Potential consequences of this haze are regional warming, melting of glaciers in the region, acceleration of seasonal snow melting due to deposition of light absorbing components on snow and changes in precipitation patterns in South Asia[6]. Recognizing the devastating impacts of air pollutants and GHGs on glacier ecosystem, climate and living organisms; several atmospheric monitoring networks are functioning in South and East Asia e.g.

[1] Monks, P.S., Granier, C., Fuzzi, S., 2009. Atmospheric composition change – global and regional air quality. Atmospheric Environment, 43(33): p. 5268-5350.

[2] Isaksen, I.S.A., Granier, C., Myhre, G., Berntsen, T., Dalsøren, S.B., Gauss, M., Klimont, Z., Benestad, and Wuebbles, D.J., 2012. Chapter 12 - Atmospheric Composition Change: Climate–Chemistry Interactions, in Ann, H.-S., and Kendal, M., eds., The Future of the World's Climate (Second Edition): Boston, Elsevier, p. 309-365.

[3] Putero, D., Landi, T.C., Cristofanelli P., 2014. Influence of open vegetation fires on black carbon and ozone variability in the southern Himalayas (NCO-P, 5079 m a.s.l.). Environmental Pollution, 184(0): p. 597-604.

[4] Chen, P., Kang, S., Yang, J., Pu, T., Li, C., Guo, J., and Tripathee, L., 2019. Spatial and temporal variations of gaseous and particulate pollutants in six sites in Tibet, China, during 2016–2017: Aerosol Air Qual. Res, v. 19, p. 516-527.

[5] Ambient air pollution: A global assessment of exposure and burden of disease, World Health Organization, Publication date: 2016, ISBN: 9789241511353

[6] Bonasoni, P., Laj, P., Angelini, F., Arduini, J., Bonafč, U., Calzolari, F., Cristofanelli, P., Decesari, S., Facchini, M., and Fuzzi, S., 2008. The ABC-Pyramid Atmospheric Research Observatory in Himalaya for aerosol, ozone and halocarbon measurements: Science of the Total Environment, v. 391, p. 252-261.

China Atmosphere Watch Network (CAWNET), Aerosol Radiative Forcing over India (ARFI), Nepal Climate Observatory at Everest (PYRAMID) (Figure3.1). Yet, no permanent atmospheric observatory exists in glaciated region in Pakistan. Consequently, there is a dearth of knowledge about the amplitude of atmospheric pollutants and magnitude of their devastating impacts on glaciers and hydrological regime in Upper Indus Basin (UIB) of Pakistan. A comprehensive baseline characterization of air quality has never been carried out in GB even the partial commencement of operations across CPEC route is already started.

Further, the tourism activities in the region are also increasing every year. Therefore, the objective of initiating air quality monitoring across CPEC in GB was to investigate the concentrations of criteria pollutants ($SO2$, NOx, $O3$, CO, $PM2.5$) and light absorbing aerosols i.e., BC; and to assess their seasonal variations.

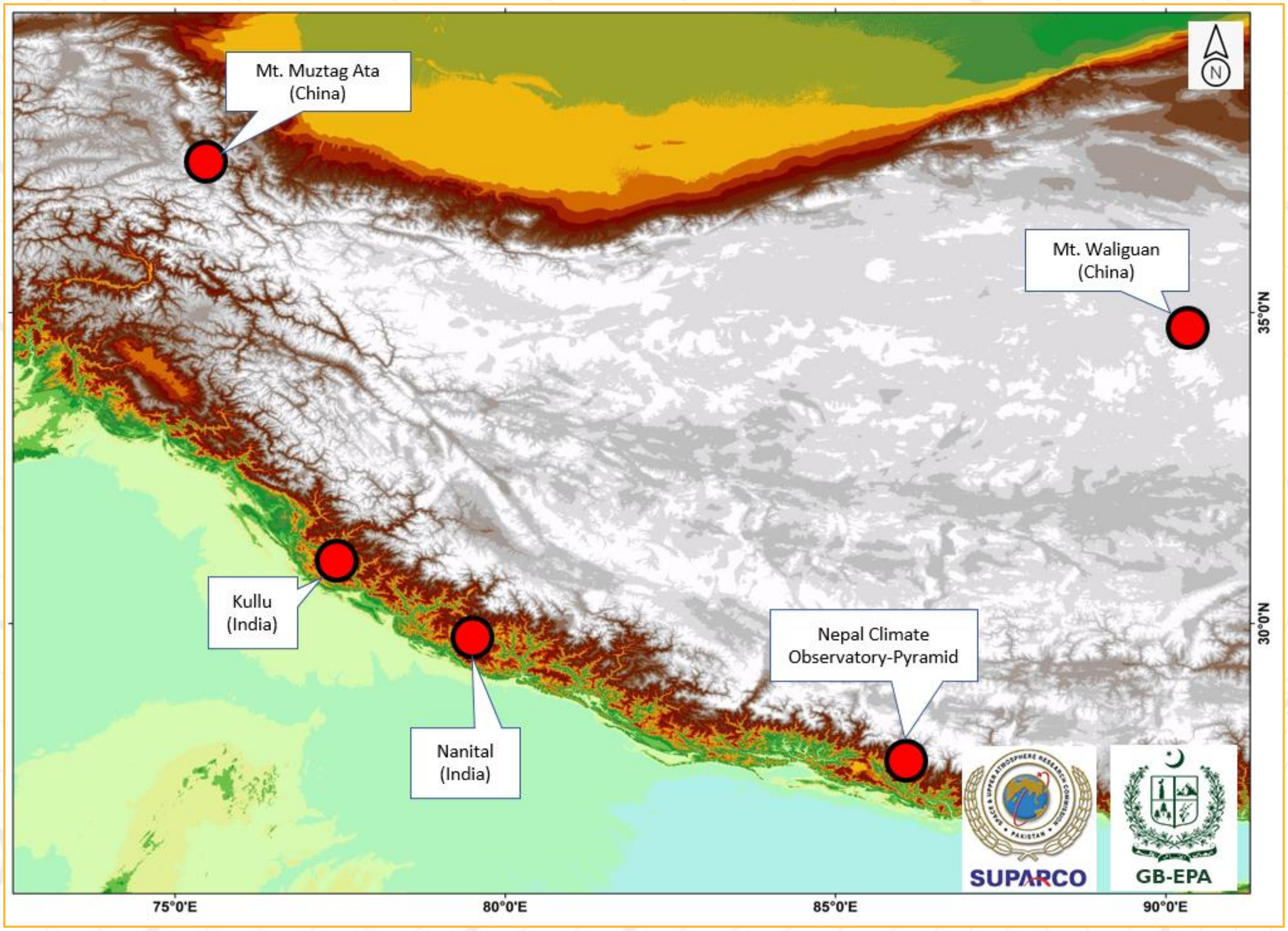


Figure 3.1: Atmospheric monitoring stations/sites in glaciated regions of China, India, and Nepal as shown by circles in "Red"

3.2 Air Monitoring Locations

GB i.e., Sost, Hunza, Gilgit, Jaglot and Chilas situated along side CPEC (Figure 3.2). The monitoring sites in these cities were identified by GB- EPA. In some cities including Sost, Hunza and Gilgit, the monitoring was conducted at more than one site. Overall, the duration of air monitoring in each city was 4 – 5 days. Table 3.1 shows the location of air monitoring sites in each GB city and monitoring duration. Locations of air quality monitoring sites in every city are shown in Figures 3.3 to 3.7.

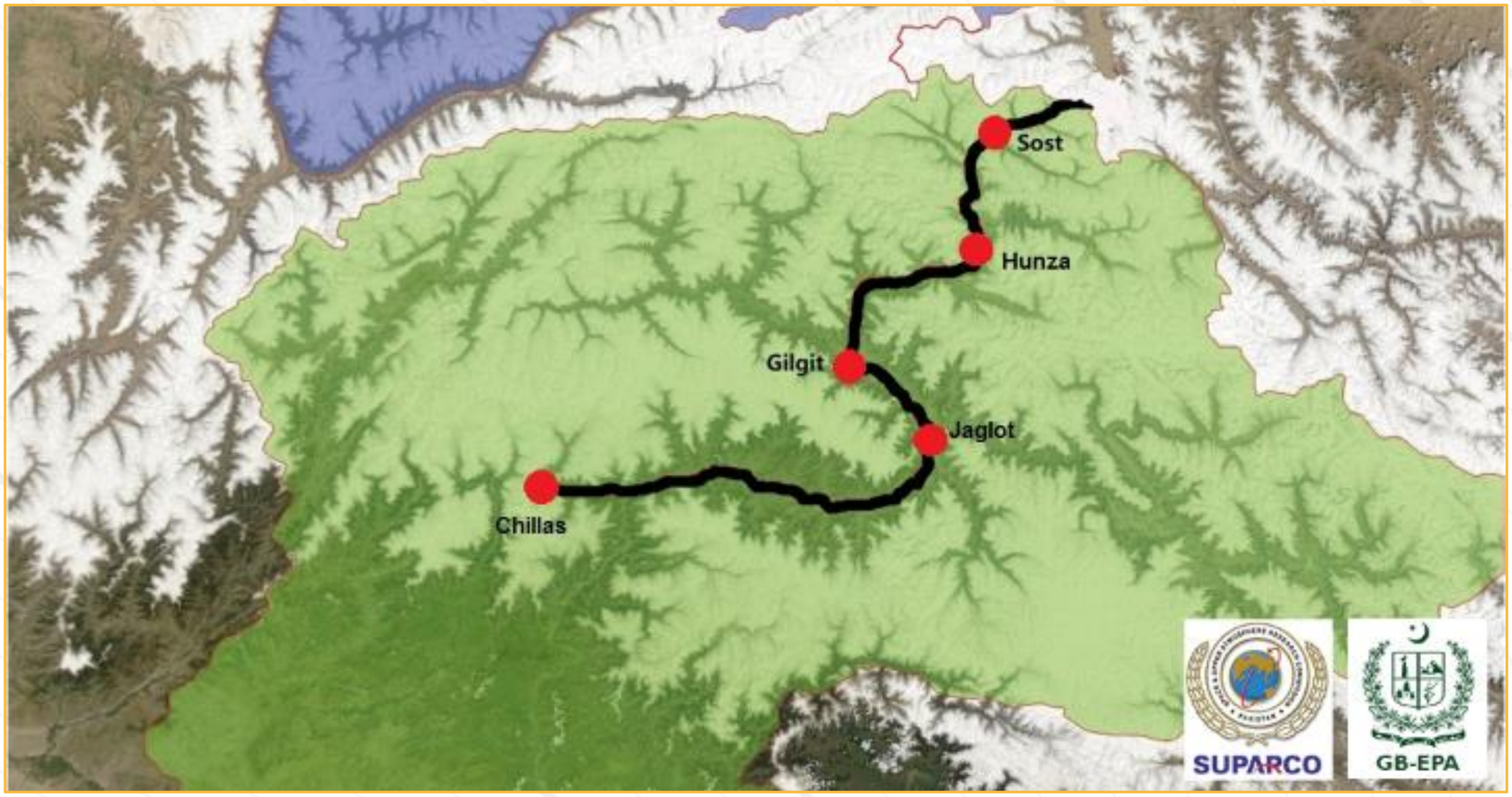


Figure 3.2: GB cities alongside CPEC route where air quality monitoring was conducted

Table 3.1: Ambient Air Monitoring Sites in GB and Monitoring Schedule

City	Site Name	Site ID	Latitude	Longitude	Winter Season		Summer Season	
					Monitoring Start (Date / Time)	Monitoring Finish (Date / Time)	Monitoring Start (Date / Time)	Monitoring Finish (Date / Time)
Sost	Sost Check post	S1	36°41'28.48"N	74°49'14.87"E	26-11-2019 1600hrs	27-11-2019 1500hrs	16-08-2020 1700hrs	17-08-2020 1400hrs
	Khudabad	S2	36°41'16.12"N	74°48'58.72"E	27-11-2019 1700hrs	28-11-2019 1600hrs	17-08-2020 1700hrs	18-08-2020 1500hrs
	Gircha	S3	36°39'41.42"N	74°50'21.25"E	28-11-2019 1500hrs	30-11-2019 800hrs	18-08-2020 1800hrs	20-08-2020 1600hrs
Hunza	Karimabad	H1	36°18'59.07"N	74°40'3.41"E	30-11-2019 1900hrs	03-12-2019 1300hrs	20-08-2020 2000hrs	23-08-2020 1300hrs
	Aliabad	H2	36°18'21.14"N	74°36'40.72"E	03-12-2019 1500hrs	05-12-2019 1000hrs	23-08-2020 1400hrs	25-08-2020 1200hrs
Gilgit	Danyor	G1	35°54'19.10"N	74°23'35.36"E	05-12-2019 1500hrs	07-12-2019 1400hrs	25-08-2020 1600hrs	27-08-2020 1500hrs
	City Park near Gilgit Airport	G2	35°54'35.90"N	74°20'10.37"E	07-12-2019 1600hrs	10-12-2019 1700hrs	27-08-2020 1800hrs	30-08-2020 500hrs
Jaglot	Jaglot	J1	35°41'6.89"N	74°38'0.47"E	10-12-2019 1900hrs	15-12-2019 1100hrs	30-08-2020 2200hrs	04-09-2020 1100hrs
Chilas	Chilas	C1	35°25'30.41"N	74° 5'40.50"E	15-12-2019 1700hrs	20-12-2019 0600hrs	04-09-2020 2000hrs	09-09-2020 1200hrs

Figure 3.3: Three air quality monitoring sites in Sost (The aerial distance between S1 & S2 is 0.8 Km whereas the distance between S1 & S3 is 6 Km) (Source: Google Earth)

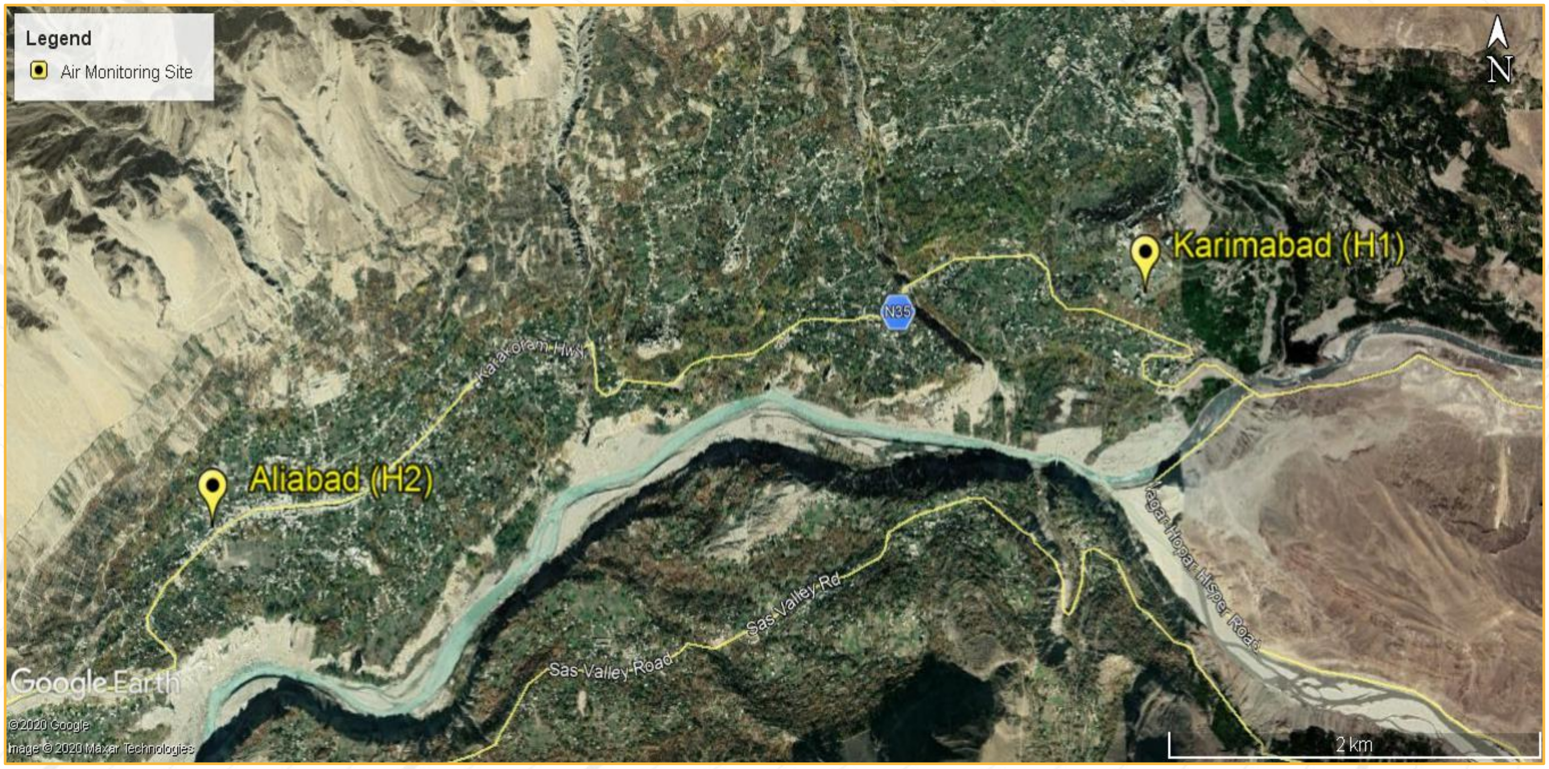


Figure 3.4: Two air quality monitoring sites in Hunza (The aerial distance between H1 & H2 is 5.5 Km (Source: Google Earth)

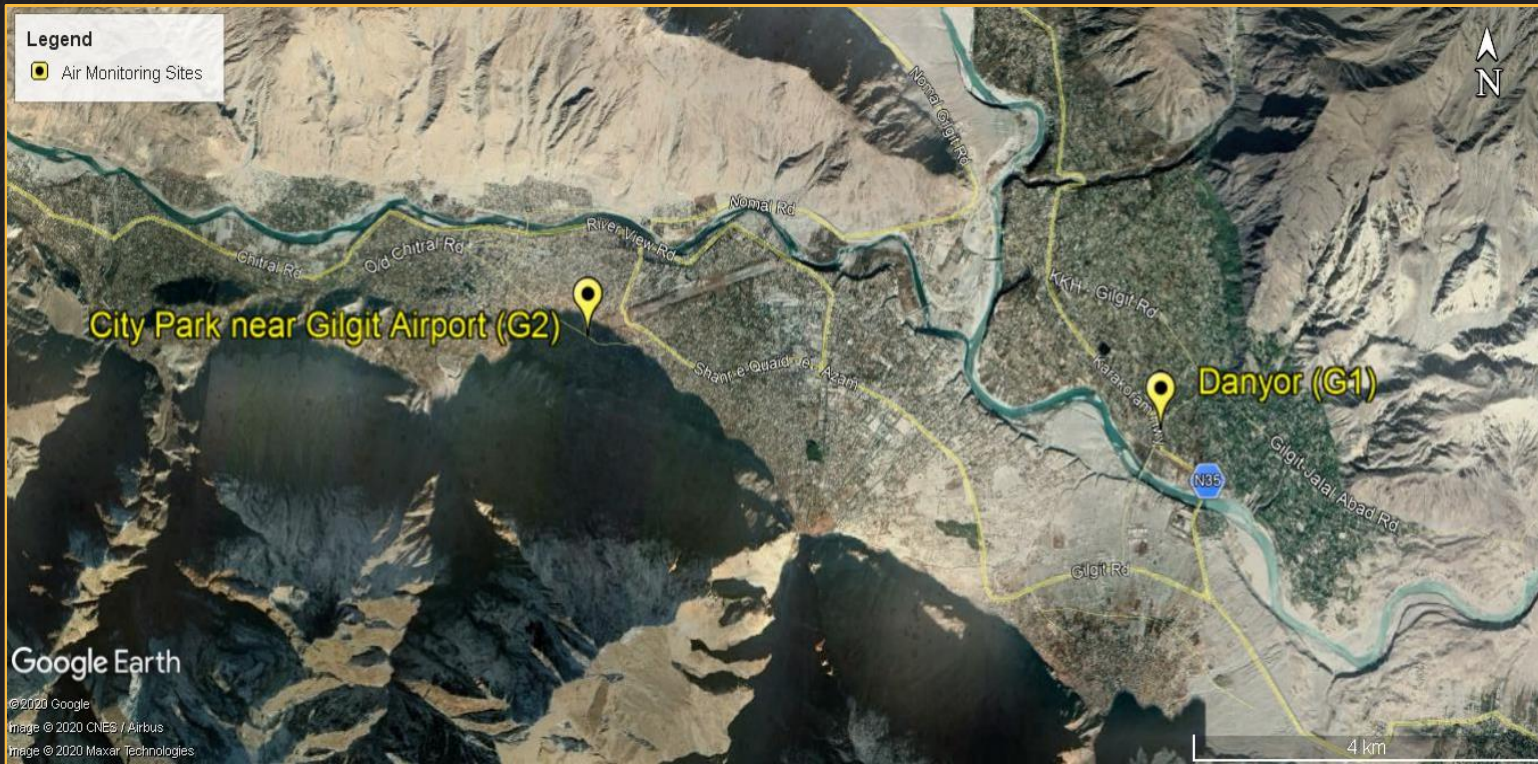


Figure 3.5: Two air quality monitoring sites in Gilgit (The aerial distance between G1 & G2 is 6.8 Km (Source: Google Earth)

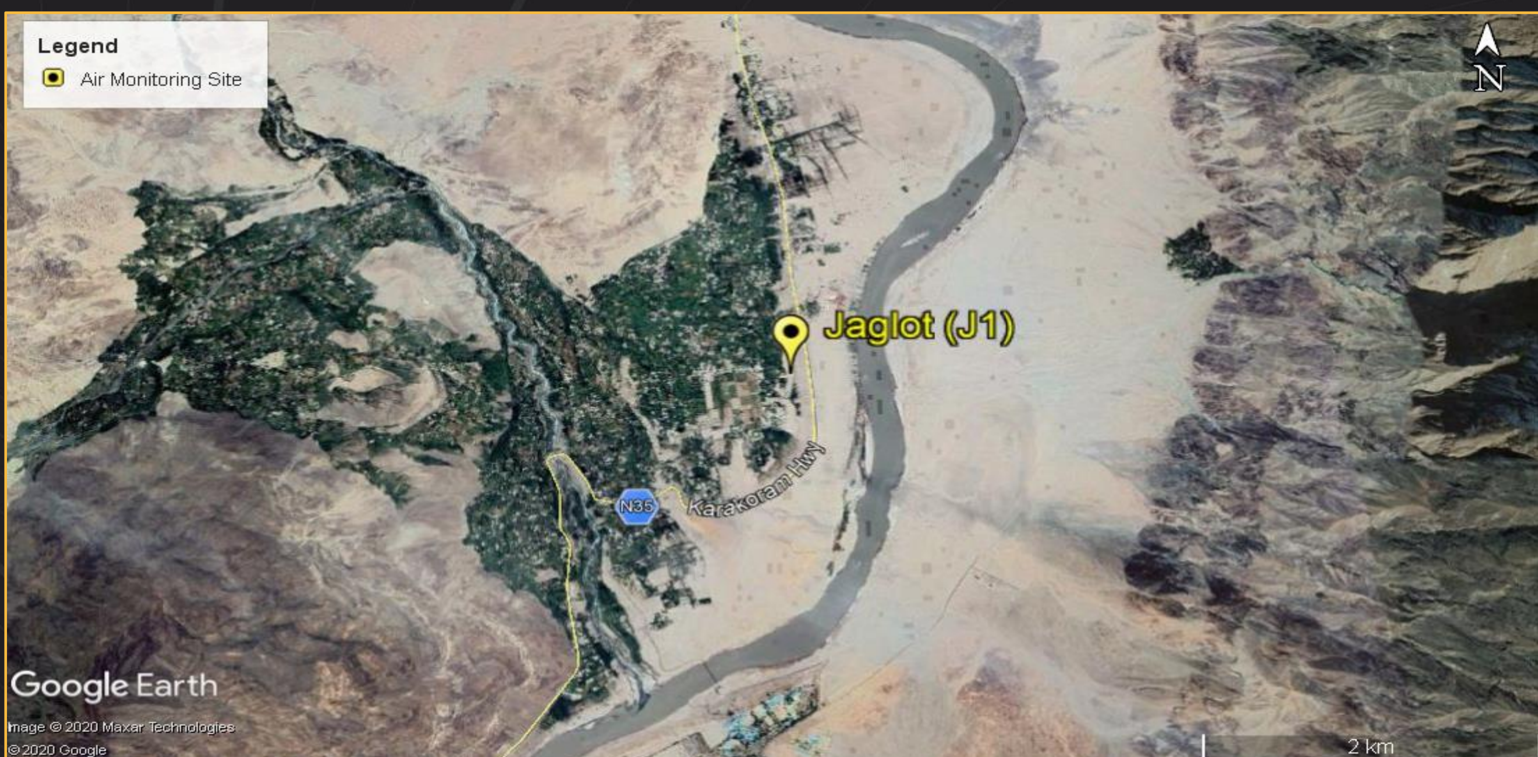


Figure 3.6: Air quality monitoring site in Jaglot (Source: Google Earth)

Figure 3.7: Air quality monitoring site in Chilas (Source: Google Earth)

3.3 Methodology

Figure 3.8: SUPARCO Air Monitoring Mobile Laboratory

SUPARCO's Ambient Air Monitoring Mobile Laboratory (Figures 3.8 & 3.9) was used for continuously monitoring (day / night) of five criteria pollutants (SO_2, NO / NO_2, CO, O_3, & $PM_{2.5}$) and light absorbing aerosols (black carbon, BC) in five cities of GB. Air monitoring sites in each city with monitoring schedule are shown in Table 3.1.

The ambient air / noise level monitoring was conducted by following internationally recommended instruments / methods as given in Table 3.2. Continuous monitoring of air pollutants including SO_2, NO / NO_2, CO, O_3, & BC) were made at the interval of 15 minutes whereas $PM_{2.5}$ were collected on filter paper by running aerosol sampler for 24 hours at each site.

Figure 3.9: Inner view of SUPARCO Air Monitoring Mobile Laboratory

The measurement of noise levels was made on the "A weighted Scale" in "Slow" response mode in terms of decibel scale dBA. At each site, noise levels were recorded on hourly basis with 15 min interval. The meteorological parameters including wind speed, wind direction, temperature and relative humidity were monitored by using Davis Vantage Pro2 Automatic Weather Station installed in SUPARCO ambient air monitoring mobile laboratory. The monitoring results of air and noise were compared with National Environmental Quality Standards (NEQS)[7] for ambient air and noise as given in Tables 3.3 & 3.4 respectively. Figures 3.10 to 3.13 depict field survey pictures of ambient air and noise level monitoring at different sites in GB.

Table 3.2: Ambient Air Quality / Noise Level Monitoring Methods

Pollutants	***Reference/Equivalent Method***	***Instruments/ Analyzers***
Nitrogen Oxides	Reference Method RFNA-0809-186 by US EPA (40 CFR, Part 53)	NOx Analyzer, Ecotech, Australia
Sulfur Dioxide	Equivalent Method EQSA-0509-188 by US EPA (40 CFR, Part 53)	SO2 Analyzer, Ecotech, Australia
Carbon Monoxide	Reference Method RFCA-0509-174 by US EPA (40 CFR, Part 53)	CO Analyzer, Ecotech, Australia
Ozone	Equivalent Method EQOA-0809-187 by US EPA (40 CFR, Part 53)	Ozone Analyzer, Ecotech, Australia
Particulate Matter (PM2.5)	Reference Method RFPS-0498-116 by US EPA (40 CFR Part 50, Appendix L)	PQ 200 BGI, USA
Black Carbon	No standard method exists. In this study, instrument runs on the principle of Dual Spot Measurement Method[8]	Aethalometer AE33, Magee Scientific, USA
Noise	IEC 61672:2013 standard	Testo 816, Germany

Table 3.3: NEQS for Ambient Air Quality

Pollutants	*National Environmental Quality Standards (NEQS)**	
	Avg. Time	*Standard*
SO_2	24 HRS	120 ug/m3
CO	8 HRS	5 mg/ m3
NO	24 HRS	40 µg/ m3
NO_2	24 HRS	80 µg/ m3
O_3	1 HR	130 µg/ m3
$PM_{2.5}$	24 HRS	35 µg/ m3
BC	-	No standard level exists

Table 3.4: NEQS for Noise Levels

S. No	*Category of Area / Zone*	*Limit in dBA Leq**	
		Day Time †	*Night Time ‡*
1	Residential Area	55	45
2	Commercial Area	65	55
3	Industrial Area	75	65
4	Silence Zone	50	45

* National Environmental Quality Standards (NEQS), S.R.O. 1062 (I)/2010, The Gazette of Pakistan, Extra., November 26, 2010
† Day Time Hours: 06:00 am to 10:00 pm
‡ Night Time Hours: 10:00 pm to 06:00 am

[7] environment.gov.pk/images/rules/SRO2010NEQSAirWaterNoise.pdf

[8] https://mageesci.com/mproducts/model-ae33-aethalometer/

3.4 Results & Discussion

Following sections contain results of ambient air monitoring, noise levels and meteorological parameters in different cities of GB. In addition, origins of air masses reached at selected city during the monitoring are also discussed.

3.4.1 Levels of air pollutants & noise

Tables 3.5 a, b illustrate the average, maximum & minimum levels of ambient air monitoring and noise in five cities of GB during winter and summer seasons respectively. The graphical representations of these results are shown in Figure 3.14 to 3.21. Hourly results of air & noise monitoring at nine sites (in five cities) are presented in Annex-I & Annex-III whereas graphical results for day / night monitoring are illustrated in Annex-II & Annex-IV.

Table 3.5(a): Ambient Air Levels in GB Cities (Winter Season 2019)

S. No	Parameters	Unit	NEQS*	Sost			Hunza			Gilgit			Jaglot			Chilas		
				Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
1	Carbon Monoxide (CO)	mg/m^3	5	0.71	2.92	1.97	1.32	3.52	2.48	1.88	5.50	3.75	0.66	3.56	2.29	1.06	3.84	2.59
2	Sulphur Dioxide (SO_2)	$\mu g/m^3$	120	4.52	20.61	11.17	8.12	24.79	13.43	9.83	47.07	25.28	5.17	30.44	12.26	10.51	34.47	19.63
3	Nitrogen Oxide (NO)	$\mu g/m^3$	40	3.20	16.23	9.23	7.71	23.41	12.62	10.18	38.71	21.02	4.17	18.82	10.25	4.23	23.99	13.35
4	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	80	5.67	20.91	14.53	9.82	30.46	19.46	15.67	55.07	32.80	7.53	27.03	17.03	9.33	36.33	20.83
5	Ozone (O_3)	$\mu g/m^3$	130	5.28	30.65	15.86	8.84	36.97	19.48	10.19	42.72	27.02	7.78	31.79	18.61	37.35	9.64	20.13
6	Black Carbon (BC)	$\mu g/m^3$	-	0.47	2.12	3.72	0.89	3.28	5.77	3.54	9.40	16.21	1.01	3.74	8.10	2.18	5.52	11.80
7	Particulate Matter ($PM_{2.5}$)	$\mu g/m^3$	35	-	-	25.4	-	-	34.20	-		60.1	-	-	29.3	-	-	48.8

Table 3.5(b): Ambient Air in GB Cities (Summer Season 2020)

S. No	Parameters	Unit	NEQS*	Sost			Hunza			Gilgit			Jaglot			Chilas		
				Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
1	Carbon Monoxide (CO)	mg/m^3	5	0.81	3.22	2.33	1.55	3.65	2.75	0.50	5.12	3.21	1.22	3.92	2.60	1.00	4.63	2.92
2	Sulphur Dioxide (SO_2)	$\mu g/m^3$	120	4.80	21.40	13.95	6.70	27.70	16.39	2.30	43.70	22.85	7.60	27.88	14.68	9.00	30.90	17.60
3	Nitrogen Oxide (NO)	$\mu g/m^3$	40	5.80	19.00	12.40	9.80	24.10	14.21	3.10	29.80	17.68	7.60	21.50	14.00	8.38	27.90	15.57
4	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	80	8.80	25.40	17.95	10.90	38.40	22.24	6.50	50.50	28.18	11.70	34.80	20.19	10.90	45.20	24.83
5	Ozone (O_3)	$\mu g/m^3$	130	13.90	45.20	26.92	19.30	50.40	30.00	4.30	59.10	31.44	17.10	48.00	28.73	20.80	54.50	33.16
6	Black Carbon (BC)	$\mu g/m^3$	-	0.62	16.23	4.11	1.84	11.92	4.88	0.65	19.89	7.83	1.13	11.33	4.27	0.86	13.44	5.21
7	Particulate Matter ($PM_{2.5}$)	$\mu g/m^3$	35	31.4	39.0	35.0	45.0	52.4	48.7	41.9	51.8	46.8	41.9	55.9	48.9	54.6	63.9	52.9

* National Environmental Quality Standards (NEQS), S.R.O. 1062 (I)/2010, The Gazette of Pakistan, Extra, November 26, 2010

Table 3.5(c): Noise Levels in GB Cities (Winter & Summer Seasons)

City	Site	Winter 2019		Summer 2020	
		Day Time	Night Time	Day Time	Night Time
		Residential 55 dB(A)* Commercial 65 dB(A)	Residential 45 dB(A)* Commercial 55 dB(A)	Residential 55 dB(A)* Commercial 65 dB(A)	Residential 45 dB(A)* Commercial 55 dB(A)
Sost	Sost Check Post	60.4	45.0	62.3	50.1
	Khudabad	50.6	42.8	54.5	44.8
	Gircha	45.7	40.6	54.9	44.0
Hunza	Karimabad	63.8	43.3	61.2	44.2
	Aliabad	65.0	44.1	61.7	44.5
Gilgit	Danyor	61.5	44.9	64.4	46.5
	Near Airport	62.9	48.2	68.7	44.2
Jaglot	Jaglot	55.0	44.7	60.1	47.3
Chilas	City Area	56.5	52.3	63.7	54.8

* National Environmental Quality Standards (NEQS), S.R.O. 1062 (I)/2010, The Gazette of Pakistan, Extra, November 26, 2010
** Day Time Hours: 6:00 am to 10:00 pm & Night Time Hours: 10:00 pm to 6:00 am

Figure 3.10: Preparation for Air Quality Monitoring in Gircha, Sost

Figure 3.11: Air Quality Monitoring in Progress in Jaglot

Figure 3.12: Air Quality Monitoring in Progress at City Park, Gilgit

Figure 3.13: Noise Level Monitoring in Sost

(a) Carbon Monoxide (CO)

Carbon monoxide is a colorless, odorless poisonous gas formed due to incomplete combustion of fuel. It is a byproduct of motor vehicle exhaust, which contributes more than two-thirds of all CO emissions nationwide. In cities, automobile exhaust can cause as much as 95 percent of all CO emissions. These emissions can result in high concentrations of CO, particularly in local areas with heavy traffic congestion. Other sources of CO emissions include industrial processes and fuel combustion in sources such as boilers and incinerators. CO enters the bloodstream and reduces oxygen saturation in body. The health threat from CO is most serious for those who suffer from cardiovascular disease.

In winter season, overall average atmospheric levels of CO in Sost, Hunza, Gilgit, Jaglot and Chilas (lied in the range of 1.97 to 3.75 mg/m3) were found within permissible limits of NEQS (5 mg/m3) (Table 3.5a; Figure 3.14a). In Gilgit, maximum levels of CO (5.5 mg/m3) at City Park near Gilgit Airport were raised beyond NEQS in afternoon and night time but that peak levels were for not more than 2 hours consecutively. The hourly data & diurnal graphs of CO for each monitoring site are given in Annexures I & II respectively.

In summer season, overall average atmospheric levels of CO in all cities lied in the range of 2.33 to 3.21 mg/m^3 hence were within permissible limits of NEQS (Table 3.5b; Figure 3.14b). Maximum levels of CO up to 5.1 mg/m^3, beyond the NEQS, were only observed near Gilgit Airport but for not more than 1 hour. The hourly data & diurnal graphs of CO for each monitoring site are given in Annexures III & IV respectively.

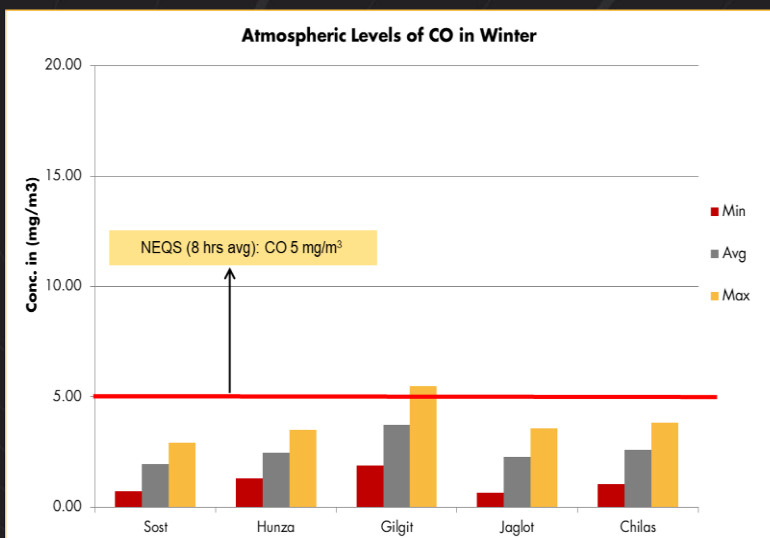


Figure 3.14(a): Concentration of CO in selected GB cities in winter

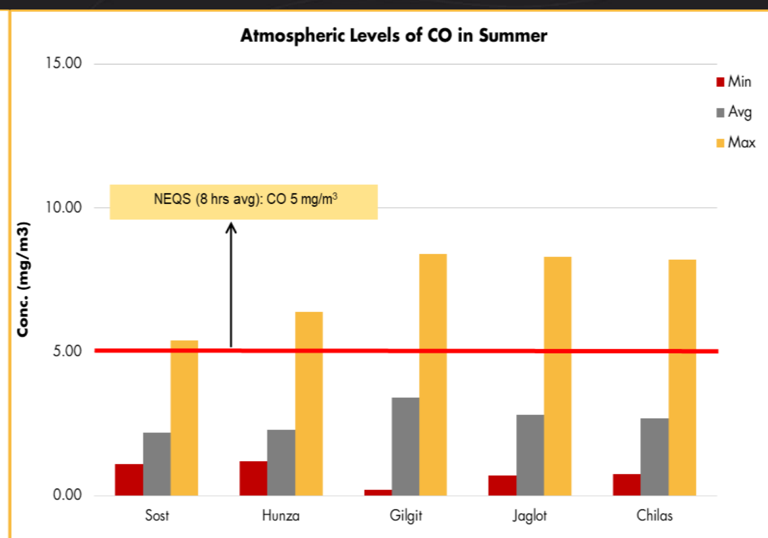


Figure 3.14(b): Concentration of CO in selected GB cities in summer

(b) Sulphur Dioxide (SO_2)

All fossil fuels contain sulphur, most of which is released as sulphur dioxide (SO_2) during combustion. types of fuels contain a wide range of sulphur contents, for instance, oil and its by-products contain between 0.1% sulphur (paraffin) and 3% (heavy fuel oil) in the form of sulfides and thiols. Coal contains 0.1–4% sulphur, mainly as flakes of iron pyrites (FeS_2). SO_2 irritates the lining of the nose, throat and lungs and may worsen existing respiratory illness especially asthma. It has also been found to exacerbate cardiovascular diseases[9].

As depicted in Figure 3.15a, in winter season, average atmospheric levels of SO_2 in all cities (ranging between 11.17 $\mu g/m^3$ to 25.28 $\mu g/m^3$) were within permissible limits of NEQS (120 $\mu g/m^3$) throughout monitoring period. Maximum concentrations of SO_2 were also remained below NEQS however it is interesting to note that higher concentrations of SO_2 were mostly observed during night time or early in the morning as shown in diurnal graphs of SO2 for all cities (Annex-II). This rise in level could be due to household burning of coal for heating purpose in winter season as well as thermal inversion phenomenon in winter season.

In summer season, average atmospheric levels of SO_2 in all cities (ranging between 13.95 µg/m3 to 22.85 $\mu g/m^3$) were also found within the permissible limit of NEQS (Figure 3.15b). Hourly data of SO_2 for each monitoring site and diurnal trends in summer are shown in Annexures III & IV respectively.

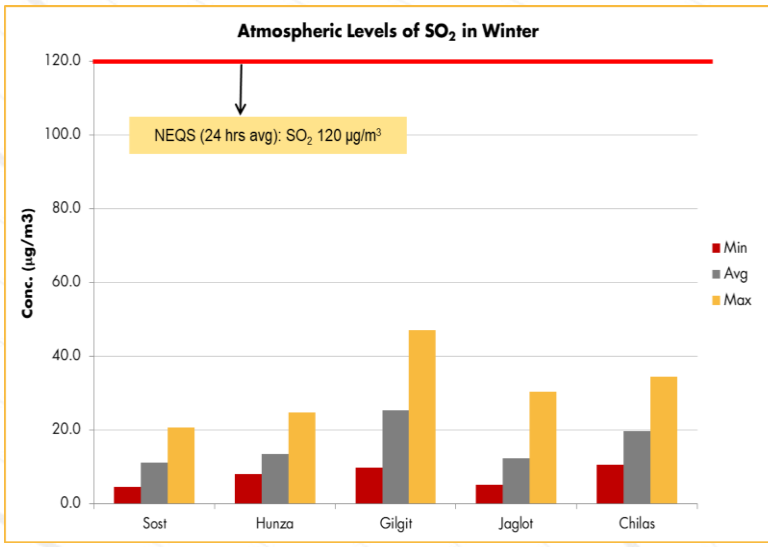


Figure 3.15(a): Avg, Max & Min concentration of SO2 in selected GB cities in winter

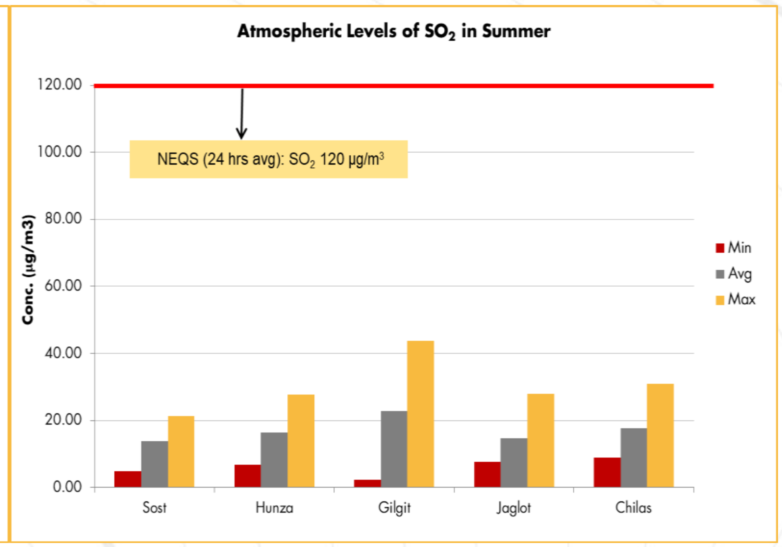


Figure 3.15(b): Avg, Max & Min concentration of SO2 in selected GB cities in summer

[9] https://www.health.nsw.gov.au/environment/air/Pages/sulphur-dioxide.aspx

(c) Oxides of Nitrogen (NO & NO_2)

The two principal oxides of nitrogen are nitric oxide (NO) and nitrogen dioxide (NO_2). The sum of these two is known as NO_x. Despite their quite different physical properties, chemical affinities and environmental impacts, they are often lumped together. Combustion always produces a mixture of NO_2 and NO. NO_x are formed during the combustion process at high temperatures by the oxidation of nitrogen content of fuel and combustion air. The main anthropogenic sources of nitrogen oxides are road transport, gas heaters, and industrial boilers. High concentrations can be found especially near busy roads and indoor environments[10]. NO_x acts mainly as an irritant affecting the mucus membrane of eyes, nose, throat, and respiratory tract. Extremely high-dose exposure to NO_x may result in pulmonary edema and diffuse lung injury. Continuous exposure to high NO_x levels can contribute to the development of acute or chronic bronchitis[11].

In winter, average atmospheric levels of NO ranging between 9.23 to 21.02 µg/m^3 in Sost, Hunza, Gilgit, Jaglot and Chilas were found within permissible limits of NEQS (40 µg/m^3) (Table 3.5a; Figure 3.16a). Regarding NO_2, the average atmospheric levels in all cities were lied between 14.53 and 32.80 i.e., within the NEQS limit of 80 µg/m3 (Table 3.5a; Figure 3.17a). In summer season, overall average atmospheric levels of NO lied in all selected cities of GB were lied between 12.40 to 17.68 µg/m^3 hence were within the NEQS of 40 µg/m^3 (Table 3.5b; Figure 3.16b) On the other hand, overall average levels of NO2 (17.95 to 28.18 µg/m^3) in all cities also met NEQS limits (Table 3.5b; Figure 3.17b).

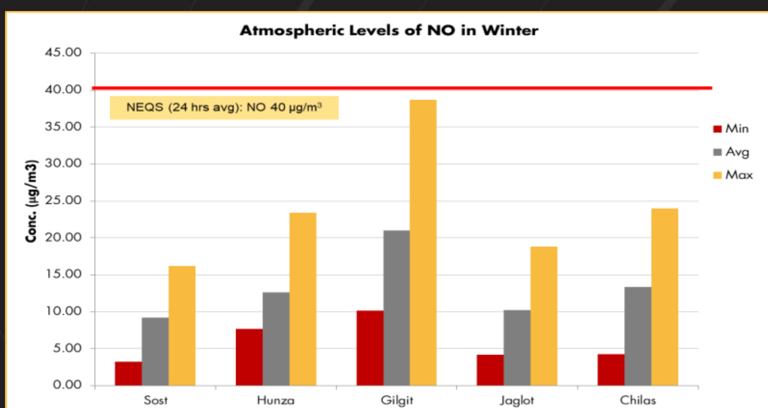


Figure 3.16(a): Avg, Max & Min concentration of NO in selected GB cities in winter

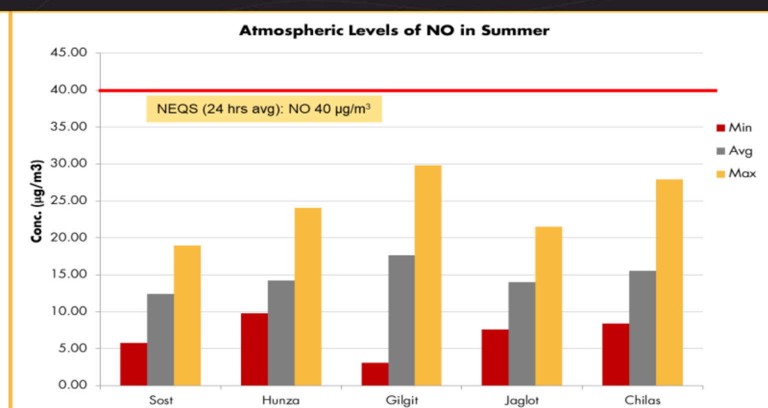


Figure 3.16(b): Avg, Max & Min concentration of NO in selected GB cities in summer

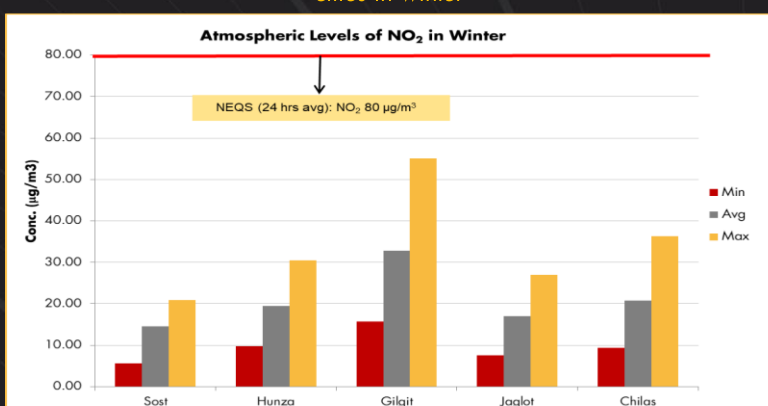


Figure 3.17(a): Concentration of NO2 in selected GB cities in winter

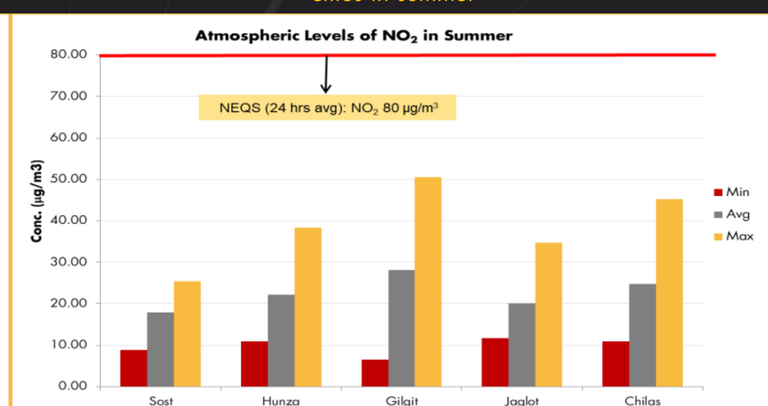


Figure 3.17(b): Concentration of NO2 in selected GB cities in summer

[10] Popescu, F., & Ionel, I., 2010. Anthropogenic air pollution sources. In A. Kumar (Ed.), Air quality (pp. 1-22): Intech.

[11] Theophanides, M., Anastassopoulou, J., Theophanides, T., 2011. Air Polluted Environment and Health Effects. Indoor and Outdoor Air Pollution. P. J. Orosa, Intech: 3-28

(d) Ozone (O_3)

Tropospheric O_3 is a secondary pollutant which is not emitted directly but is produced photo-chemically in the troposphere by its precursors i.e., nitrogen oxides (NO_x), carbon monoxide (CO), methane (CH_4), and other volatile organic compounds (VOCs) which are emitted by vehicles, power plants, industrial boilers, refineries, chemical plants, and other sources. The natural source of tropospheric O_3 is its exchange process between stratosphere & troposphere. Long term exposure to O_3 reduces lung function and thus may lead to exacerbation of asthma symptoms and premature deaths[12].

As shown in Table 3.5a & Figure 3.18a, in winter season, the overall average atmospheric levels of O_3 in all selected cities of GB were ranging between 15.86 to 27.02 µg/m^3 hence below the NEQS limit (130 µg/m^3). The hourly data & diurnal graphs of O_3 for each monitoring site are given in Annex I & II respectively.

In summer season, the overall average atmospheric levels of 34.33 µg/m^3 hence below the NEQS limit (130 µg/m^3) (Table 3.5b & Figure 3.18b). The hourly data & diurnal graphs of O_3 for each monitoring site are given in Annex III & IV respectively.

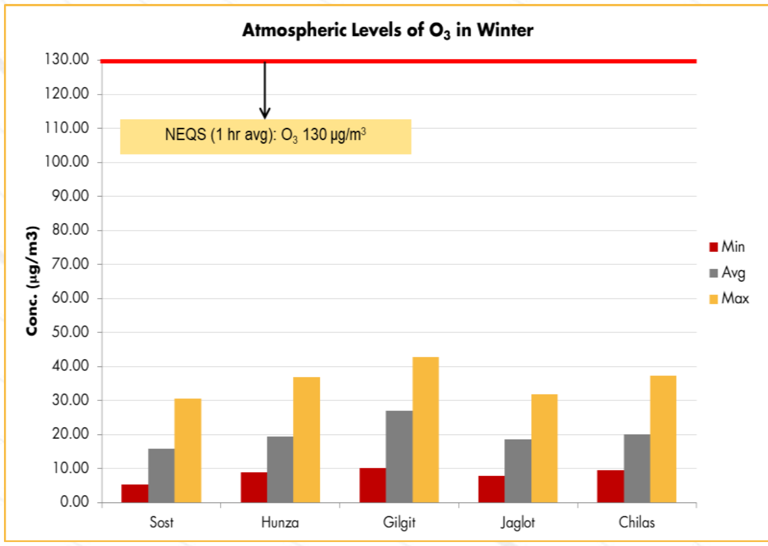


Figure 3.18(a): Avg, Max & Min concentration of O3 in selected GB cities in winter

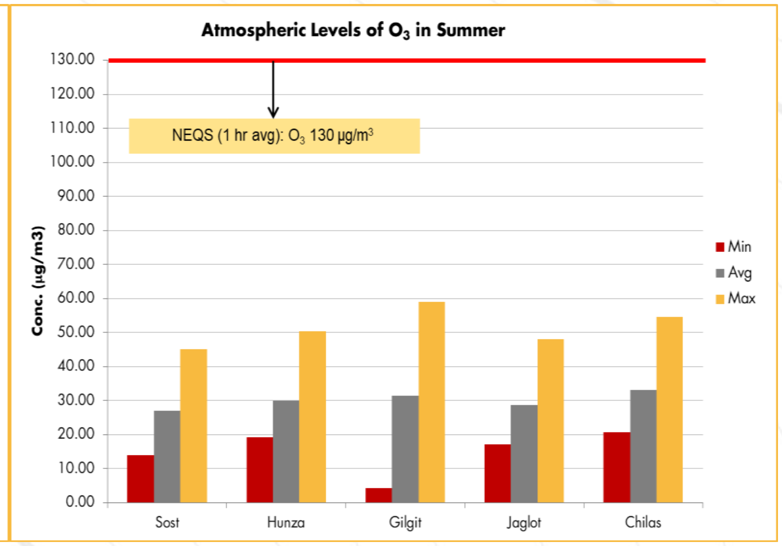


Figure 3.18(b): Avg, Max & Min concentration of O3 in selected GB cities in summer

[12] Council, N. R. (2010). Global sources of local pollution: An assessment of long-range transport of key air pollutants to and from the United States, National Academies Press.

(e) Black Carbon (BC)

BC is produced by combustion of fossil fuels and biomass burning. Though it is not a criteria pollutant, however due to its strong light-absorbing characteristic, it has recently received special attention by scientific community. Due to its strong properties of absorbing the sunlight, BC can efficiently heat the atmosphere, thus crucially contributing to regional warming. BC accumulates on snow and ice, which can reduce the surface albedo and consequently accelerate the melting of glaciers[13].

In winter season, the average atmospheric levels of BC in Sost, Hunza, Gilgit, Jaglot and Chilas ranged between 2.12 to 9.40 µg/m^3 (Table 3.5a; Figure 3.19a). The average atmospheric levels of BC in summer ranged between 4.11 to 7.83 µg/m^3 (Table 3.5b; Figure 3.19b) in five cities. In Sost, it was particularly noticed that in summer season when Pak-China border was functional and road activities were on the peak, levels of BC were instantaneously raised 2 – 3 times higher in morning (7:00 am to 11:00 am) as compared to night time levels. During this time period, the heavy-duty diesel vehicles stationed at Sost dry port were simultaneously started on to warm up. In winter season, this trend was not observed due to insubstantial road activities however higher levels of BC were observed in night time that could be due to household burning activities.

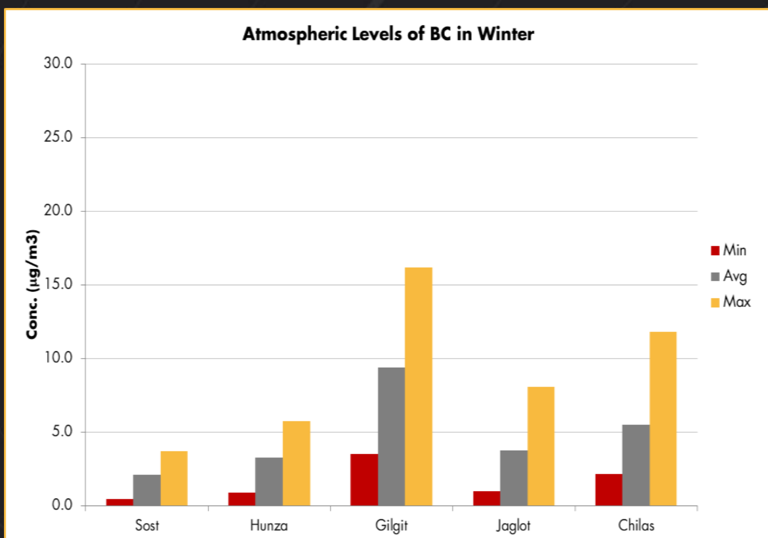


Figure 3.19(a): Avg, Max & Min concentration of BC in selected GB cities in winter

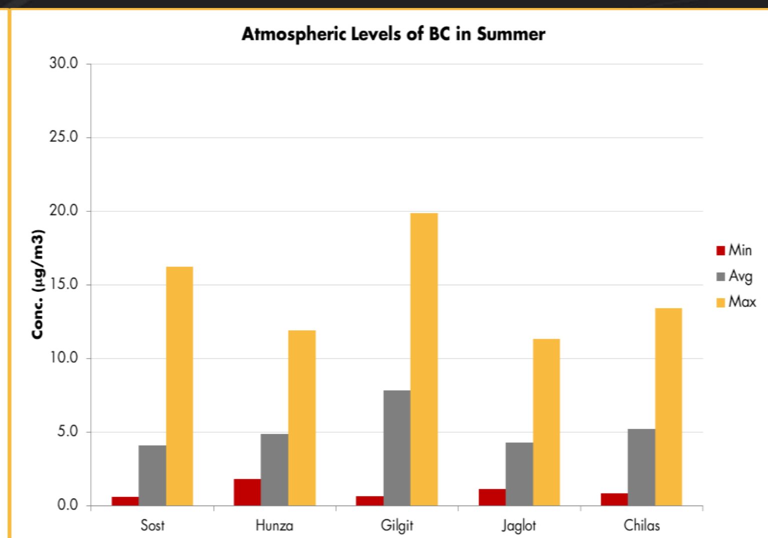


Figure 3.19(b): Avg, Max & Min concentration of BC in selected GB cities in summmer

[13] Bond, T., Doherty, S., Fahey, D., Forster, P., Berntsen, T., DeAngelo, B., Flanner, M., Ghan, S., Kärcher, B., Koch, D., (2013). Bounding the role of black carbon in the climate system: A scientific assessment. Journal of Geophysical Research: Atmospheres.

(f) Particulate Matter ($PM_{2.5}$)

Combustion of fossil fuels and biofuels are large primary anthropogenic sources of PM. These combustion processes are also the sources of BC, which has an important role in PM light absorption. Mineral dust is also a source of PM. Exposure to elevated levels of PM has long been associated with adverse human health impacts including bronchitis and asthma attacks, and is a major source of morbidity and mortality worldwide.

In winter season, 24 hours continuous sampling of $PM_{2.5}$ was carried out on daily basis. As shown in Figure 3.20a, highest average concentration of PM2.5 was observed in Gilgit (57.4 µg/m^3) followed by Chilas (40.8 µg/m^3), Jaglot (30.7 µg/m^3) and Hunza (26.2 µg/m^3). Lowest levels were recorded in Sost (20.4 µg/m^3).

In summer season, sampling of $PM_{2.5}$ was conducted for 2 times in 24 hours (i.e., 12 hrs from 6:00 am to 6:00 pm in day & 12 hrs from 6:00 pm to 6:00 am in night). The 24-hrs average levels of $PM_{2.5}$ were below NEQS limit of 35 µg/m3 in all cities (Figure 3.20b) however during day time, the 12-hrs average levels of $PM_{2.5}$ were found above 35 µg/m^3 in Gilgit (42.8 µg/m^3) & Chilas (39.30 µg/m^3). In this regard, in GB, $PM_{2.5}$ has been noted as dominating pollutant as compare to gaseous pollutants which is an alarming situation and needs continuous monitoring throughout the year at critical locations in GB for effective control measures.

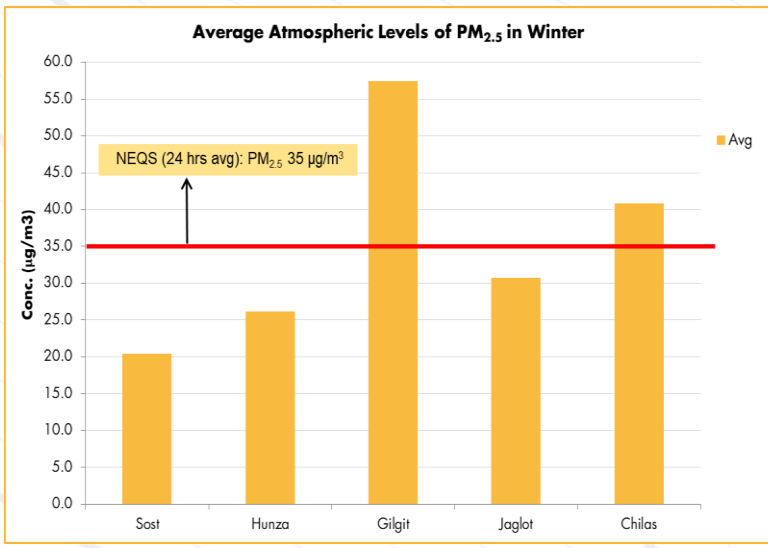


Figure 3.20(a): 24 hours Avg concentration of $PM_{2.5}$ in selected GB cities in winter

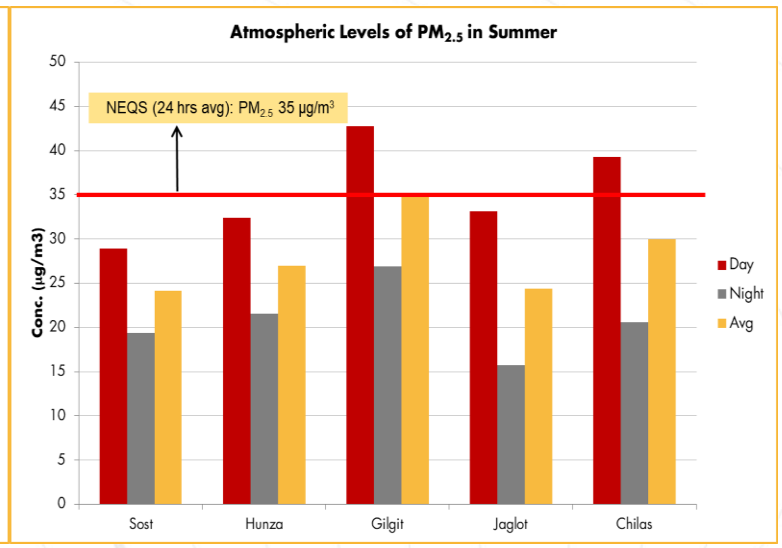


Figure 3.20(b): 24 hours Avg concentration of $PM_{2.5}$ in selected GB cities in summer

Note: During winter season, $PM_{2.5}$ monitoring was performed on 24 hrs basis whereas in summer season, the monitoring was carried out in 12 hrs intervals i.e., day (06:00 am to 06:00 pm) / night (06:00 pm to 06:00 am)

(g) Noise Levels

Figures 3.21a & 3.21b show day and night time average noise levels in five GB cities in winter & summer seasons respectively. Average noise levels at Sost Check Post (commercial area) met permissible limits of NEQS for commercial area whereas noise levels at Khudabad & Gircha which are residential areas in Sost, met NEQS for residential areas. In Hunza, the average noise levels in Karimabad and Aliabad were beyond the day time NEQS for residential area but met the day time NEQS for commercial areas in winter and summer seasons. Night time average noise levels were within the permissible limits of NEQS for residential and commercial areas in both seasons. In Gilgit city, the average day time noise levels at Danyor were within the NEQS for commercial area but exceeded the safe limits for residential area in both seasons. In winter season, the average day time noise levels near Gilgit Airport were within the safe limits for commercial area however in summer season, the average day time noise levels were exceeded the NEQS for commercial area. The average night time noise levels at both sites in Gilgit were within the permissible levels of NEQS in winter and summer seasons. In Jaglot, the average day/night time noise levels were within the safe limits for commercial and residential areas in winter season. In contrary, during summer season, the average day / night time noise levels were exceeded the NEQS for residential area but found below the NEQS for commercial area. In Chilas, the average day / night time noise levels were above the NEQS limit for residential area but were found meeting the NEQS for commercial area in both seasons.

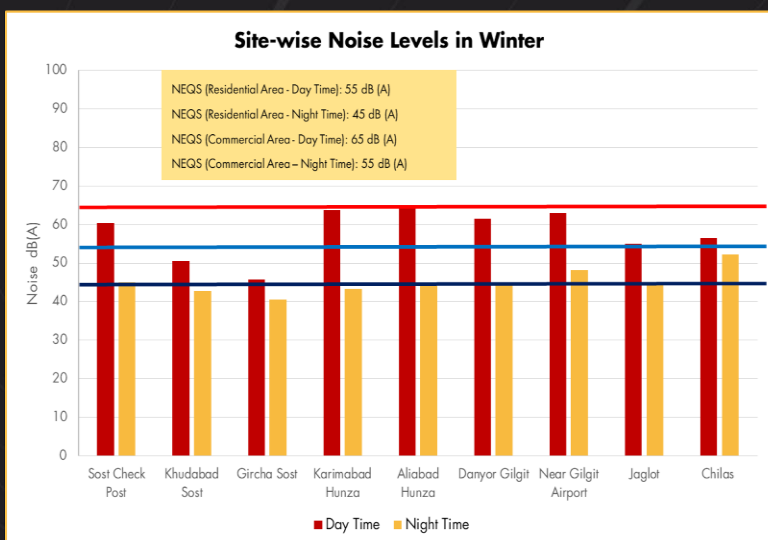


Figure 3.21(a): Average day & night time noise levels in GB cities in winter

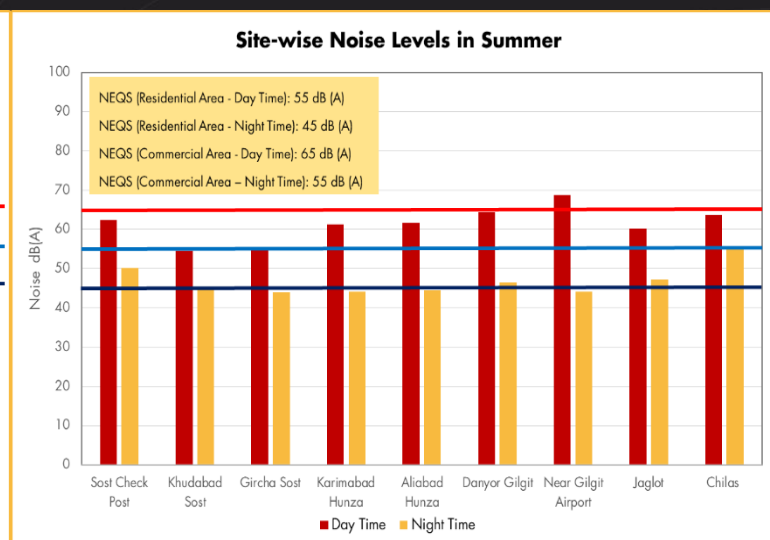


Figure 3.21 (b): Average day & night time noise levels in GB cities in summer

3.4.2 City-wise Meteorological Parameters

Table 3.6 illustrates the meteorological conditions (average temperature, humidity, wind speed & wind direction) prevailed during field surveys for air and noise level monitoring in five cities of GB in winter 2019 and summer 2020.

Table 3.6: Meteorological Conditions at study sites during winter & summer seasons

City	Winter Season (Nov - Dec 2019)				Summer Season (Aug - Sep 2020)			
	Temp (°C)	Humidity (%)	Wind Speed (m/s)	Wind Direction	Temp (°C)	Humidity (%)	Wind Speed (m/s)	Wind Direction
Sost	-0.8	80.2	Calm to 5.7	Northwest & Northeast	21.9	33.9	0.5 to 4.5	Northwest & Southeast
Hunza	0.4	78.3	Calm to 4.5	Northwest & Southeast	22.2	36.5	0.5 to 2.0	Southwest & Northwest
Gilgit	2.0	74.8	Calm to 2.4	Northwest & South	22.8	59.3	0.4 to 4.0	Northwest & Southwest
Jaglot	4.8	70.3	Calm to 2.1	Northwest & South	21.4	57.8	0.4 to 4.0	Northwest & Southeast
Chilas	6.4	69.8	Calm to 1.9	Northwest & Southeast	23.7	52.6	0.4 to 2.0	Northwest & Southwest

3.4.3 Origin of Air Masses at Study Sites

By using back trajectories, it is possible to examine source–receptor relationships and the timescales of long-range and local transport, and their effect on the observed composition. In short-range transport, the airflow pathway is more influenced by emission source areas than in long-range transport, where various exchange and mixing processes (e.g., deposition and advection), physical losses and chemistry have more influence on the composition at the receptor location.

To identify the origin of air masses reached at study sites during winter and summer seasons, TrajStat GIS-based software[14] was run based on 5-days back trajectory calculation from Hybrid Single-Particle Lagrangian Integrated Trajectory Model (HYSPLIT)[15] at altitudes of 500 m, 1000 m and 1500 m above the ground level.

(a) Winter Season

Figures 3.22 to 3.26 illustrate that major fraction of air masses over Sost, Hunza, Gilgit, Jaglot and Chilas respectively, was originated primarily from the Black Sea or Caspian Sea regions and traveled over Eastern Europe and central Asia before reaching Gilgit-Baltistan region (northern Pakistan). Regions of Mediterranean Sea and Middle East were second dominant sources of westerlies passed over Iran, Afghanistan and Pakistan before reaching study sites in Gilgit-Baltistan. The third major source of pollutants at study sites were the fractions of eastern winds originating over northern India that could also carry over the local emissions from household burnings and vehicular emissions over northern Punjab and GB region to study sites.

[14] Wang, Y., Zhang, X., and Draxler, R.R., 2009, TrajStat: GIS-based software that uses various trajectory statistical analysis methods to identify potential sources from long-term air pollution measurement data: Environmental Modelling & Software, v. 24, p. 938-939.

[15] Draxler, R.R., and Rolph, G., 2003, HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) model access via NOAA ARL READY website (http://www. arl. noaa. gov/ready/hysplit4. html). NOAA Air Resources Laboratory, Silver Spring, Md.

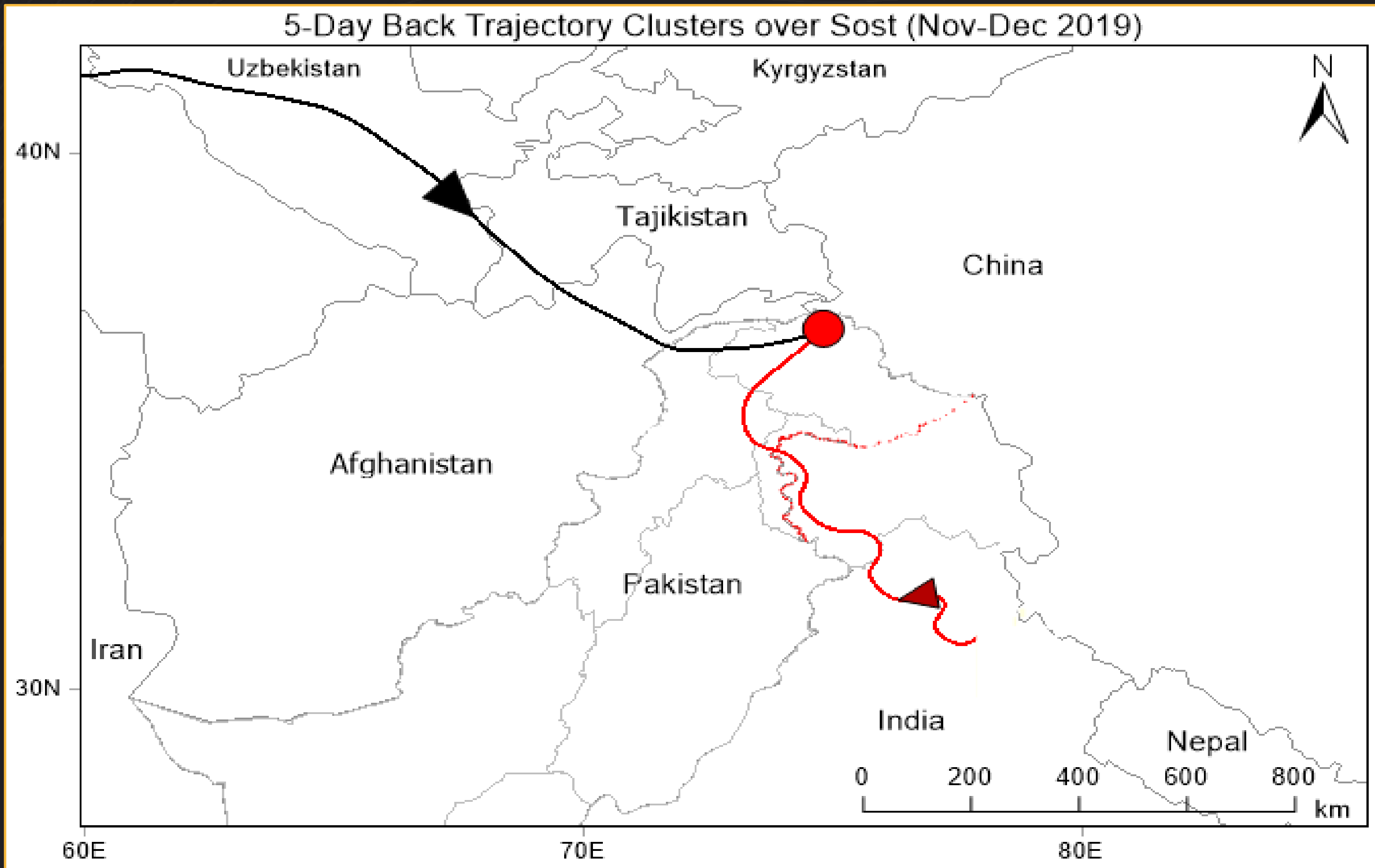


Figure 3.22: Clusters of air trajectories reached over Sost during Winter 2019

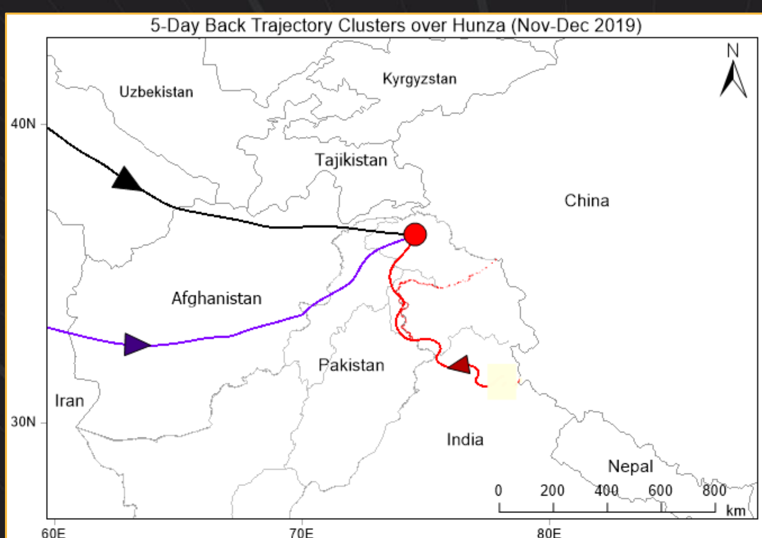


Figure 3.23: Clusters of air trajectories reached over Hunza during Winter 2019

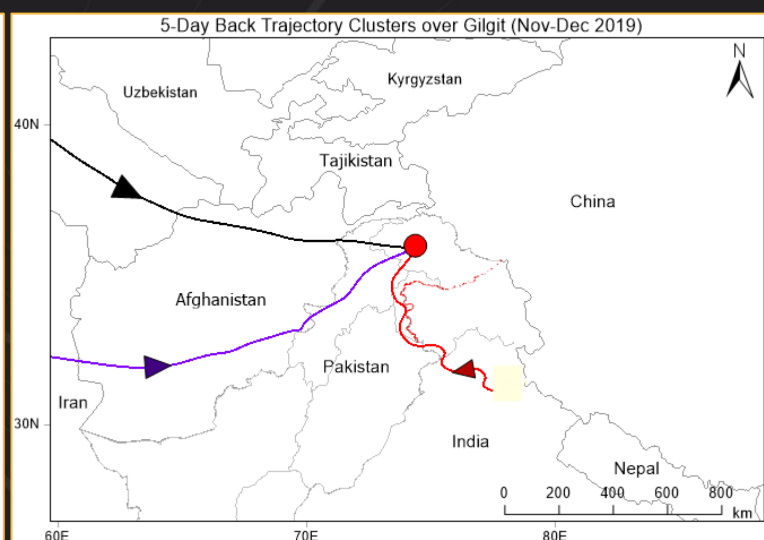


Figure 3.24: Clusters of air trajectories reached over Gilgit during Winter 2019

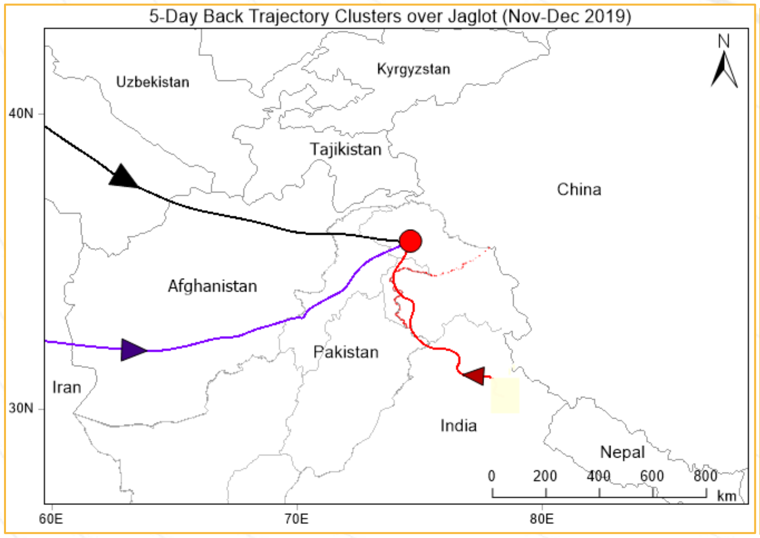


Figure 3.25: Clusters of air trajectories reached over Jaglot during Winter 2019

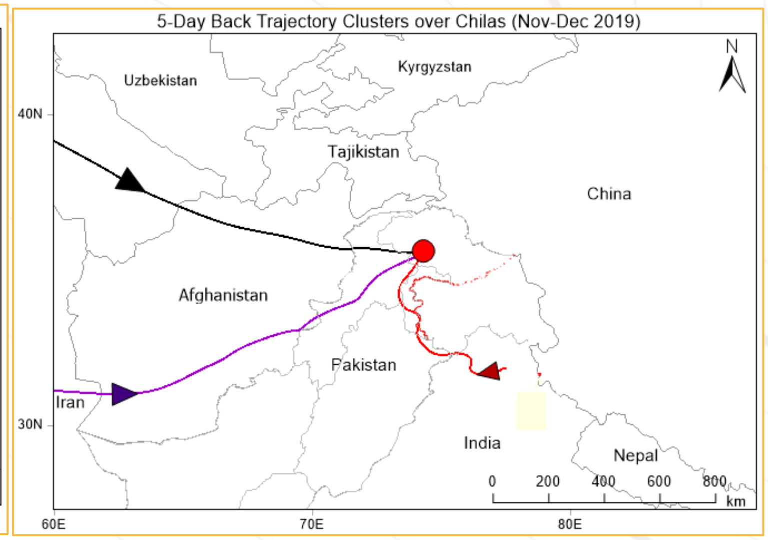


Figure 3.26: Clusters of air trajectories reached over Chilas during Winter 2019

(b) Summer Season

Figures 3.27 to 3.31 illustrate that during summer, a major fraction of air masses over Hunza, Gilgit, Jaglot and Chilas respectively, was originated primarily from the Black Sea or Caspian Sea regions and traveled over Eastern Europe and central Asia before reaching GB region. For Sost, major fraction of air masses was arrived from central Asia whereas minor fractions from China also moved in during summer. The secondary source region of pollutants at all monitoring sites could be the fractions of eastern winds originating over northern India that could also carry over the local emissions from household burnings and vehicular emissions over northern Punjab and GB region to study sites.

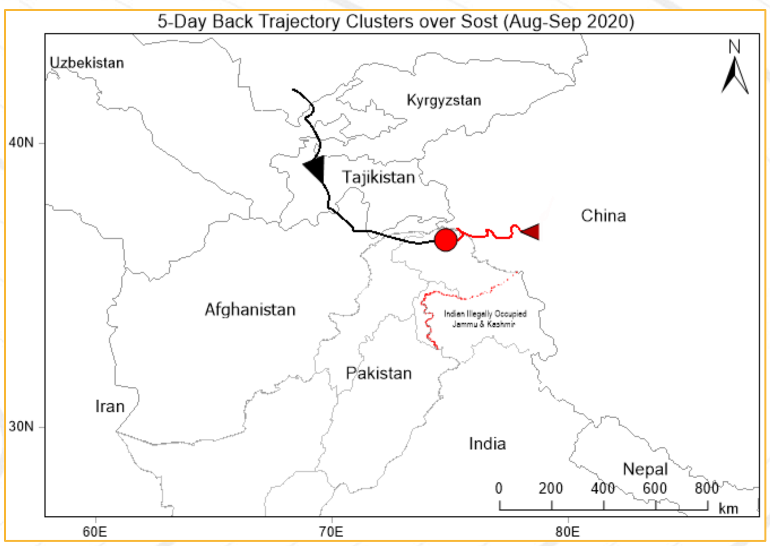


Figure 3.27: Clusters of air trajectories reached over Sost during Summer 2020

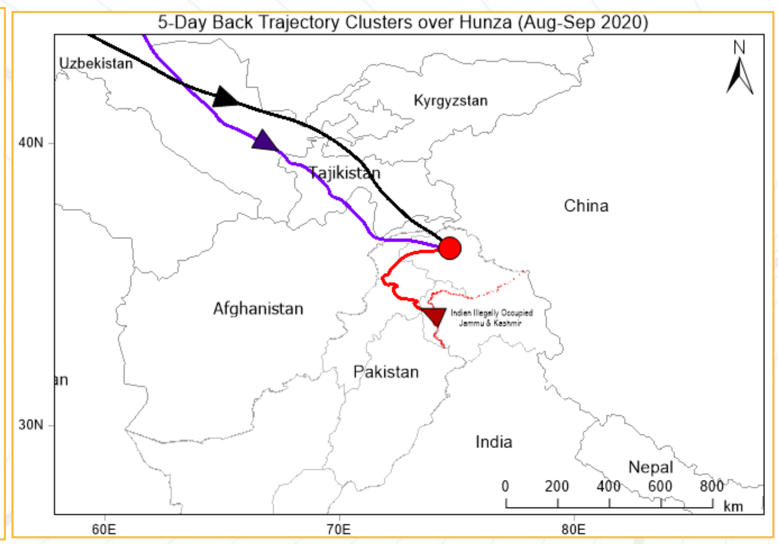


Figure 3.28: Clusters of air trajectories reached over Hunza during Summer 2020

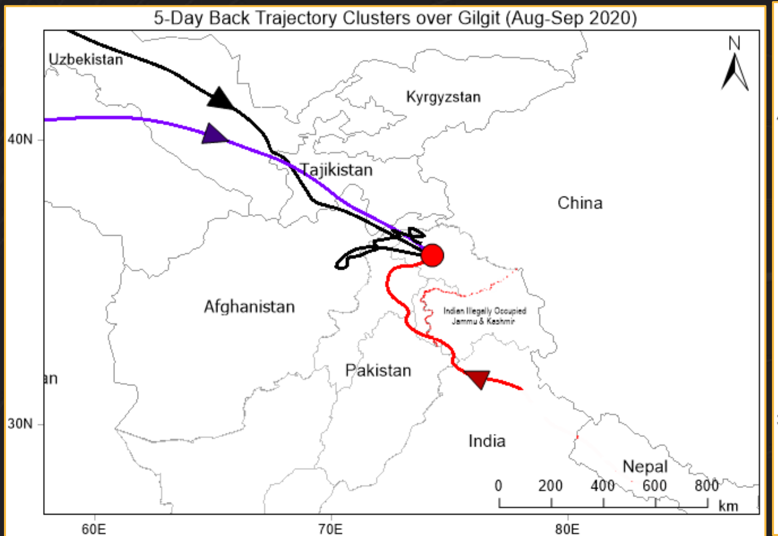


Figure 3.29: Clusters of air trajectories reached over Gilgit during Summer 2020

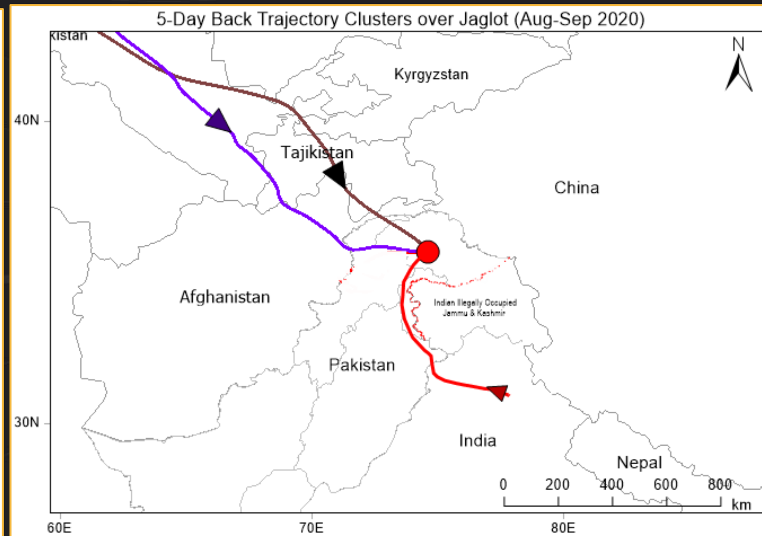


Figure 3.30: Clusters of air trajectories reached over Jaglot during Summer 2020

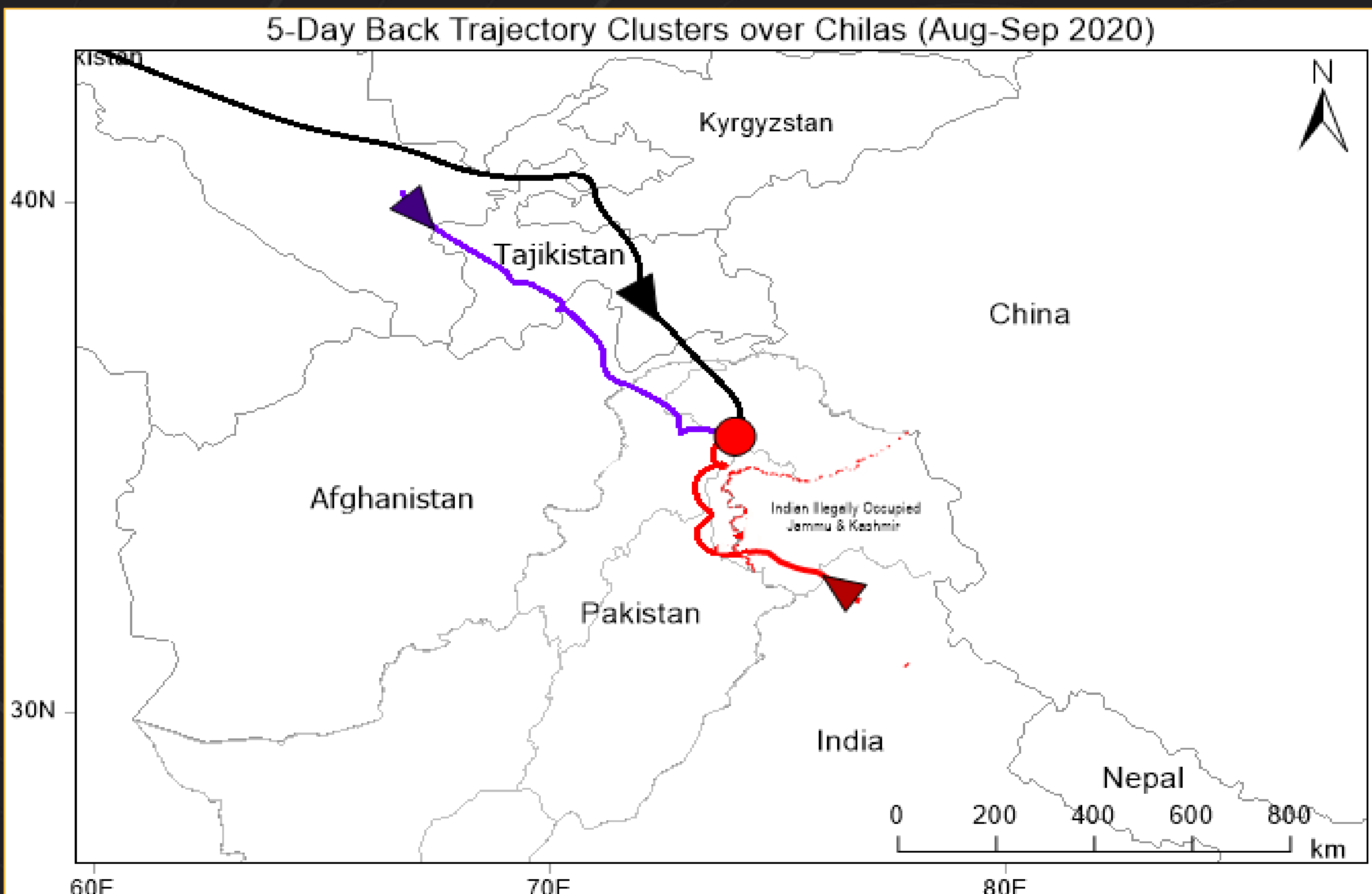


Figure 3.31: Clusters of air trajectories reached over Jaglot during Summer 2020

3.5 Conclusion

Ambient air, noise level and meteorological monitoring was carried out in five cities of GB including Sost, Hunza, Gilgit, Jaglot and Chilas during two seasons i.e., in winter 2019 and summer 2020. Continuous air monitoring was conducted for gaseous pollutants including Carbon Monoxide (CO), Sulfur Dioxide (SO2), Oxides of Nitrogen (NO + NO2) and Ozone (O3); as well as aerosol pollutants including Black Carbon (BC) & Particulate Matters (PM2.5).

In winter season, the average atmospheric levels of gaseous pollutants (CO, SO2, NO, NO2 & O3) in all selected cities of GB were observed within National Environmental Quality Standards (NEQS). Highest levels of all pollutants were recorded in Gilgit city particularly in the vicinity of City Park and Airport. Similarly, maximum levels of all gaseous pollutants in five cities were also below NEQS except CO in Gilgit where it was recorded up to 5.50 mg/m3 during peak traffic hours, higher than standard limit (5 mg/m3). The average atmospheric levels of aerosols (PM2.5) in Gilgit (57.4 µg/m3) and Chilas (40.8 µg/m3) were found exceeding the NEQS (35 µg/m3) whereas for Sost, Hunza and Jaglot, their levels were below NEQS.

In summer season, the average atmospheric levels of gaseous pollutants (CO, SO2, NO, NO2 & O3) in all selected cities of GB were also observed within National Environmental Quality Standards (NEQS). Like in winter, higher levels of all pollutants were recorded around Gilgit City Park and Gilgit Airport where maximum levels of CO were recorded up to 5.1 mg/m3 during peak traffic hours, slightly higher than standard limit (5 mg/m3). The average atmospheric levels (day/night) of aerosols (PM2.5) in all cities were found meeting the NEQS (for 24 hrs) however during day time (12 hrs), average PM2.5 levels in Gilgit and Chilas were recorded as 42.8 µg/m3 and 39.3 µg/m3 respectively. It is pertinent to note that except for few air pollutants, the general trend of air pollutant levels in GB cities was in the order of Gilgit > Chilas > Hunza > Jaglot > Sost in summer and winter seasons. Regarding the seasonal comparison, in winter season, higher pollutants levels were observed in Gilgit and Chilas than in summer whereas in other cities i.e., Hunza, Jaglot and Sost, overall higher pollutant levels were observed in summer than winter season. The dry weather conditions and frequent inversion layers during wintertime together with traffic congestions in populated areas; and burning of wood or other fuel for heating purpose resulted in relatively higher level of pollution load in Gilgit and Chilas.

For BC aerosols, although these are not enlisted as criteria pollutants therefore no NEQS exists for them, however the purpose of generating their database is that these aerosols recently have received special attention by scientific community due to their strong property of absorbing the sunlight. Due to this unique characteristic, BC can efficiently heat the atmosphere and can reduce the surface albedo by accumulating in snow & glacier ice, consequently accelerate the glacier melting. Therefore, the database of BC can be used to compare their atmospheric concentration during post-operational phase of CPEC as well as to simulate mathematical models to estimate atmospheric warming and impact on snow albedo.

The influence of long range transported air pollutants from outside the region cannot be ignored at all however since calm wind conditions were dominant in all cities during the field monitoring in both seasons especially in Gilgit and Chilas therefore local emissions could have profound effect in the form of gaseous and aerosol pollutants.

The average levels of noise, during both monitoring seasons, in all cities were within the average permissible limits of NEQS for commercial areas i.e., 60 dBA for day / night however these levels exceeded the safe limits for residential areas i.e., 50 dBA for day/night times.

The scope of present study was limited to gather and compile the data on present levels of air pollutants in selected cities along CPEC as baseline indicators. In order to make informed environmental management decisions, and to take timely & effective measures to reduce or control the anthropogenic emissions in GB during operational phase of CPEC, following technical / administrative actions are recommended:

1. Permanent air quality monitoring stations may be established at critical locations along CPEC in GB for year-round monitoring of gaseous and aerosol

pollutants. The collected data be disseminated to atmosphere knowledge hub that may be established at GB-EPA to develop the air pollution database. The data may be compiled and shared with policy makers, researchers and general public.

2. GIS-based emission inventory of air pollutants from mobile and stationary sources may be developed integrated with computer modelling and satellite data to identify the source contribution and forecast future emission load in GB

3. Stringent measures / policies to be devised to restrict the blooming growth of Non-Custom Paid (NCP) vehicles by introducing mass transit system for local commuting; and also discourage the burning of solid waste (plastic material, tyres etc.) for heating purpose by seeking the potential for renewable energy resources.

4. Government of GB may set & adopt its own air emission standards keeping in view the local situation and sensitivity of natural ecosystem.

5. District-wise studies may be initiated in collaboration with research organizations and universities on the sources, and impacts of air pollutants on health, ecosystem and economy.

6. Alternate sources of clean energy like hydropower for lightening, cooking and heating; LPG and solar energy be explored.

04

LAND COVER CLASSIFICATION AND MAPPING

Chapter Four

4. Land Cover Classification and Mapping

4.1 Introduction

It is a well-known fact that human activities had posed devastating impacts on glaciers stability, snow cover and hydrological cycles in Tibetan Plateau, Himalayas and Polar Regions as well. Since, more than 400 km of the CPEC route passes through Gilgit-Baltistan, it is envisaged that human interventions together with changing climate patterns could have adverse impacts on glaciers stability, permanent snow cover, local agriculture & forest cover as well as probabilities of land sliding and avalanches. Therefore, the land cover classification and mapping of GB region at current stage of CPEC development is the need of hour. Satellite imagery and GIS maps for land cover, land use and to monitor temporal changes have diverse applications such as glaciers, environment, forestry, hydrology, agriculture and geology.

Natural resource management, planning and monitoring programs depend on accurate information about the land cover in a region. Land cover provides a snapshot of its distribution in given time. Satellite remote sensing is an ideal source for land cover mapping in hilly area as it minimizes the accessibility problem. Satellite remote sensing images due to their synoptic view, map like format and repetitive coverage provide a viable source of gathering effective land cover information. GB region is uniquely situated at the confluence of the world's three great mountain ranges: Himalaya, Karakoram and Hindukush (HKH).

The HKH glaciers are headwaters of Indus River, which is aptly termed as "The lifeline of Pakistan". Therefore, mapping the land cover of GB along CPEC route is of critical importance for environment and ecosystem of GB. In this regards, high resolution satellite imagery, for instance, SPOT data is very useful for capturing the land cover features along CPEC route in GB.

SPOT is a high-resolution optical imaging satellite run by Spot image. It is developed by CNES - the French Space agency. SPOT imagery product offers high resolution data over broad areas using the SPOT satellite 1, 2,3,4,5 (archive only) and 6/7. SPOT satellite acquisition covers large areas in a single pass at resolutions up to 1.5m. SPOT produces two high resolution optical images.

The multispectral (MS) mode is in the red, green and infrared bands of the EM spectrum whereas the panchromatic mode is a single wide band in the visible part of the spectrum with higher resolution (Table 4.1). Such precise coverage is ideal for diverse applications at national and regional scales from 1:250,000 to 1:15,000. Therefore, SPOT-6/7 high resolution data can be applied to monitor agriculture crop, forest disturbance, land use/land cover and land inventory.

Table 4.1: SPOT 6/7 Wavelength and Resolution

Satellite	Sensors	Bands	Resolution (m)
SPOT-6/7	MS	Blue (0.455 µm – 0.525 µm)	6 m
		Green (0.530 µm – 0.590 µm)	6 m
		Red (0.625 µm – 0.695 µm)	6 m
		(0.760 µm – 0.890 µm)	6 m
	PAN	(0.450 µm – 0.745 µm)	1.5 m

4.2 Data & Methods

4.2.1 Image Acquisition and Pre-Processing

SPOT 6 & 7 imagery was utilized to map land cover along CPEC route, Pakistan. The imagery was analyzed with respect to cloud cover percentage and image quality. Post-monsoon scenes of the year 2016-2018 were selected to map the land cover, keeping in view minimum cloud cover and temporary snow cover. In this regard, 26 imageries of SPOT-6/7 satellite were acquired along CPEC route in GB. These imageries are available with GB-EPA office in DVDs, and their IDs are mentioned in Table 4.2.

All images were geometrically corrected to UTM projection following which ortho-rectification was performed. The images were then sub divided into the desired area of interest and re-projected to Mercator projection. Subsequently, the images were pan-sharpened to 1.5m spatial resolution for land cover mapping.

Table 4.2: SPOT 6/7 Scene IDs acquired for Area of Interest

S.No	SPOT Image Acquire with Scene Ids
1	spot7_201710090531232_ort_spot7_20191202_0705171mhyuotojcejm_1_r1c1
2	spot7_201710090531232_ort_spot7_20191202_0705171mhyuotojcejm_1_r2c1
3	spot7_201712070528365_ort_spot7_20191210_0725281ezt98z67bckx_1_r1c1
4	spot6_201710170520385_ort_spot6_20191202_07063918d1aewfwgyzc_1_r1c1
5	spot7_201801020528366_ort_spot7_20191210_0737491betfbc5f461g_1_r1c1
6	spot7_201801020528366_ort_spot7_20191210_0737491betfbc5f461g_1_r1c2
7	spot7_201801020528366_ort_spot7_20191210_0737491betfbc5f461g_1_r2c1
8	spot7_201801020528366_ort_spot7_20191210_0737491betfbc5f461g_1_r2c2
9	spot7_201801020528366_ort_spot7_20191210_0737491betfbc5f461g_1_r3c1
10	spot7_201801020528366_ort_spot7_20191210_0737491betfbc5f461g_1_r3c2
11	spot7_201808050525585_ort_spot7_20191202_0659351q1due30wsaey_1_r1c2
12	spot7_201808050525585_ort_spot7_20191202_0659351q1due30wsaey_1_r2c1
13	spot6_201712010525137_ort_spot6_20191210_074244167etwwfim3f4_1_r1c1
14	spot6_201801220525289_ort_spot6_20191210_0740081efia7jys9fwa_1_r3c1
15	spot6_201710170520385_ort_spot6_20191202_07063918d1aewfwgyzc_1_r2c1
16	spot6_201801220525289_ort_spot6_20191210_0740081efia7jys9fwa_1_r1c1
17	spot6_201801220525289_ort_spot6_20191210_0740081efia7jys9fwa_1_r1c2
18	spot6_201801220525289_ort_spot6_20191210_0740081efia7jys9fwa_1_r2c1
19	spot6_201801220525289_ort_spot6_20191210_0740081efia7jys9fwa_1_r2c1
20	spot6_201808110528550_ort_spot6_20191210_0734251wqbq6d1r3xia_1_r1c1
21	spot7_201808050525585_ort_spot7_20191202_0659351q1due30wsaey_1_r1c1
22	spot7_201712070528365_ort_spot7_20191210_0725281ezt98z67bckx_1_r1c2
23	spot6_201808110528550_ort_spot6_20191210_0734251wqbq6d1r3xia_1_r1c1
24	spot6_p_201808110528550_ort_spot6_20191210_0734251wqbq6d1r3xia_1_r1c2
25	spot6_201801220525289_ort_spot6_20191210_0740081efia7jys9fwa_1_r2c1
26	spot6_201801220525289_ort_spot6_20191210_0740081efia7jys9fwa_1_r3c1

4.2.2 Image Processing & Interpretation

(a) Segmentation

Segmentation is the process of grouping pixels to simplify the image into meaningful pixel groups (i.e., segments or objects). Image segmentation provide layer of polygons based on spatially continuous and spectrally homogenous regions or objects. Each segment represents regions with similar pixel values with respect to some characteristics such as color, intensity or texture. For land cover mapping segmentation helps in developing cluster pixels that belong to same land cover class. For this study, segmentation was performed using eCognaition software. Multi-resolution segmentation approach was implemented to perform segmentation at the scale ranged 35 to 55 depending on the complexity of image. In addition, compactness was set to 0.9 and shape to 0.1 to get more homogenous segments.

(b) Image Interpretation

Image interpretation is the process of identifying and delineating useful spatial information and labeling of the image object using land cover legends and ancillary information. The Mapping Device Change Analysis Tool (MADCAT) was used for the creation of land cover database using the remote sensing imagery and the LCCS legend to assign the land cover class label of each polygon. In order to assure interpretation consistency inside the same mosaic, a block of contiguous scenes (a sub-mosaic) was assigned to each interpreter. Photo-interpretation of the scene was carried out at 1:25000 scale, taking care of the matching between scenes belonging to the same sub mosaic. Topology was checked and confirmed after completion of interpretation. Subsequently, the original segmentation of interpreted scenes was dissolved while keeping a copy of the full resolution interpretation.

(c) Image Intermediate Supervision Process – Quality Control

A team of interpreters undertook an independent quality control of the database. The team checked the dissolved segments of each working area and highlighted the errors. Where errors were identified or the interpretation did not attain a minimum standard and/or contain non coded polygons, the quality control supervisor was tasked to reject/sent back the scene/mosaic for re-photo-interpretation. After the errors were removed by the photo interpreter, the corrected interpretation was again submitted to a Quality Control supervisor for quality check. The process was repeated in case errors still exist. After the quality check, edge matching of the dissolved tiles was carried out between same sub-mosaic and bordering mosaics.

(d) Field Validation

On completion of the interpretation phase, field survey was conducted by SUPARCO officials to validate the image interpretation and to remove the ambiguities related to land cover classes based on detailed field surveys. For survey point, the land cover type and the coordinates were recorded using GPS systems.

(e) Evaluation

After the completion of interpretation, a quality check, and edge matching was undertaken followed by final evaluation of the land cover database.

(f) Field Data Harmonization and Final Database Generation

As a final step, the land cover data was thoroughly reviewed and harmonized to create a consistent land cover database, minimizing difference from the subjectivity of different interpreters. Finally, detailed topology rules were applied to correct inconsistencies and to remove slivers or voids in the database.

4.3 Legend

The legend for land cover mapping was created by SUPARCO. The photo-keys of different land cover types were developed which serve to illustrate the aspect on the ground (texture, tone, color and reflectance) of the land cover units, present in the images. The final version of the legend is composed of 37 land cover classes aggregated into 13 main classes which are as follow:

4.3.1 Crop Irrigated

This class includes all land which is actively tilled such as wheat, maize, vegetables etc. The differentiation of this class with rain fed crops is made on the basis of the presence of channels, geographic location and local knowledge. Herbaceous crop irrigated and herbaceous crop surrounded by tree orchards are also included in crops irrigated.

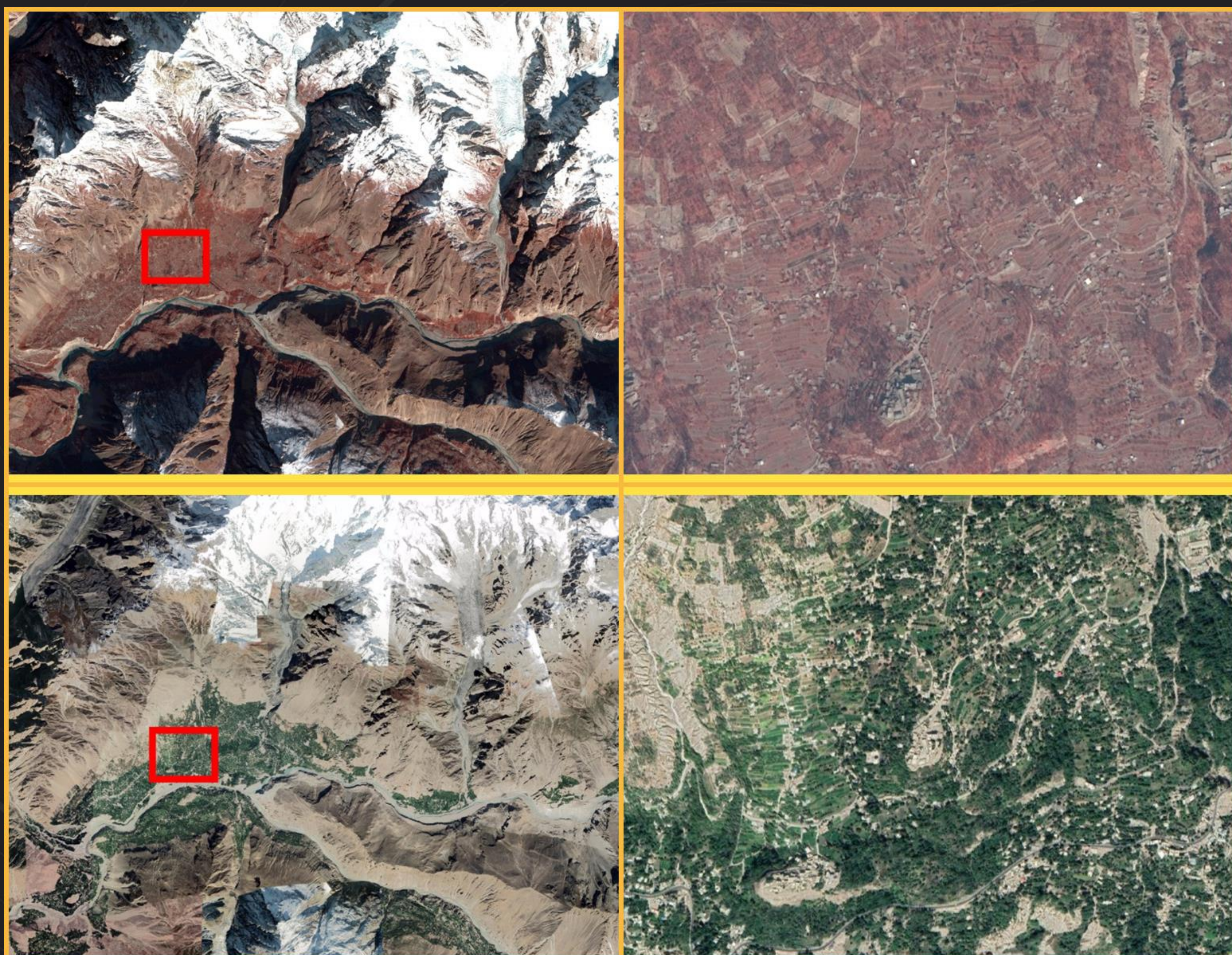


Figure 4.1: Satellite imagery showing crop irrigated landcover class in Gilgit-Baltistan

4.3.2 Crop Marginal and Irrigated Saline

Crop marginal and irrigated saline are identified as those areas which are currently used for agriculture with low and unstable rainfall or higher rainfall areas intensively used, relative to user-capability, under existing population densities, traditional technologies and institutional structures.

Figure 4.2: Satellite imagery showing crop marginal landcover class in Gilgit-Baltistan

4.3.3 Crop in Flood Plain

Herbaceous crop located only in proximity of the river bed is termed as crop in floodplain. The water supply is provided either by irrigation or by the annual floods. Crop in floodplain includes herbaceous crop irrigated in floodplain and herbaceous crop post-flooding. Generally, no flood plains exist in GB.

4.3.4 Forest

Forest is described as area characterized by tree cover natural or semi-natural woody vegetation, generally taller than 6 meters. Forest includes both natural and planted forest. Tree forest plantation refers to governmental plantation. This class can be identified with large area and regular shape. Tree closed are type of vegetation with tree percentage cover more than 60%. The class closed trees occurs in the different parts of the country. It has woody natural vegetation, found both in broad as well as in needle leaves. Open trees are type of vegetation with mandatory presence of trees and herbaceous growth forms with percentage cover varying from 10 to 60 percent in both.

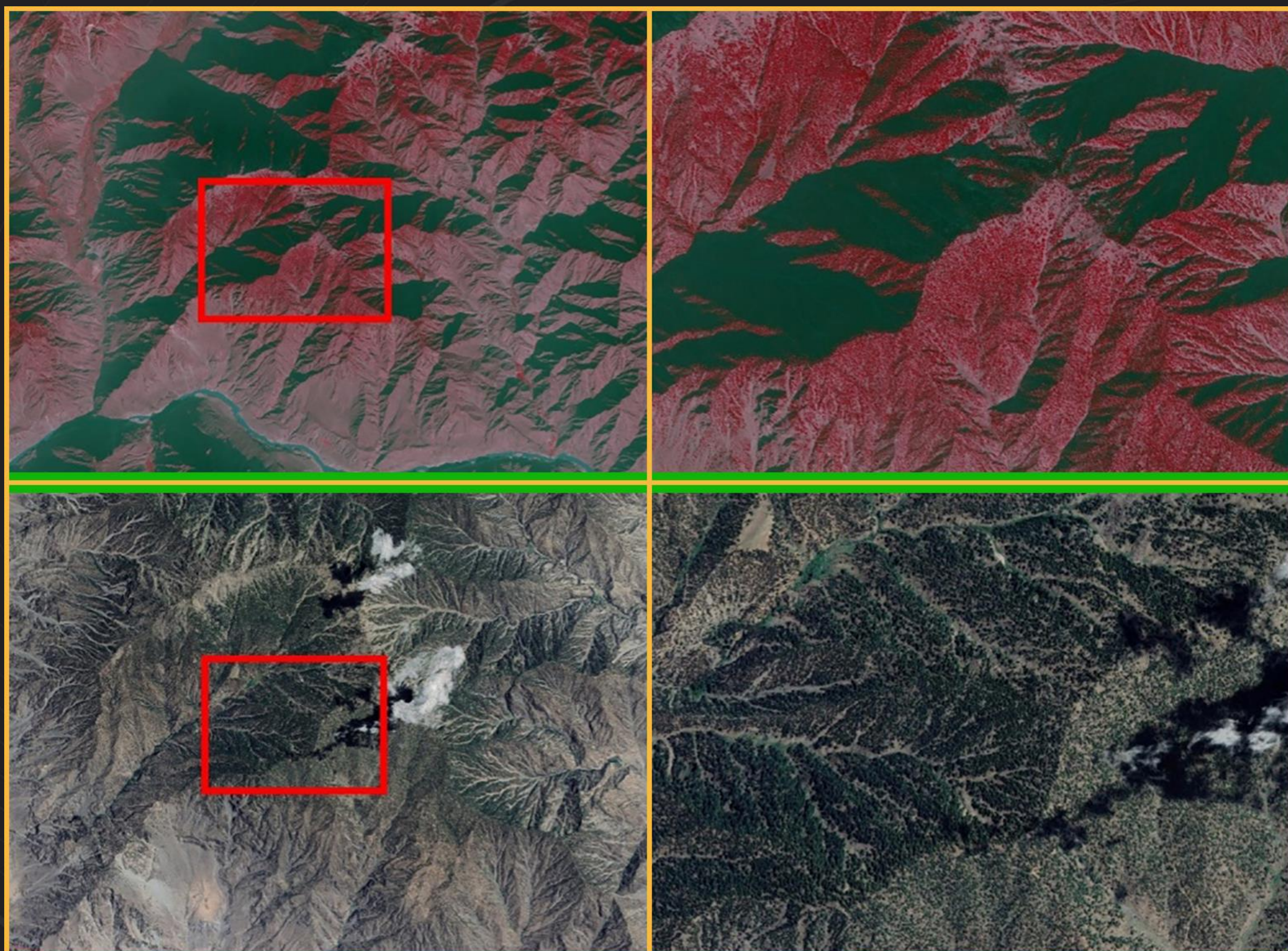


Figure 4.3: Satellite imagery showing Forest landcover class in GB

4.3.5 Natural Vegetation in Wet Areas

The subclasses include river bank, wetlands, shrubs closed to open in wetland, tree closed in wet land and tree open in wetland. The classes are derived on the basis of soil and vegetation type. River bank is a part of the river bed flooded during the rainy season (Floodplain). The bed of the seasonal rivers is included in this class. Wetlands are herbaceous vegetation with cover ranging from 60% to 100% found in flooded/wet areas, sometimes associated with shrubs.

Shrubs closed to open in wetland found along the rivers and associated flooded areas. Generally, in the vegetated portion of the riverbank, made of shrubs with cover 20-100%. Tree closed in wetland are woody vegetation occurring along the rivers and associated flooded areas, with cover from 60 to 100%. Tree open in wetlands are the woody vegetation with cover ranging from 10 to 60%.

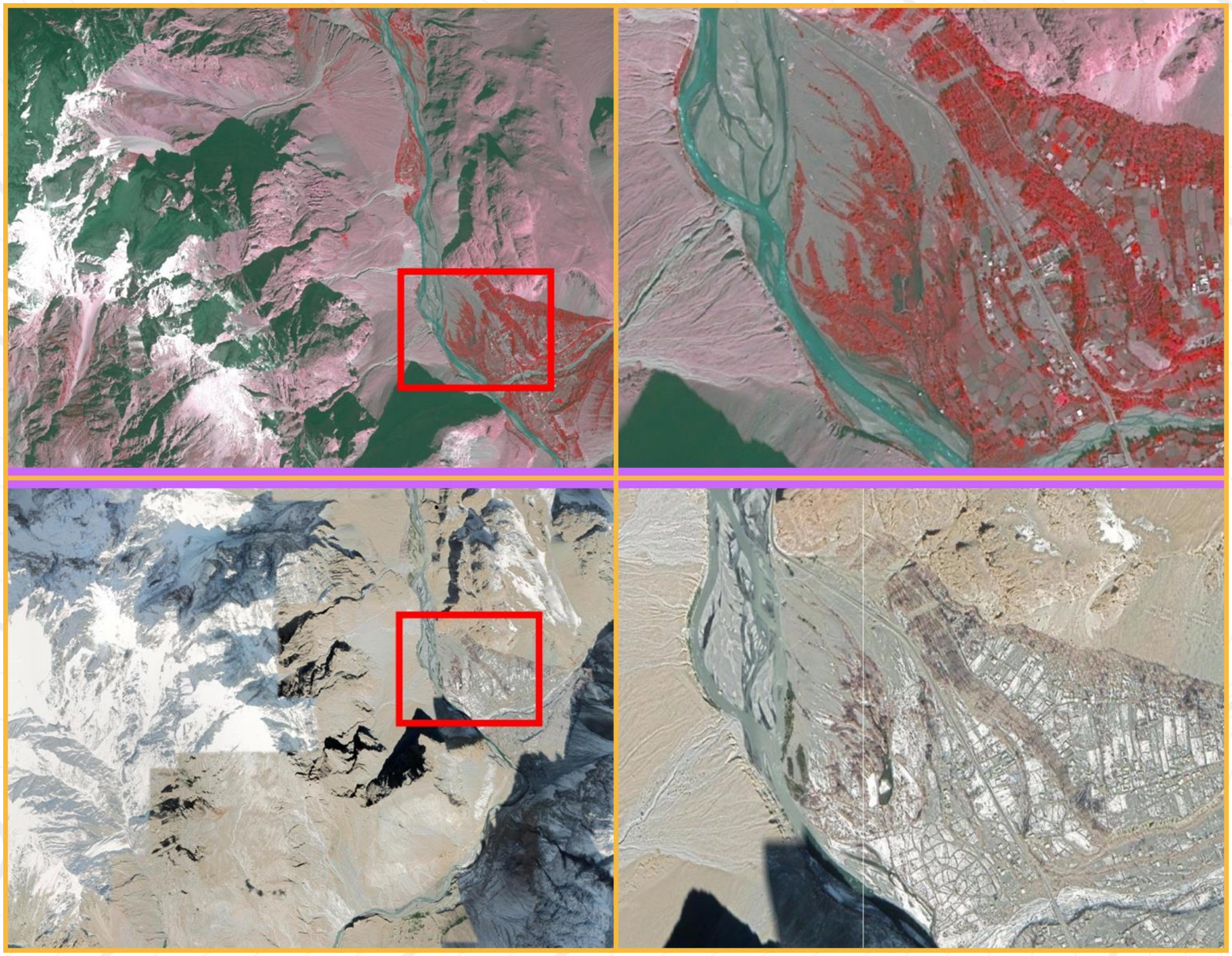


Figure 4.4: Satellite imagery showing natural vegetation in wet areas landcover class in GB

4.3.6 Range Land – Natural Shrubs and Herbs

Rangelands are vast natural landscapes in the form of grasslands, shrub lands and woodlands. Areas characterized by natural or semi-natural woody and herbaceous vegetation with aerial stems, generally less than 6 meters tall, with individuals or clumps not touching to interlocking. These areas are not subject to intensive management such as tilling, but can be utilized for grazing. Shrub closed, shrubs open and herbaceous closed to open are the subclasses that are included in rangelands. Shrubs with a cover from 60 to 100% are considered as shrub closed. A layer of trees sparse (1-10%) could be present with shrub closed. Open shrubs are natural or semi-natural vegetation with shrubs ranging from 10 to 60%and trees ranging from 1 to 10%. These are found mainly on the hilly areas of Pakistan and generally have broad as well as needle leaves. Herbaceous closed to open is a type of vegetation where mandatory presence of herbaceous growth forms varies from 10 to 100% and optional presence of trees and shrubs up to 10% percent of cover.

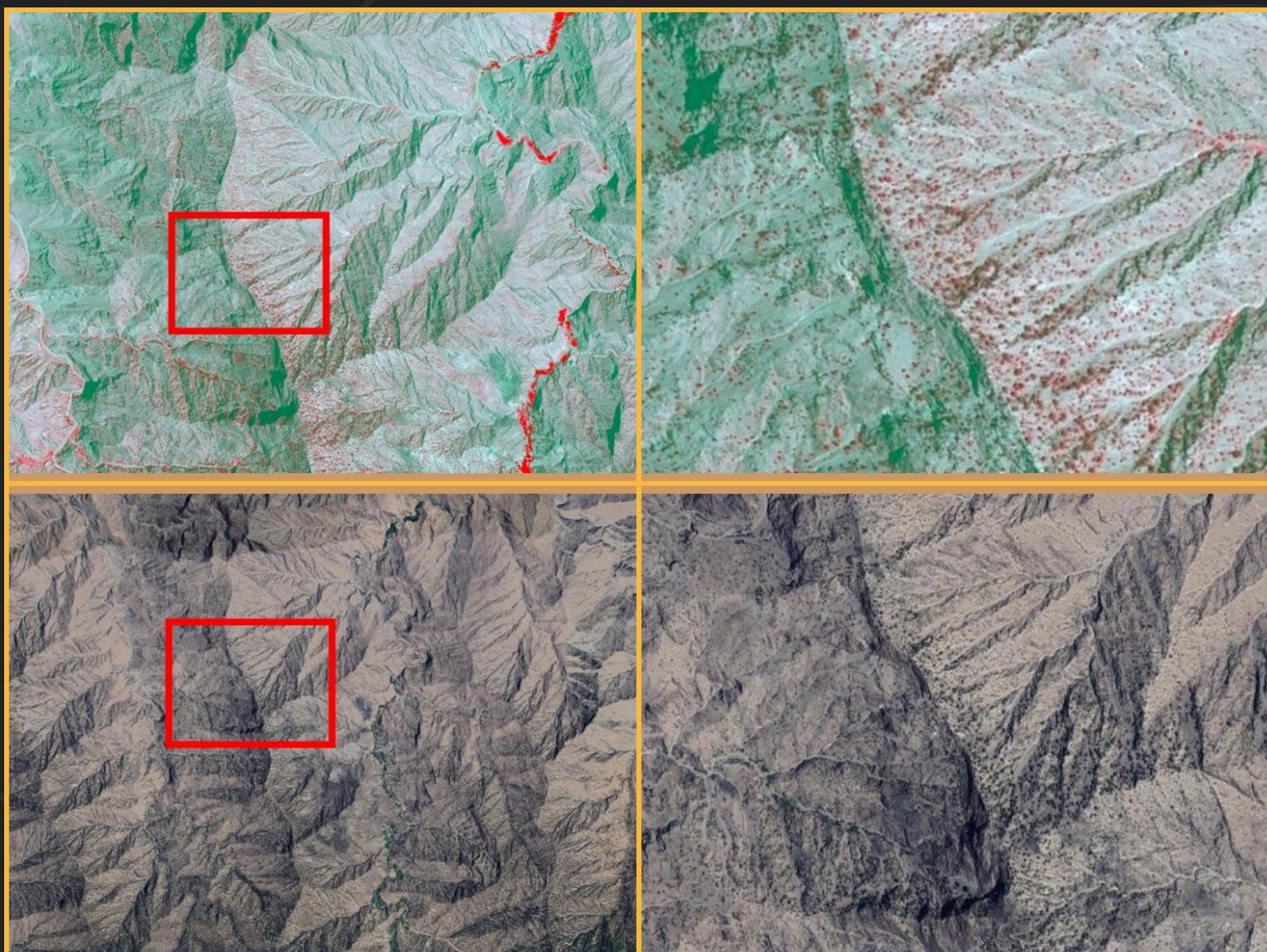


Figure 4.5: Satellite imagery showing Range land – natural shrubs and herbs landcover class in GB

4.3.7 Built-up Area

It defines all the built-up areas (urban, industrial, airport and all the structures associated with human settlements etc.) with all vegetated areas linked to the built-ups such as gardens, urban recreation parks, plots devoted to urban expansion etc.

Figure 4.6: Satellite imagery showing built-up areas landcover class in GB

4.3.8 Bare Areas

This class describes areas that have very less natural and manmade vegetative cover. The subclasses include sand dunes and barren land. Barren land is bare soil area with very low density of shrubs and no agriculture activity. Sand dunes are made of low ridges or hillocks of drifted sand mainly moved by wind. The shifting sand is not covered by vegetation and if present, is negligible.

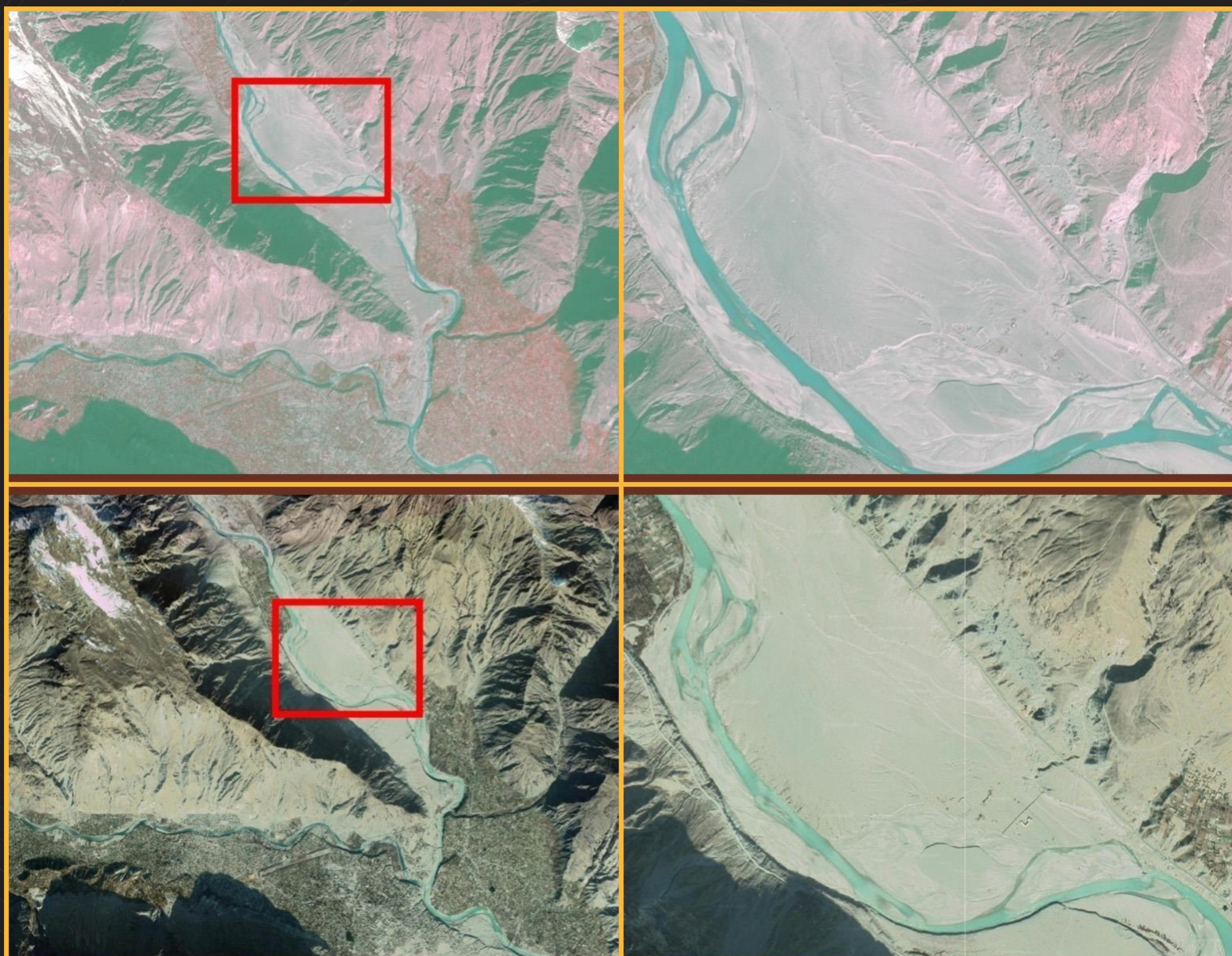


Figure 4.7: Satellite imagery showing bare areas landcover class in Gilgit-Baltistan

4.3.9 Bare Areas with Natural Vegetation

Sand Dunes with natural vegetation, bare rocks (with sparse vegetation) and desert flat plain are included in bare areas with sparse natural vegetation. These are the areas where sparse vegetation could be present but the percentage coverage would be less than 10%. Sand Dunes with natural vegetation are dunes that have permanent vegetation cover ranges from 1 to 40%.

The vegetation cover causes a process of dune stabilization. According to the amount of vegetation cover, dunes are stabilized or semi stabilized. Bare rocks (with sparse vegetation) are a class that contains less than 10% of growth forms. The class based on the geographical location of the area that is declared as desert other than sand dunes.

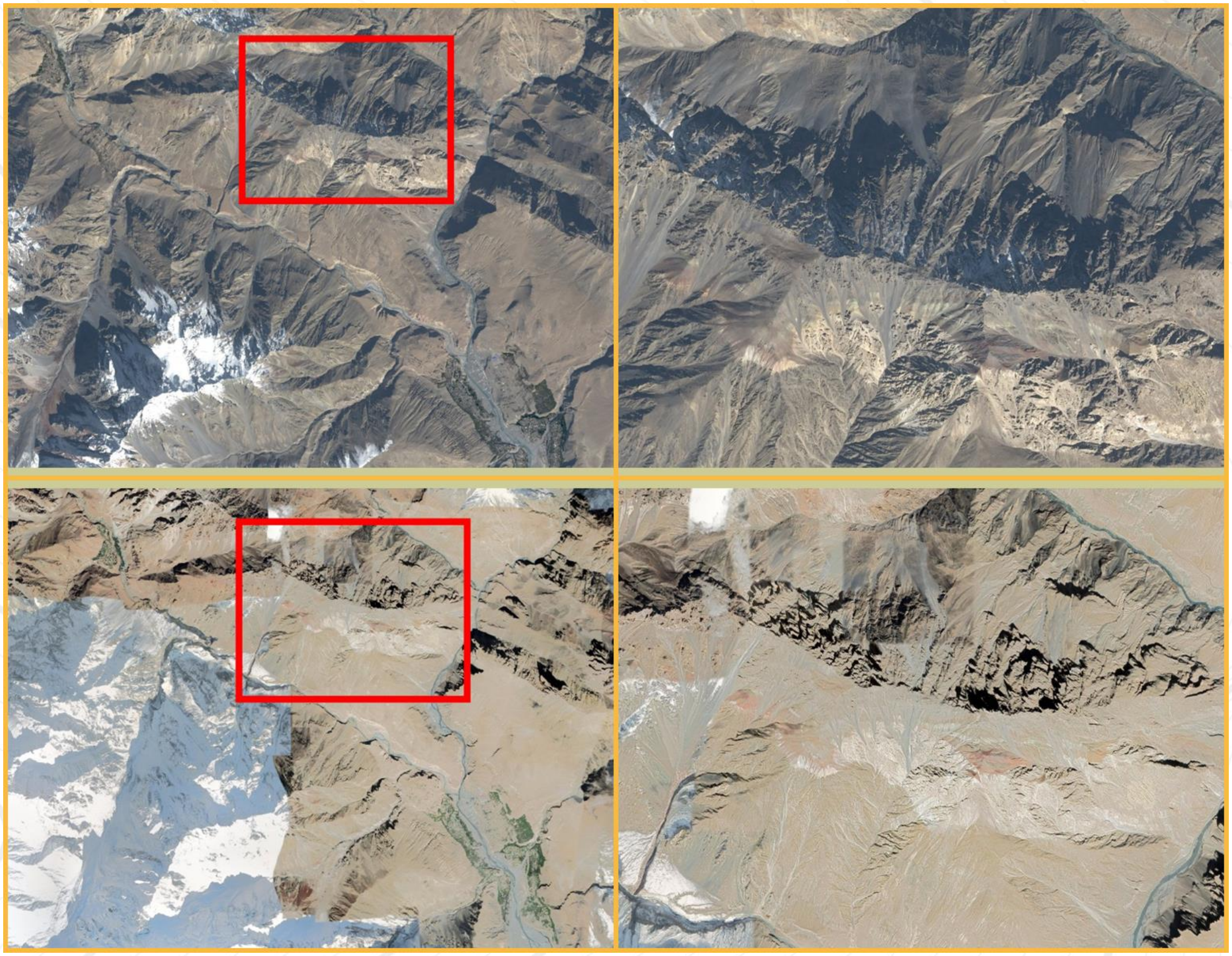


Figure 4.8: Satellite imagery showing bare areas with natural vegetation landcover class in GB

4.3.10 Wet Areas

Areas which are naturally covered with fresh or saline water such as river and lakes are grouped in this class. Wet areas are characterized by drainage and the consequent presence of sluggishly moving or standing water saturating the soil with sparse natural vegetation. The subclasses include mud flats, river perennial, salt lakes, water bodies, saline area and water-logged bare areas. The classes are derived on the basis of presence of water at the surface. River perennial is a part of the riverbed where there is a constant presence of flowing water throughout the year.

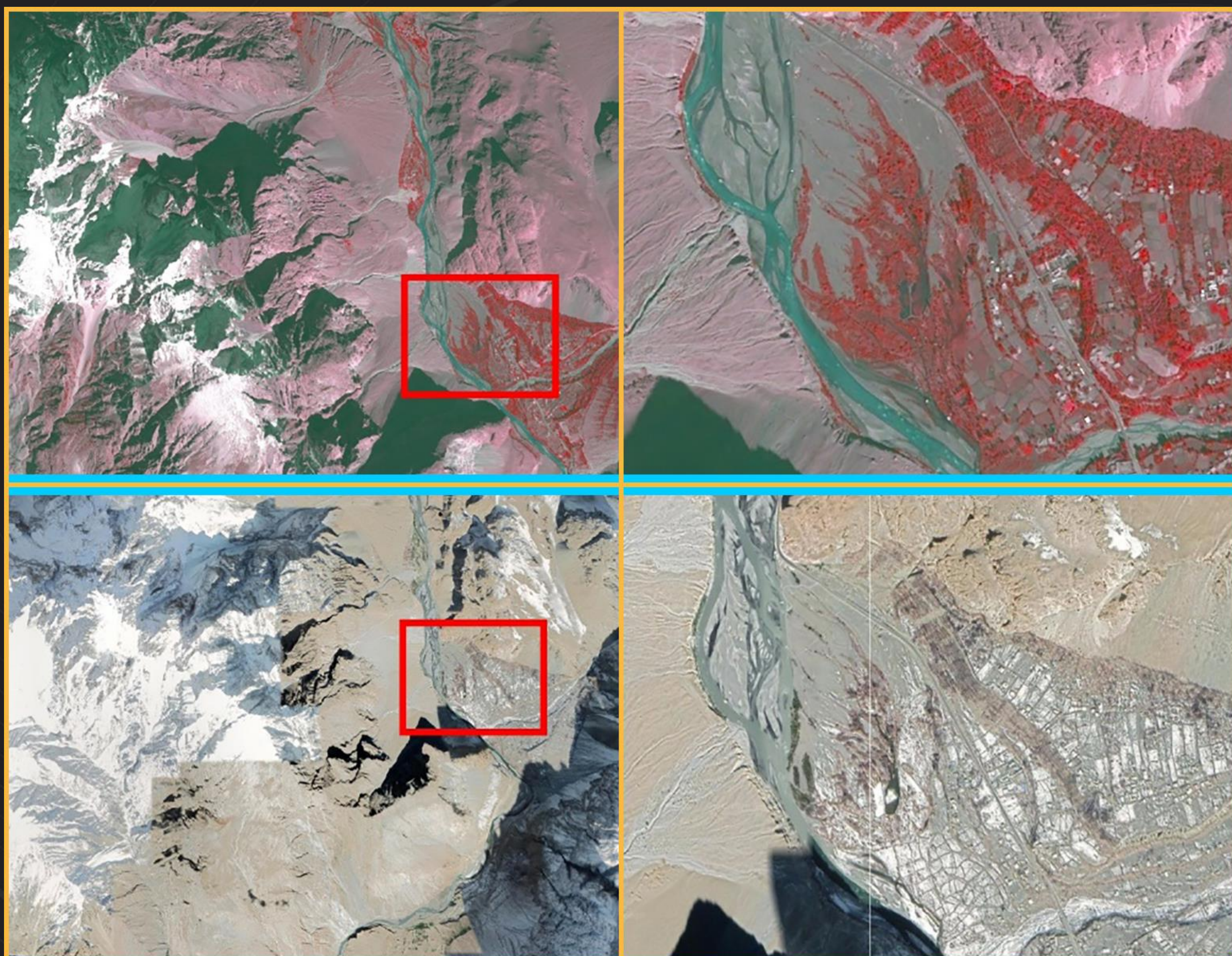


Figure 4.9: Satellite imagery showing wet areas landcover class in GB

4.3.11 Snow

Gilgit Baltistan receives significant snowfall in the seasons of winter and spring. Westerly circulations bring significant snow to the Upper Indus River basin region. During winter more than 70% of the area of Gilgit Baltistan is covered by Seasonal snow. In this landcover classification, Snow permanent is the area characterized by year-long surface cover of ice and/or snow.

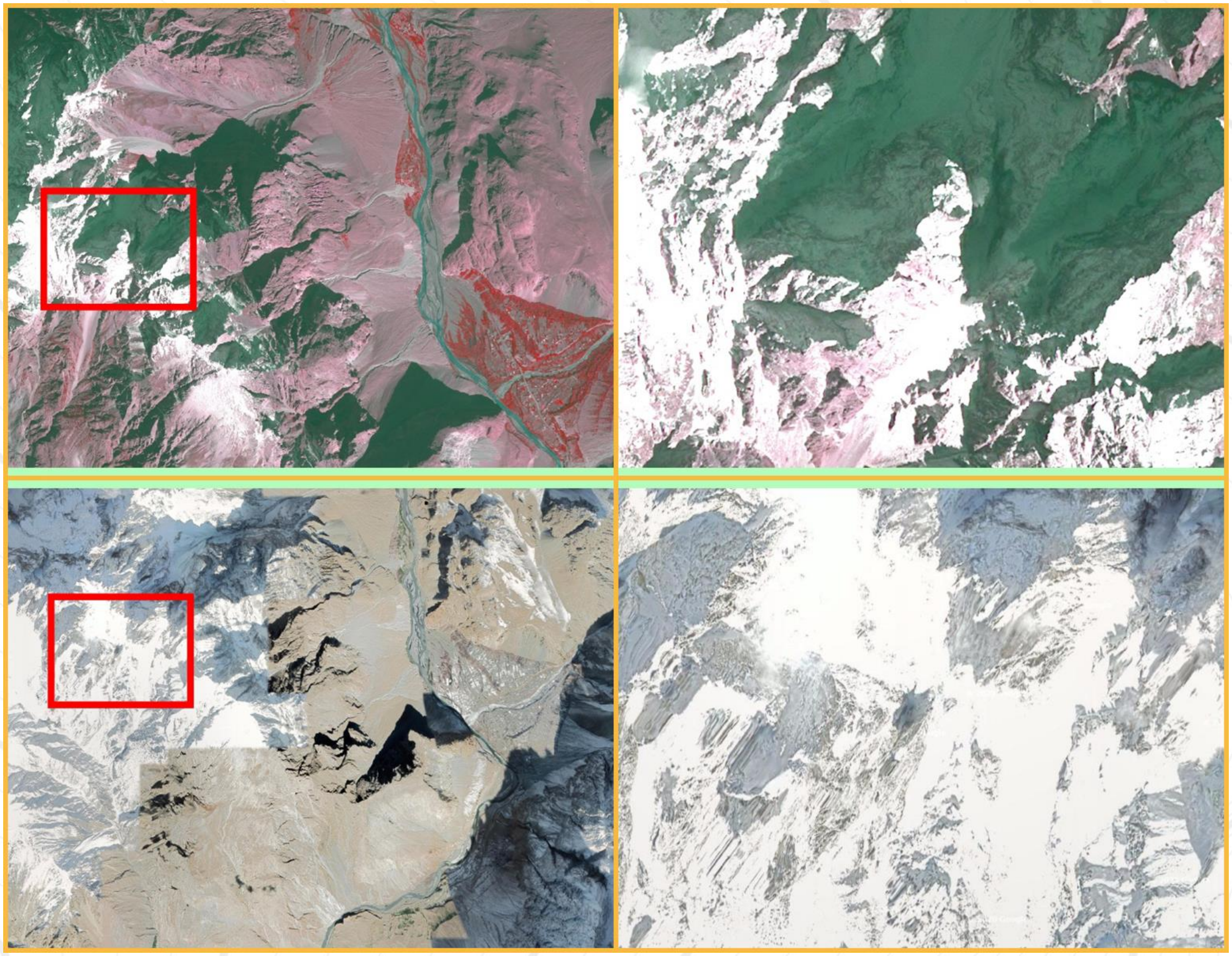


Figure 4.10: Satellite imagery showing snow landcover class in GB

4.3.12 Glaciers

Glaciers are permanent solid moving under its own gravity; it forms where the accumulation of snow exceeds its ablation (melting and sublimation) over many years, often centuries. The weight of the snow mass causes the ice to become flexible and move downhill. Glaciers must have sufficient ice mass to flow under gravity. Retreating glaciers are those that melt more than they accumulate new snow.

Glaciers are dynamic – changing in response to temperature, precipitation, and other geologic processes. Ice is continuously cycling through a glacier, going from snow to ice, and that moves down and out as water. The ice does not persist forever in the glacier, although the glacier remains if there is enough snow accumulation to offset melting.

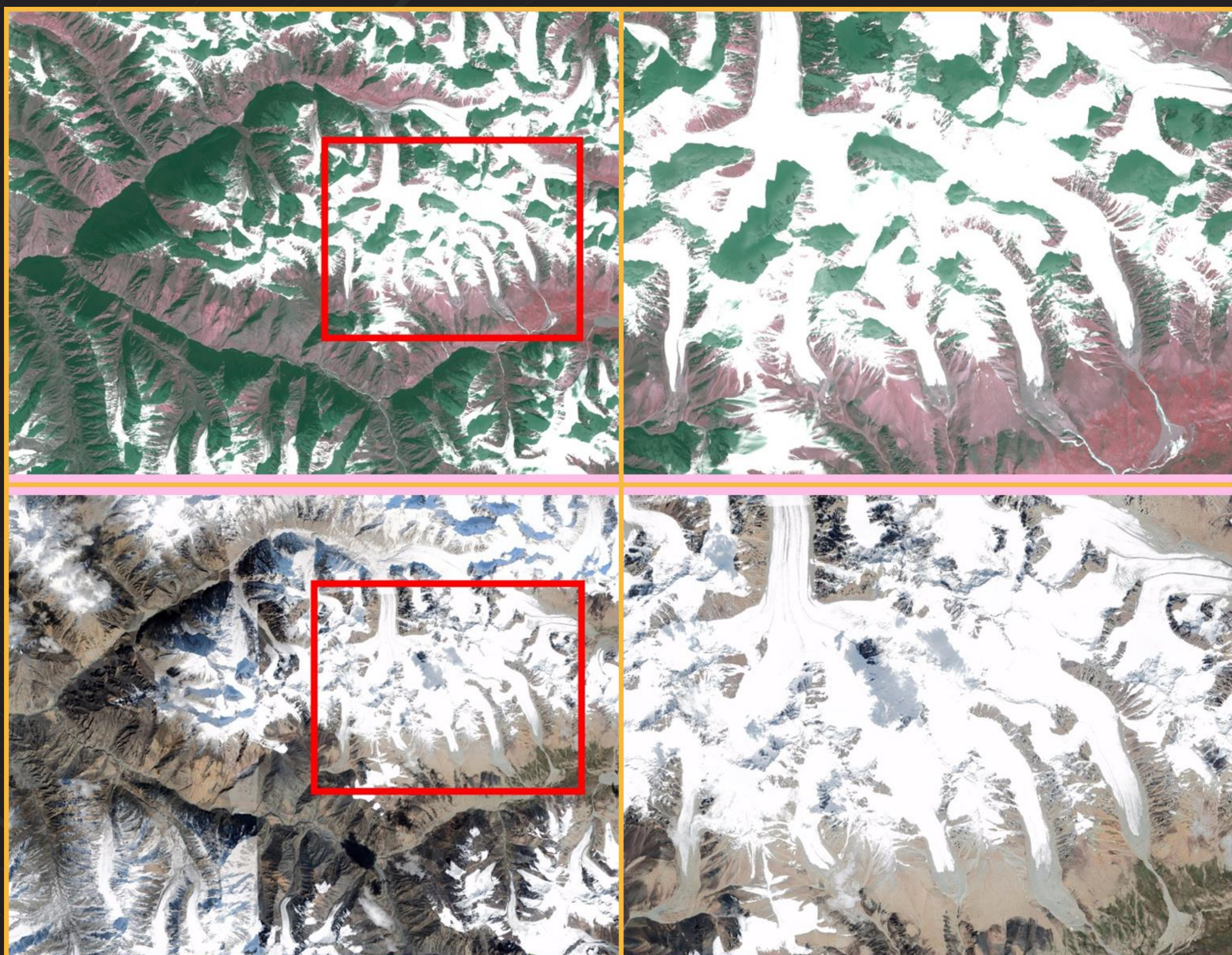


Figure 4.11: Satellite imagery showing glaciers landcover class in GB

4.3.13 Glaciers with Debris

Glaciers with debris contain permanent moving ice with deposits of eroded material from rocks on its surface. The land cover atlas would provide not only the robust statistics of different land covers but would also provide the basis for the development of an improved capacity for natural and environmental resources monitoring and management along CPEC route in GB.

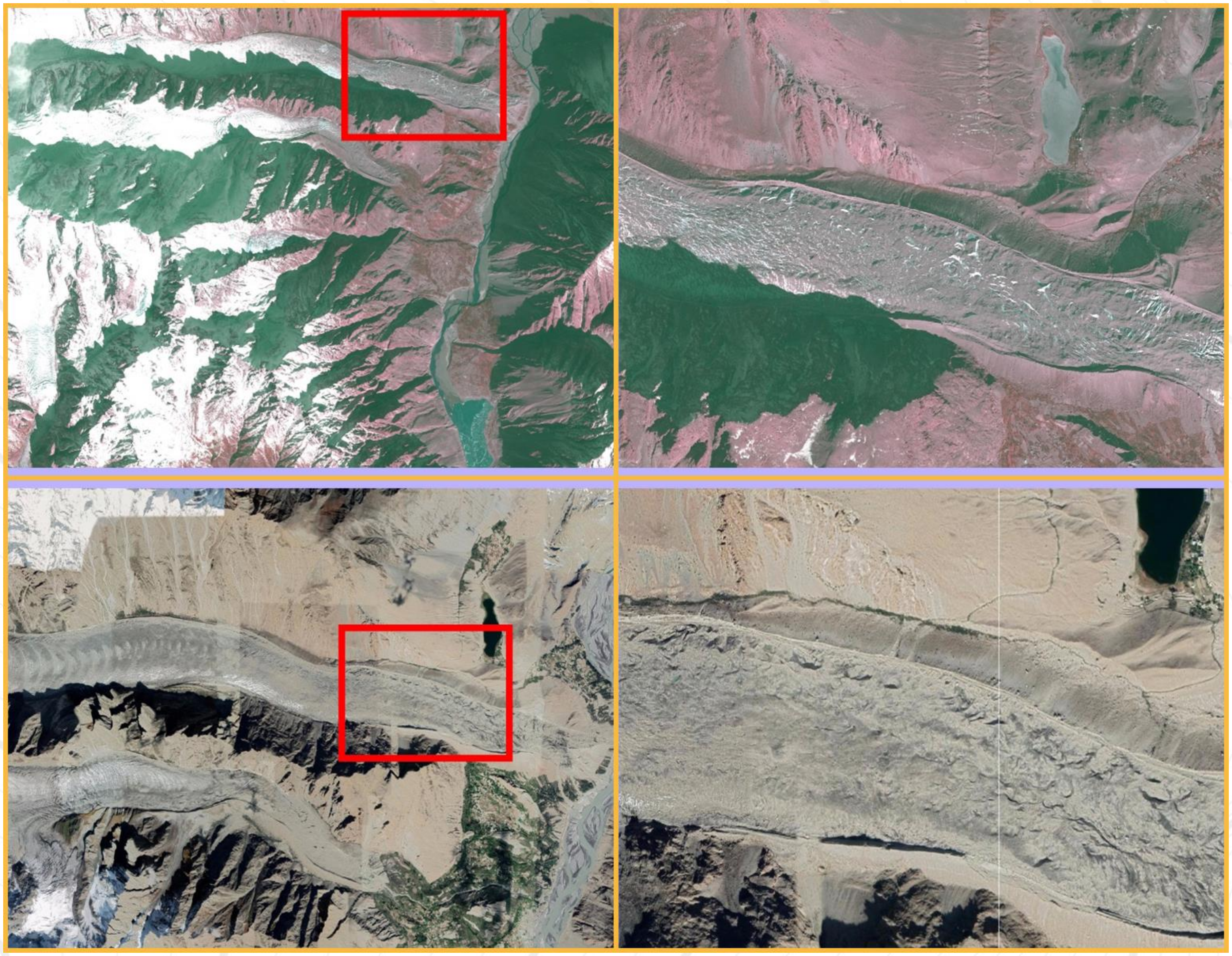
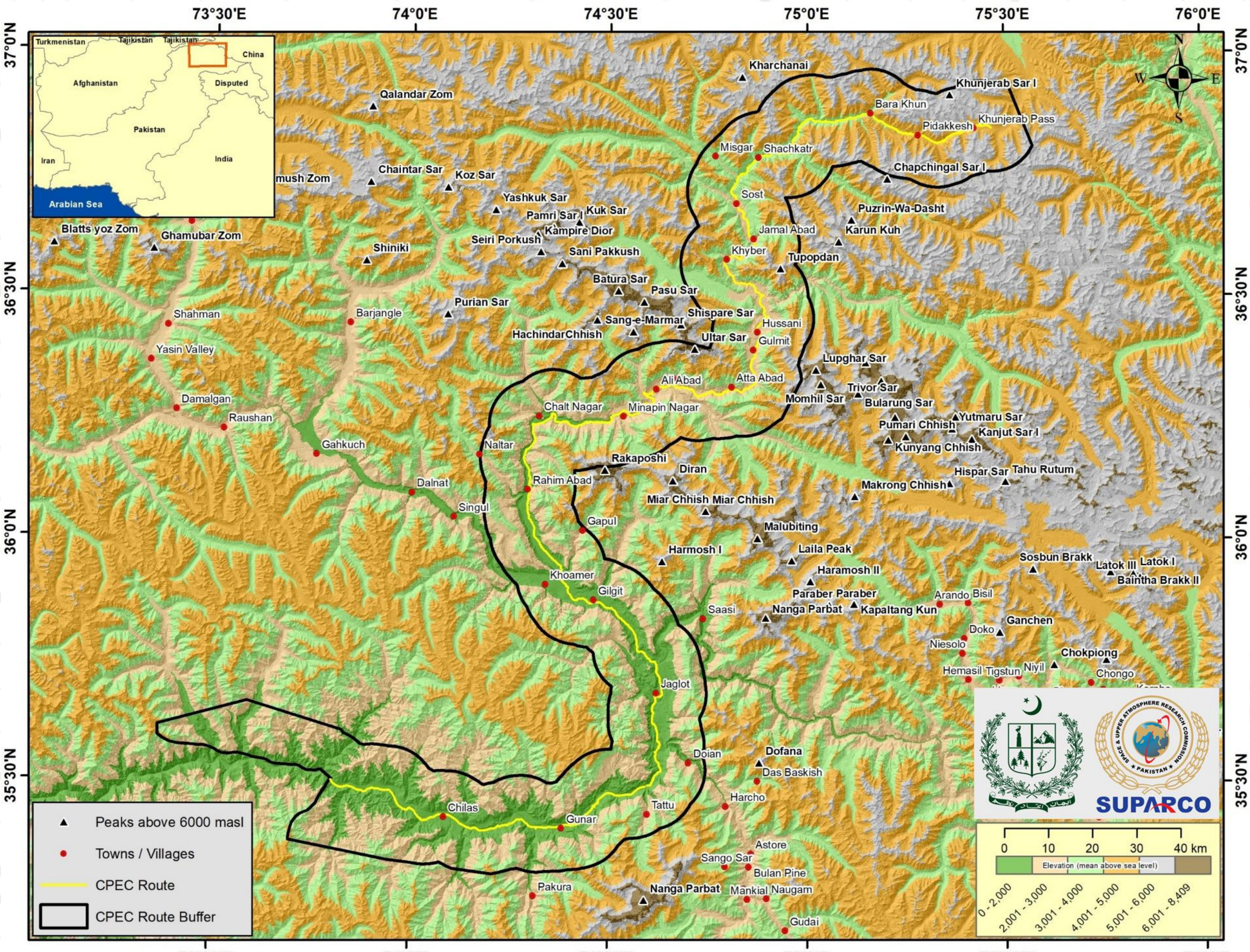


Figure 4.12: Satellite imagery showing glaciers with debris landcover class in Gilgit-Baltistan

4.4 Mapping

CPEC Route in GB with 20 Km Buffer (Study Area)



Land Use Land Cover (LULC) Classification of Study Area

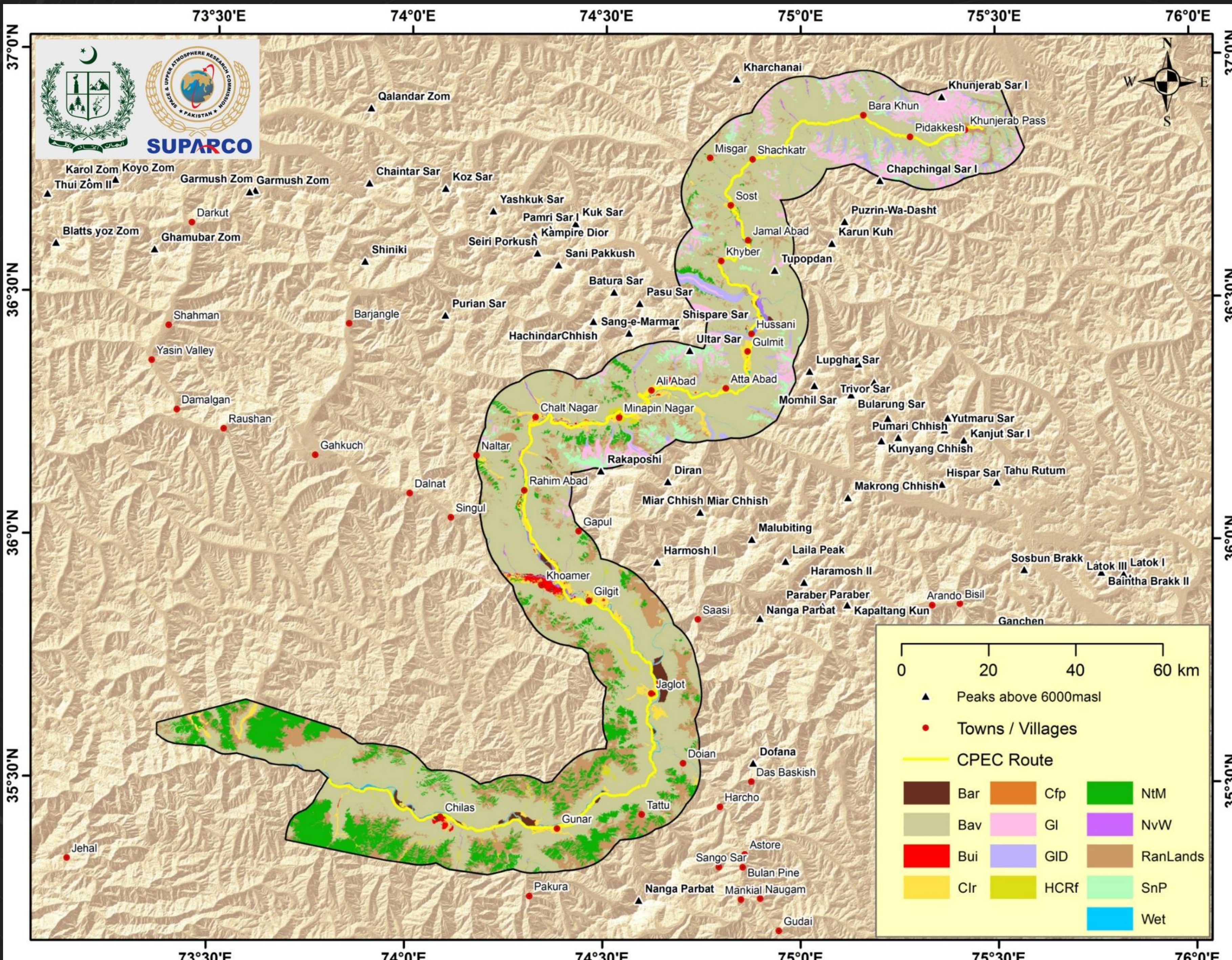
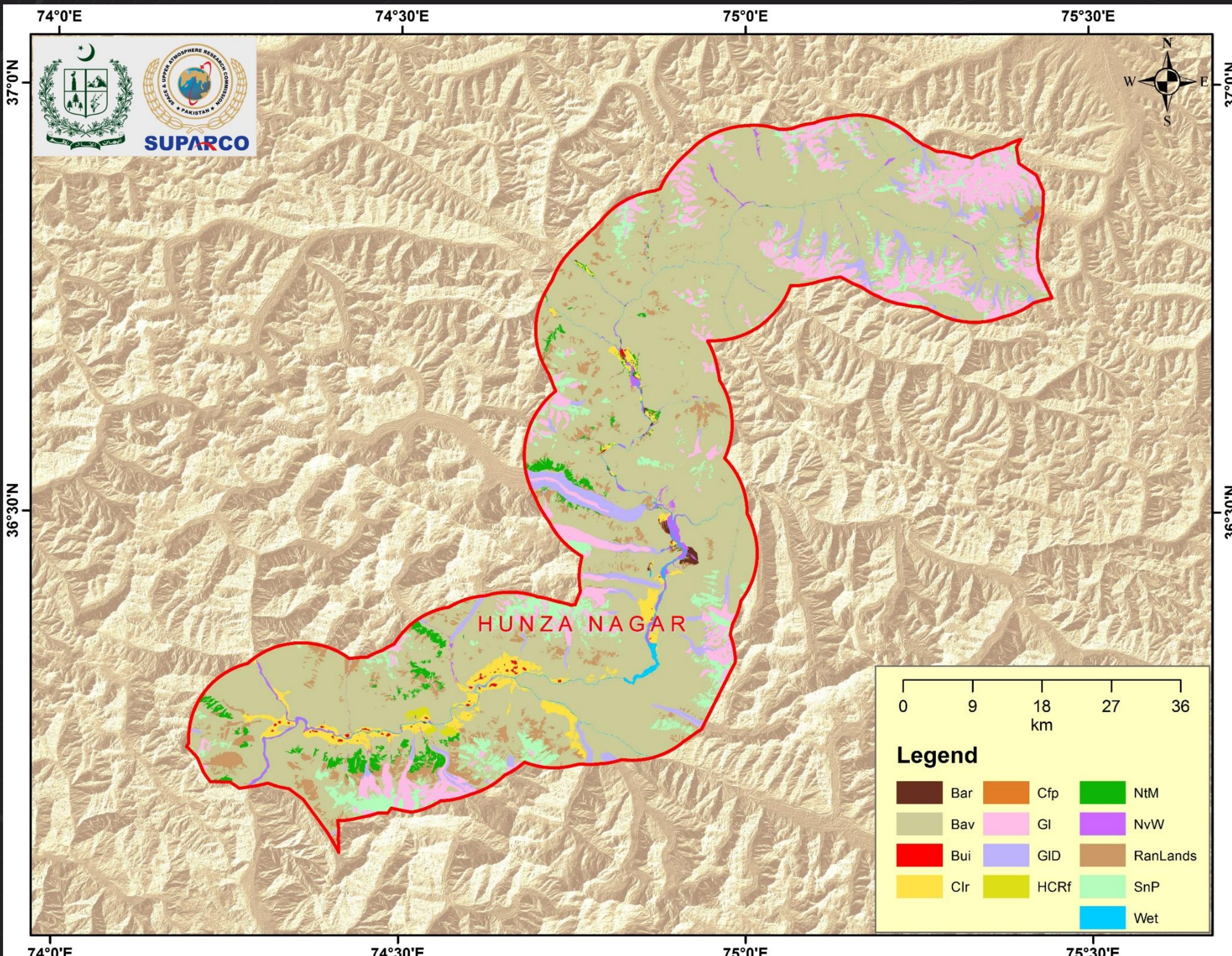


Table 4.3: Total digitized area of study across CPEC in GB with 20 Km buffer

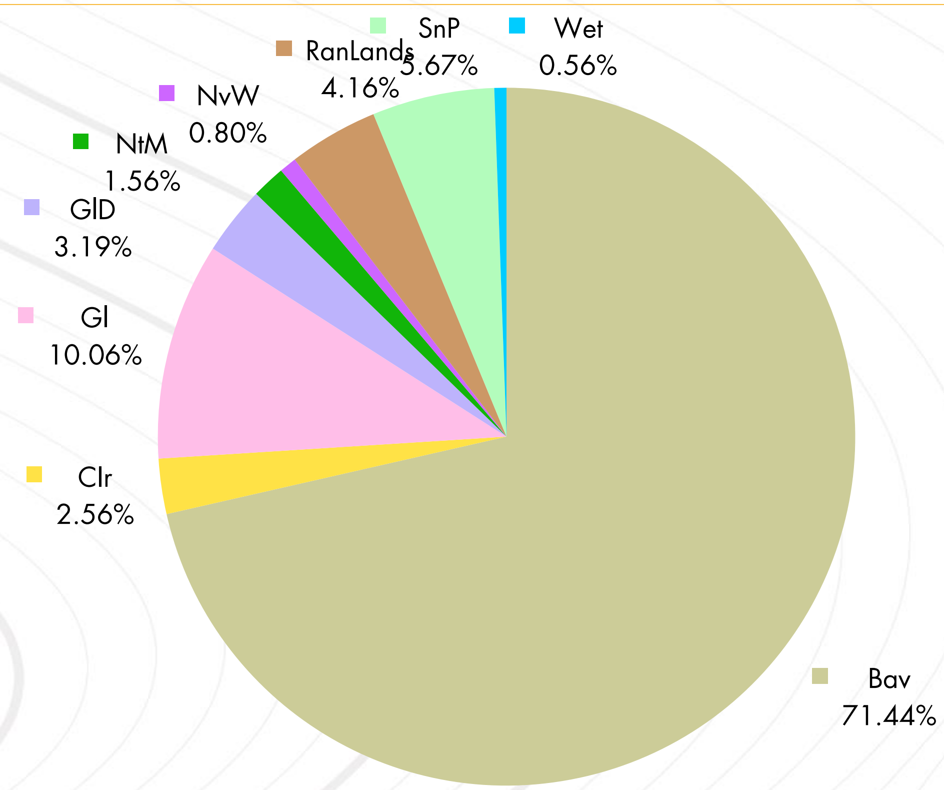
Class Code	Abbreviation	Hunza & Nagar (km²)	Gilgit (km²)	Astore (km²)	Diamer (km²)	Total in %	Total in km²
Bar	Bare Land	5.379	7.828	16.198	20.758	0.66	50.163
Bav	Bare Area with Sparse Natural Vegetation	2554.58	968.545	219.006	1194.92	65.14	4937.06
Bui	Built-up	4.698	22.162	0.046	5.362	0.43	32.268
Cfp	Crop in Flood Plain	0	0.254	0	0	0.01	0.254
CIr	Crop Irrigated	91.605	66.428	9.004	40.568	2.74	207.605
Gl	Glacier	359.902	7.231	0	0	4.84	367.133
GlD	Glacier with Debris	114.07	1.437	0	0	1.52	115.507
HCRf	Herbaceous Crop Rainfed	6.585	9.274	0.004	17.15	0.44	33.013
NtM	Forest – Natural Vegetation and Trees	55.705	81.563	17.029	545.589	9.23	699.886
NvW	Natural Vegetation in Wet Area	28.631	12.39	0.334	6.125	0.63	47.48
RanLands	Range Land	148.691	168.693	50.052	468.889	11.04	836.325
SnP	Snow Permanent	202.838	2.605	0	0	2.7	205.443
Wet	Wet Areas	20.044	8.992	2.867	14.776	0.62	46.679
Grand Total (km²)							**7578.814**

Land Use Land Cover (LULC) Classification of Hunza and Nagar Districts



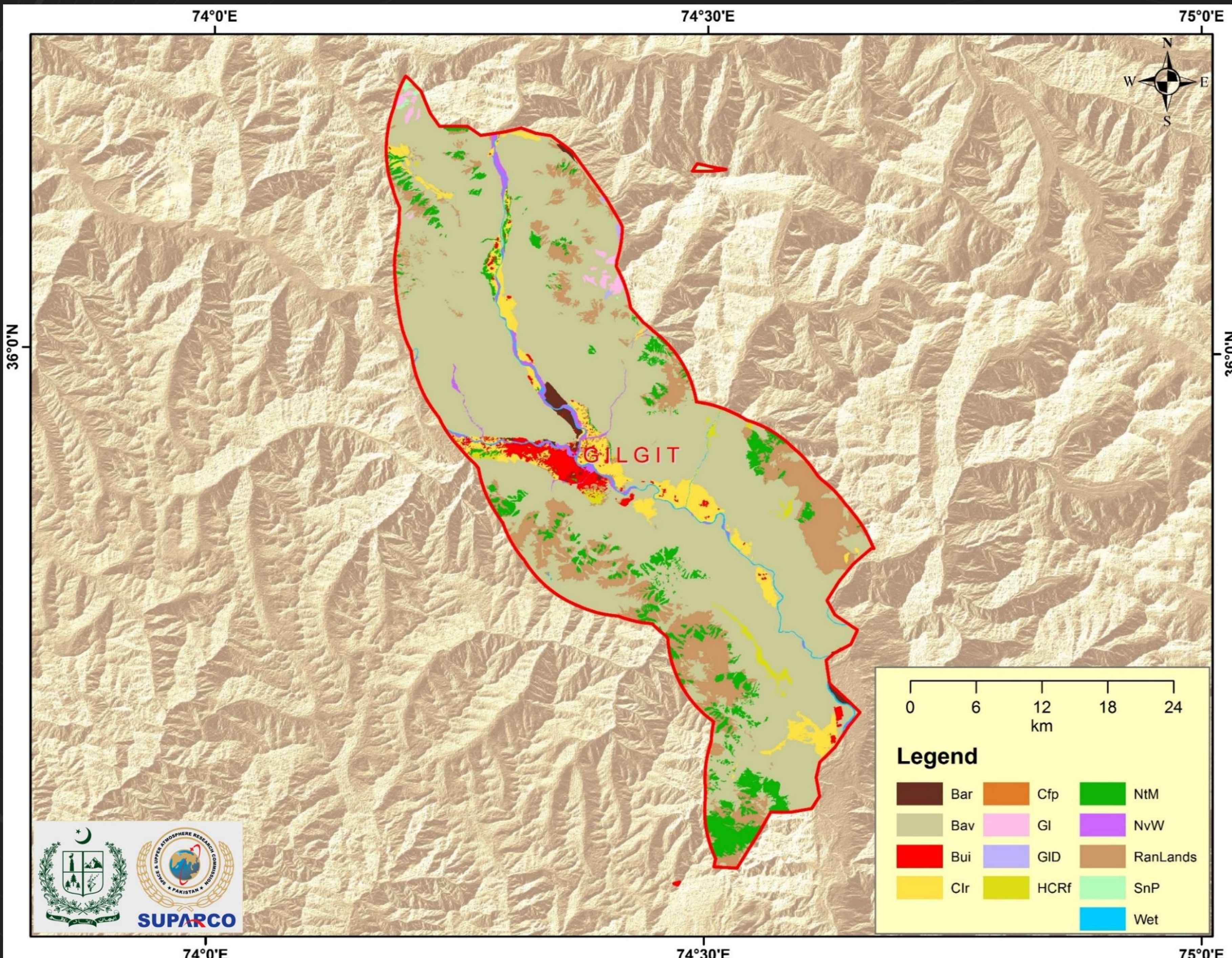
LULC Statistic of Hunza and Nagar District

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0.15	5.379
Bav		Bare Area with Sparse Natural Vegetation	71.44	2554.584
Bui		Built-up	0.13	4.698
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	2.56	91.605
Gl		Glacier	10.06	359.902
GlD		Glacier with Debris	3.19	114.070
HCRf		Herbaceous Crop Rainfed	0.18	6.585
NtM		Forest – Natural Vegetation and Trees	1.56	55.705
NvW		Natural Vegetation in Wet Area	0.80	28.631
RanLands		Range Land	4.16	148.691
SnP		Snow Permanent	5.67	202.838
Wet		Wet Areas	0.56	20.044
		Total Area (Sq km)		**3592.732**



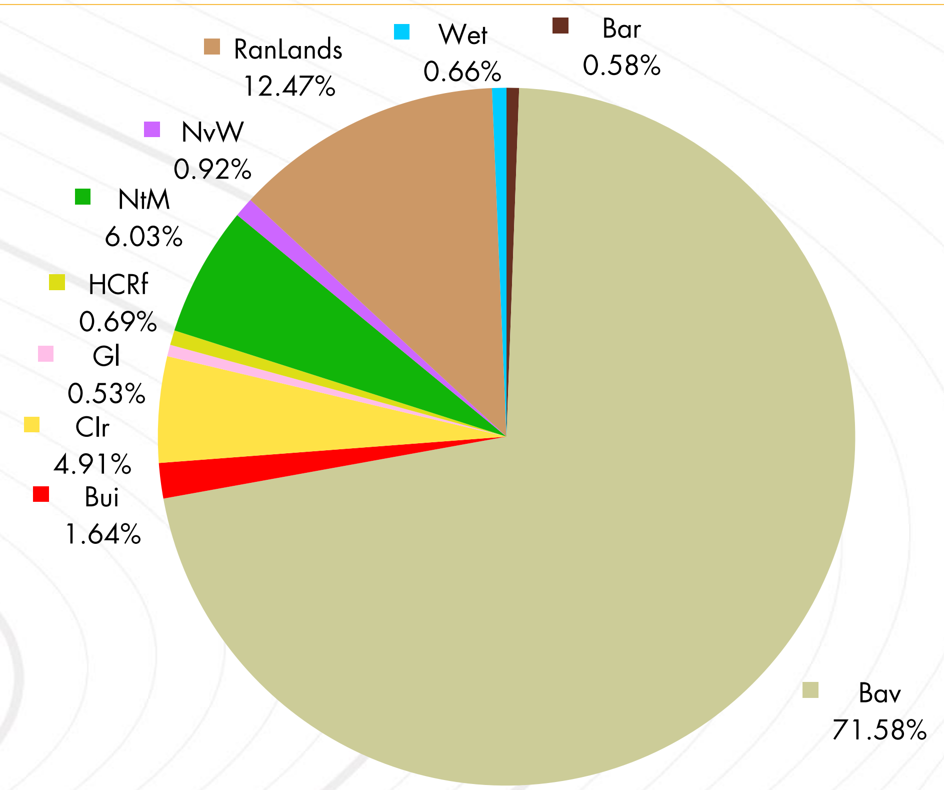
***Note:** Area less than 0.5% is not shown in graph.*

Land Use Land Cover (LULC) Classification of Gilgit District



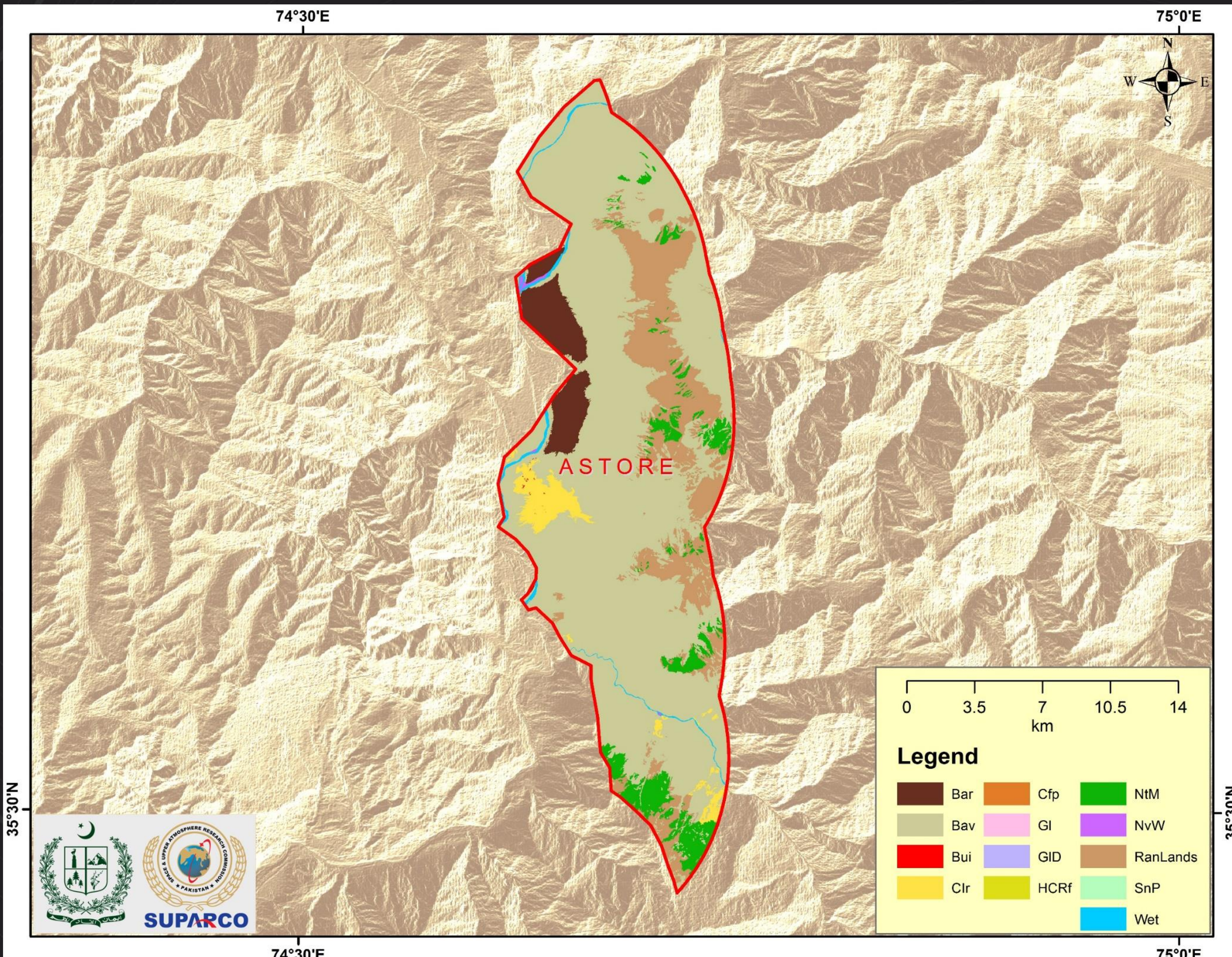
LULC Statistic of Gilgit District

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0.58	7.828
Bav		Bare Area with Sparse Natural Vegetation	71.58	968.545
Bui		Built-up	1.64	22.162
Cfp		Crop in Flood Plain	0.02	0.254
Clr		Crop Irrigated	4.91	66.428
Gl		Glacier	0.53	7.231
GlD		Glacier with Debris	0.11	1.437
HCRf		Herbaceous Crop Rainfed	0.68	9.274
NtM		Forest – Natural Vegetation and Trees	6.01	81.563
NvW		Natural Vegetation in Wet Area	0.91	12.390
RanLands		Range Land	12.47	168.693
SnP		Snow Permanent	0.19	2.605
Wet		Wet Areas	0.66	8.992
Total Area (Sq km)				**1357.402**



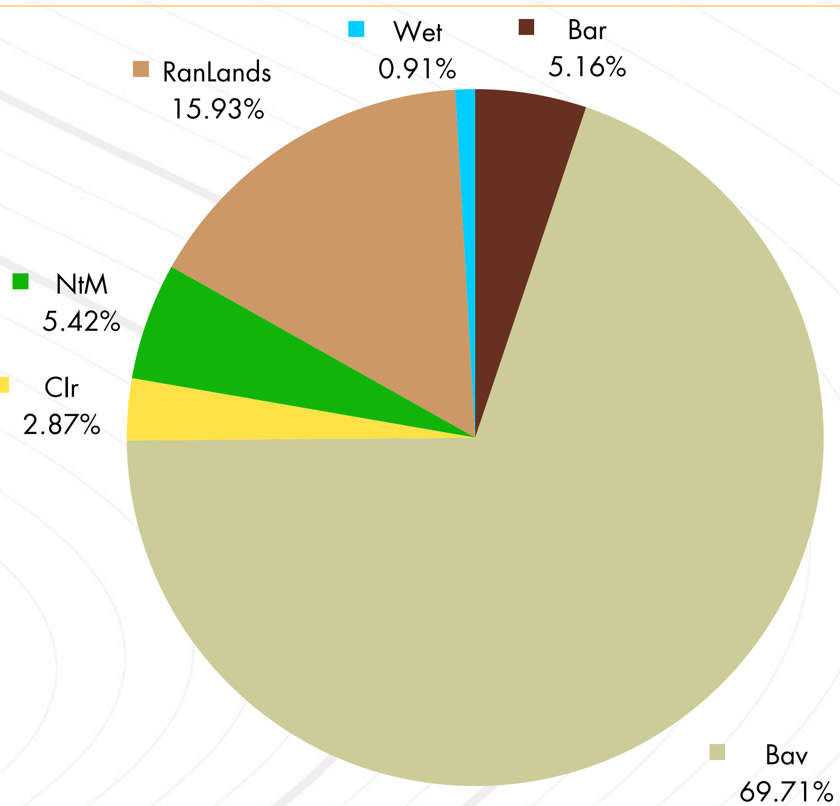
Note: *Area less than 0.5% is not shown in graph.*

Land Use Land Cover (LULC) Classification of Astore District



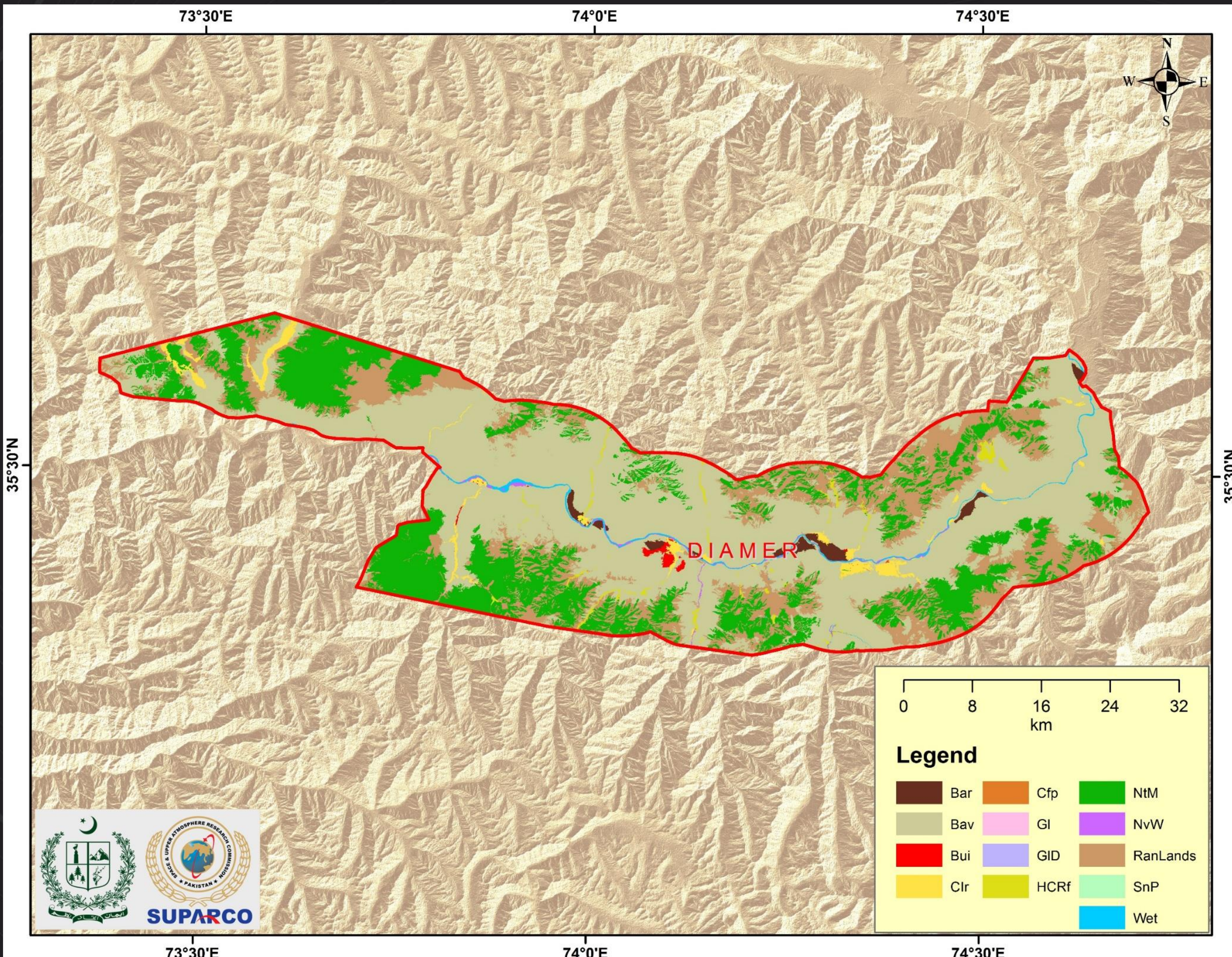
LULC Statistic of Astore District

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	5.17	16.198
Bav		Bare Area with Sparse Natural Vegetation	69.71	219.006
Bui		Built-up	0.01	0.046
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	2.87	9.004
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	5.42	17.029
NvW		Natural Vegetation in Wet Area	0.11	0.334
RanLands		Range Land	15.93	50.052
SnP		Snow Permanent	0	0
Wet		Wet Areas	0.91	2.867
Total Area (Sq km)				**314.536**



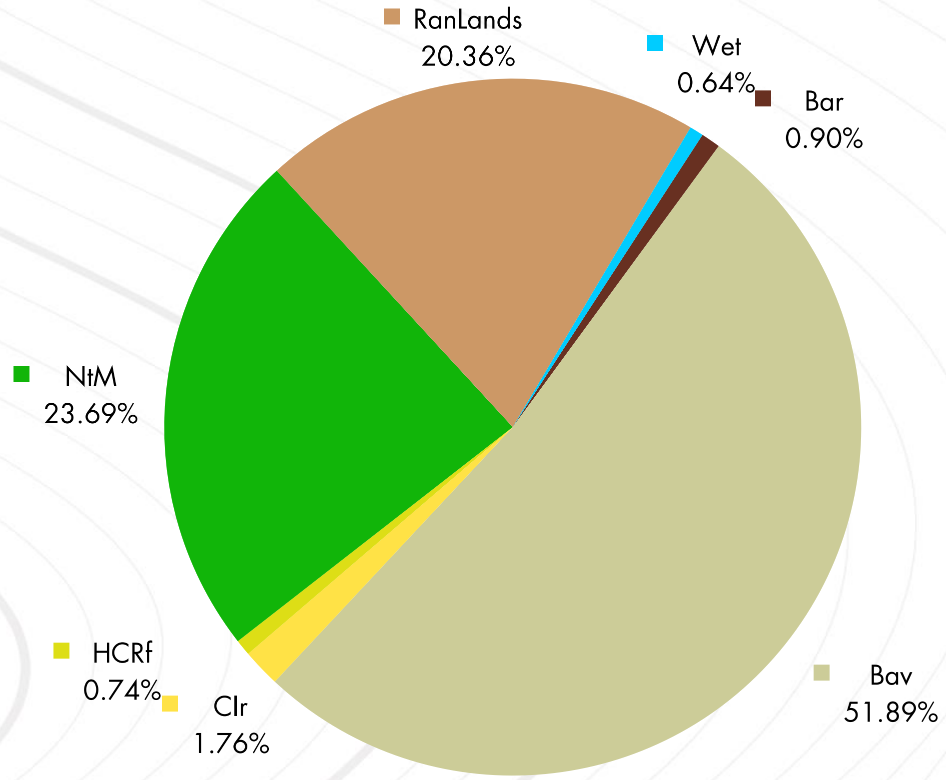
Note: *Area less than 0.5% is not shown in graph.*

Land Use Land Cover (LULC) Classification of Diamer District



LULC Statistic of Diamer District

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0.90	20.758
Bav		Bare Area with Sparse Natural Vegetation	51.89	1194.923
Bui		Built-up	0.23	5.362
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	1.75	40.568
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0.74	17.150
NtM		Forest – Natural Vegetation and Trees	23.69	545.589
NvW		Natural Vegetation in Wet Area	0.26	6.125
RanLands		Range Land	20.36	468.889
SnP		Snow Permanent	0	0
Wet		Wet Areas	0.64	14.776
		Total Area (Sq km)		**2314.141**

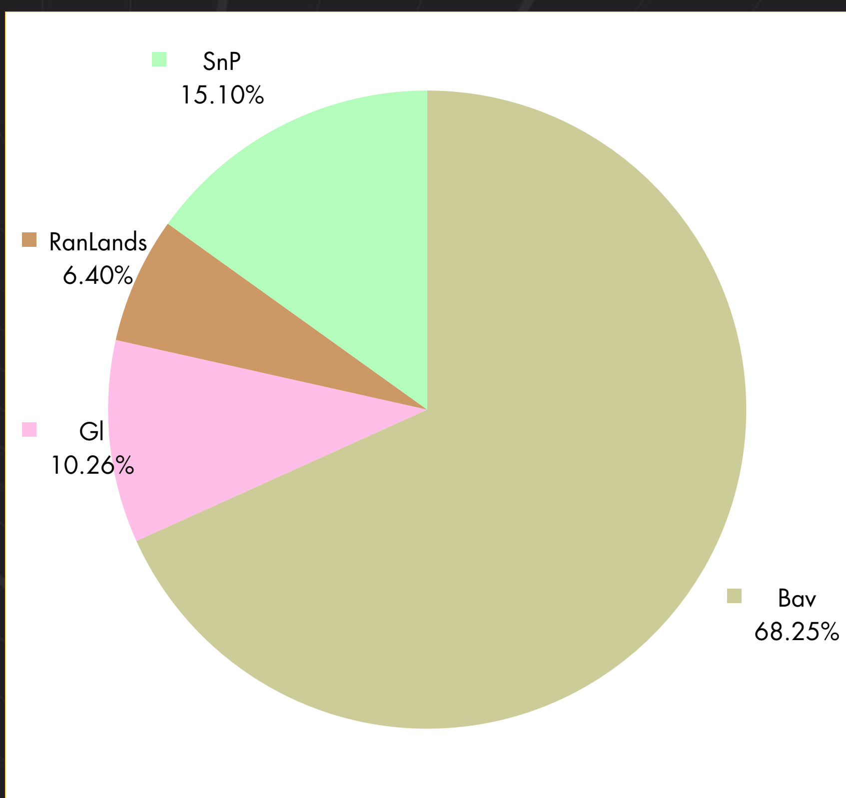


Note: *Area less than 0.5% is not shown in graph.*

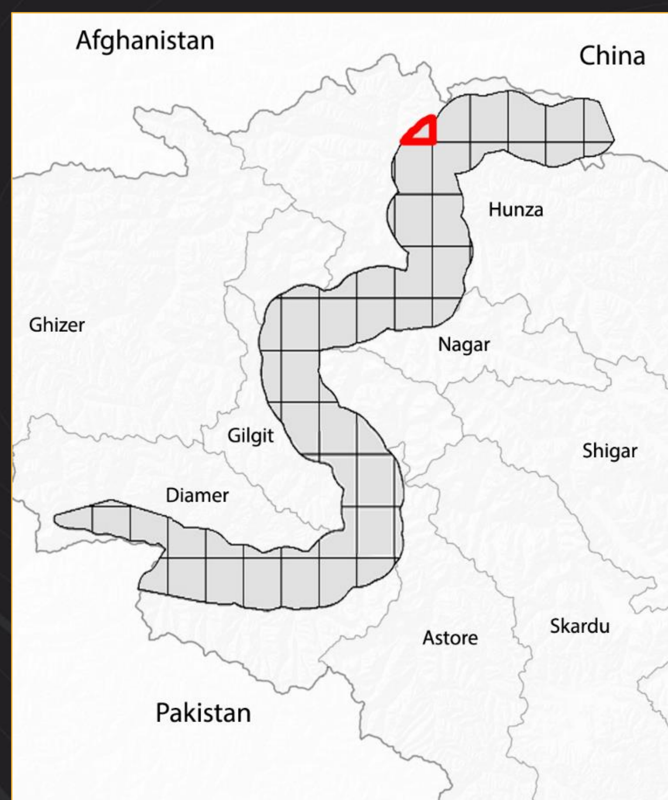
Land Use and Land Cover (LULC) Statistics Map of Zone 01

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0.07	0.035
Bav		Bare Area with Sparse Natural Vegetation	68.25	35.083
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	10.26	5.272
GlD		Glacier with Debris	0.07	0.037
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0.08	0.041
NvW		Natural Vegetation in Wet Area	0.21	0.107
RanLands		Range Land	6.40	3.288
SnP		Snow Permanent	15.10	7.763
Wet		Wet Areas	0.04	0.022
Total Area (Sq km)				**51.648**

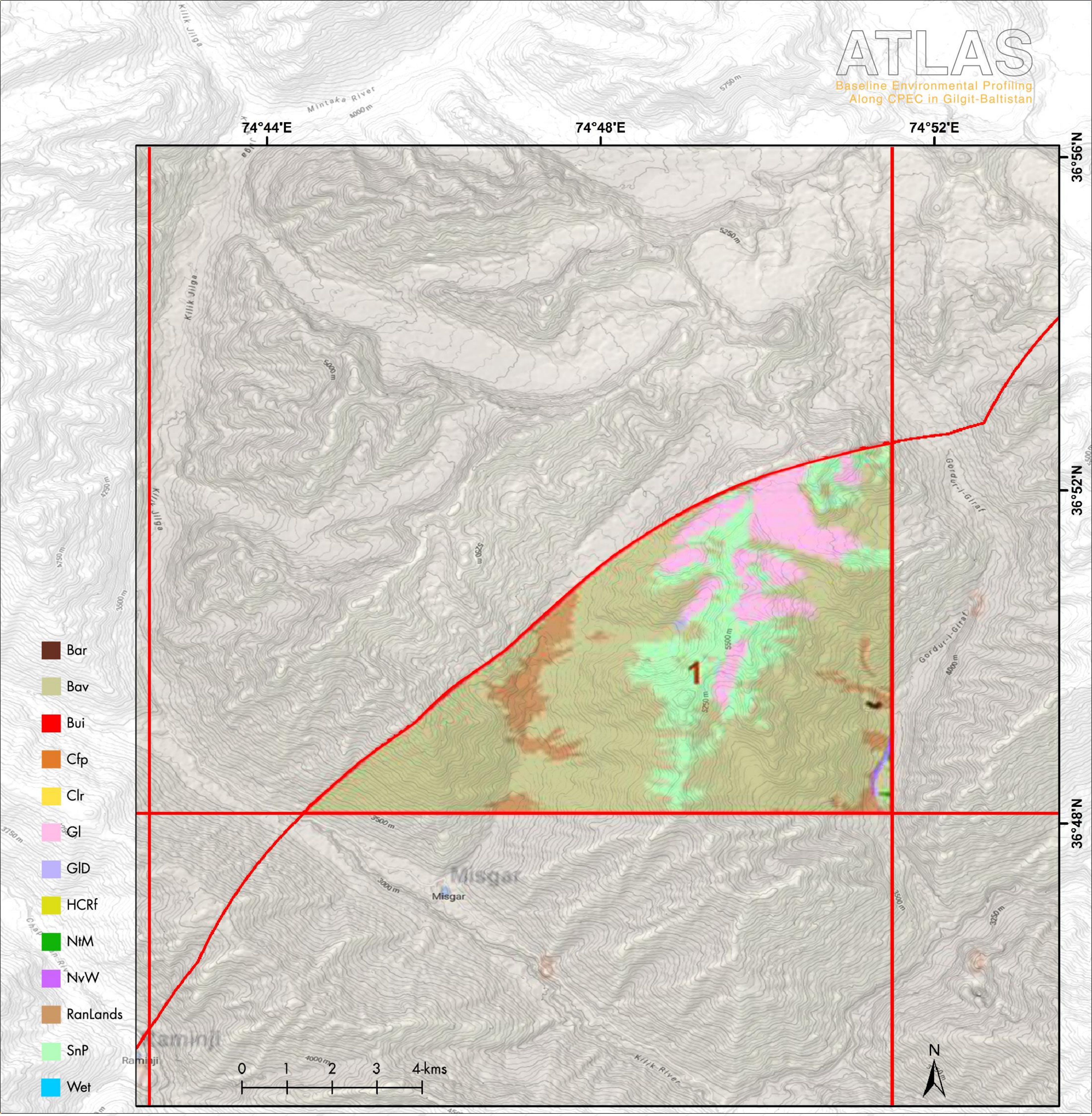
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



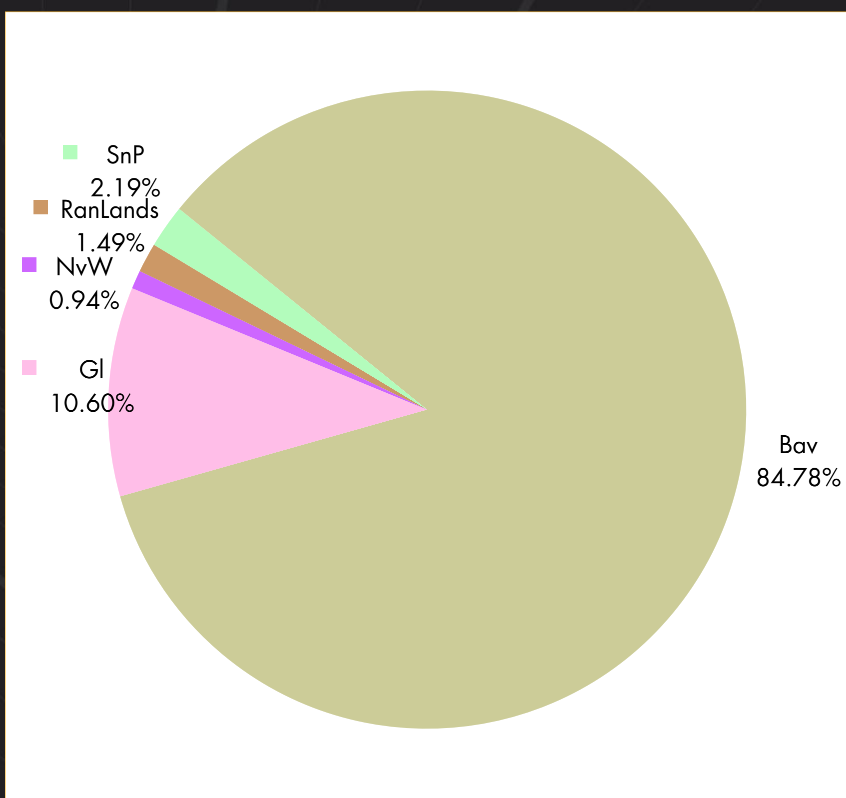
Map zone on the facing page.


74°44'E
74°48'E
74°52'E
36°56'N
36°52'N
36°48'N
Killk Jilga
Mintaka River
Gordur-i-Giraf
Misgar
Raminji
Kilik River
1
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

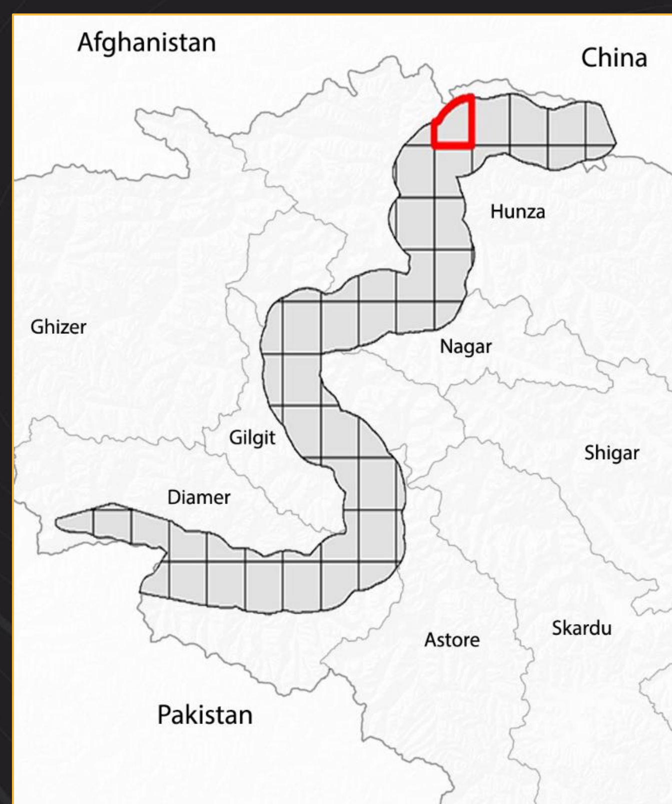
Land Use and Land Cover (LULC) Statistics Map of Zone 02

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0.01	0.014
Bav		Bare Area with Sparse Natural Vegetation	84.78	153.807
Bui		Built-up	0.01	0.011
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	10.60	19.231
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0.03	0.058
NvW		Natural Vegetation in Wet Area	0.94	1.698
RanLands		Range Land	1.49	2.704
SnP		Snow Permanent	2.19	3.978
Wet		Wet Areas	0.19	0.351
Total Area (Sq km)				**181.852**

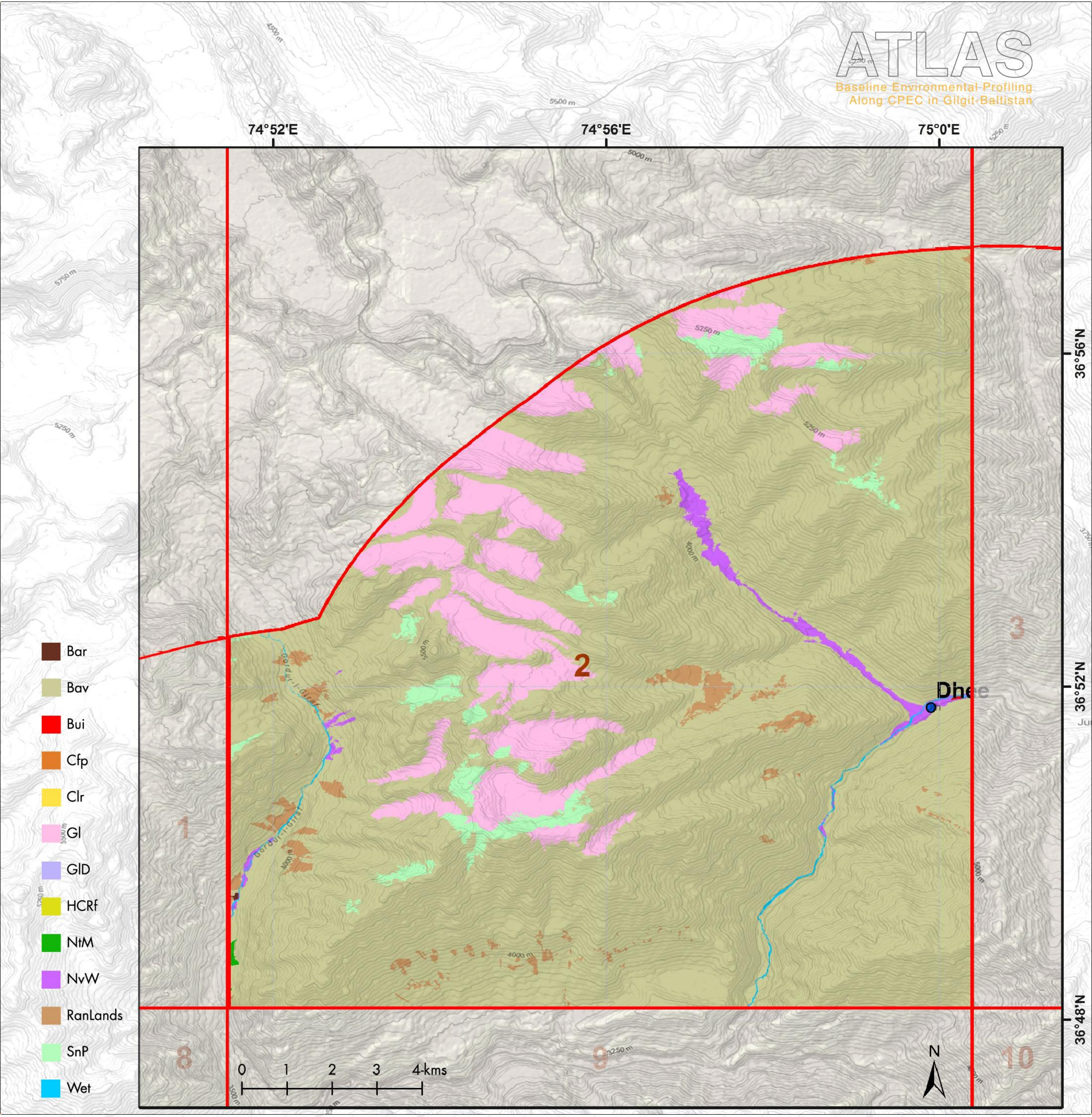
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

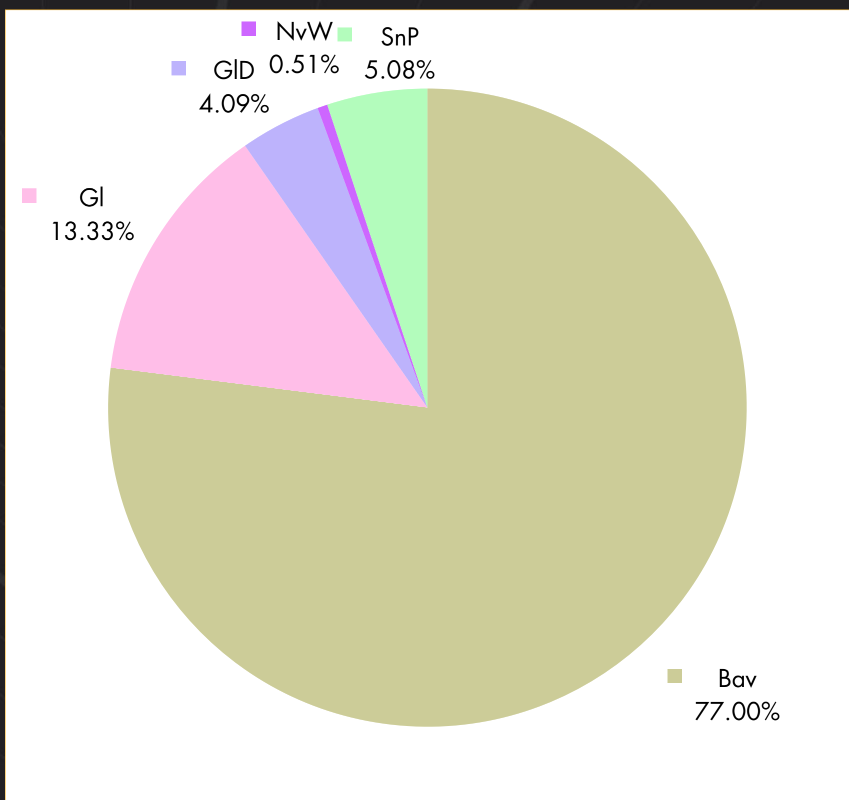


ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
74°52'E
74°56'E
75°0'E
36°56'N
36°52'N
36°48'N
2
1
3
8
9
10
Dhee
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4 kms
N

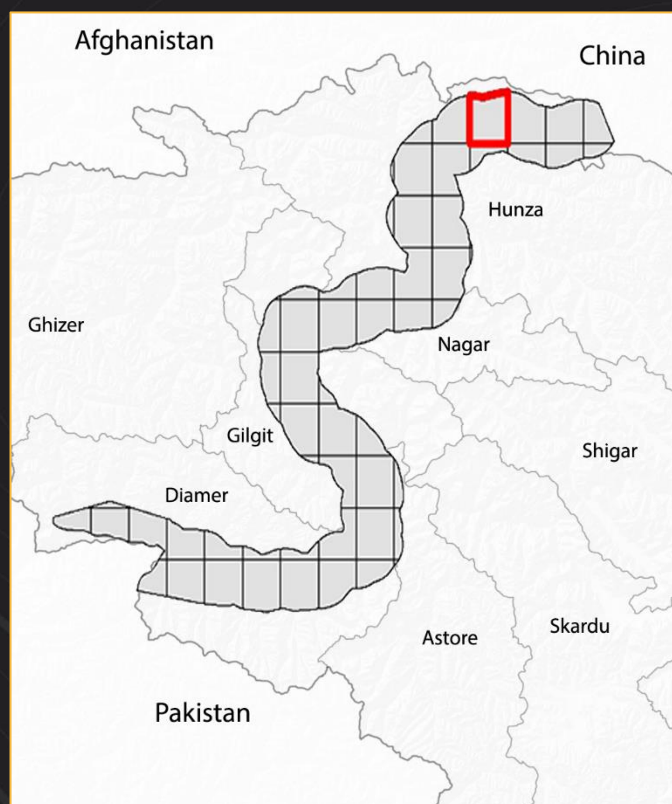
Land Use and Land Cover (LULC) Statistics Map of Zone 03

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	77.00	174.049
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	13.33	30.123
GlD		Glacier with Debris	4.09	9.245
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0.03	0.059
NvW		Natural Vegetation in Wet Area	0.51	1.149
RanLands		Range Land	0.22	0.506
SnP		Snow Permanent	5.08	11.483
Wet		Wet Areas	0.24	0.539
Total Area (Sq km)				**227.153**

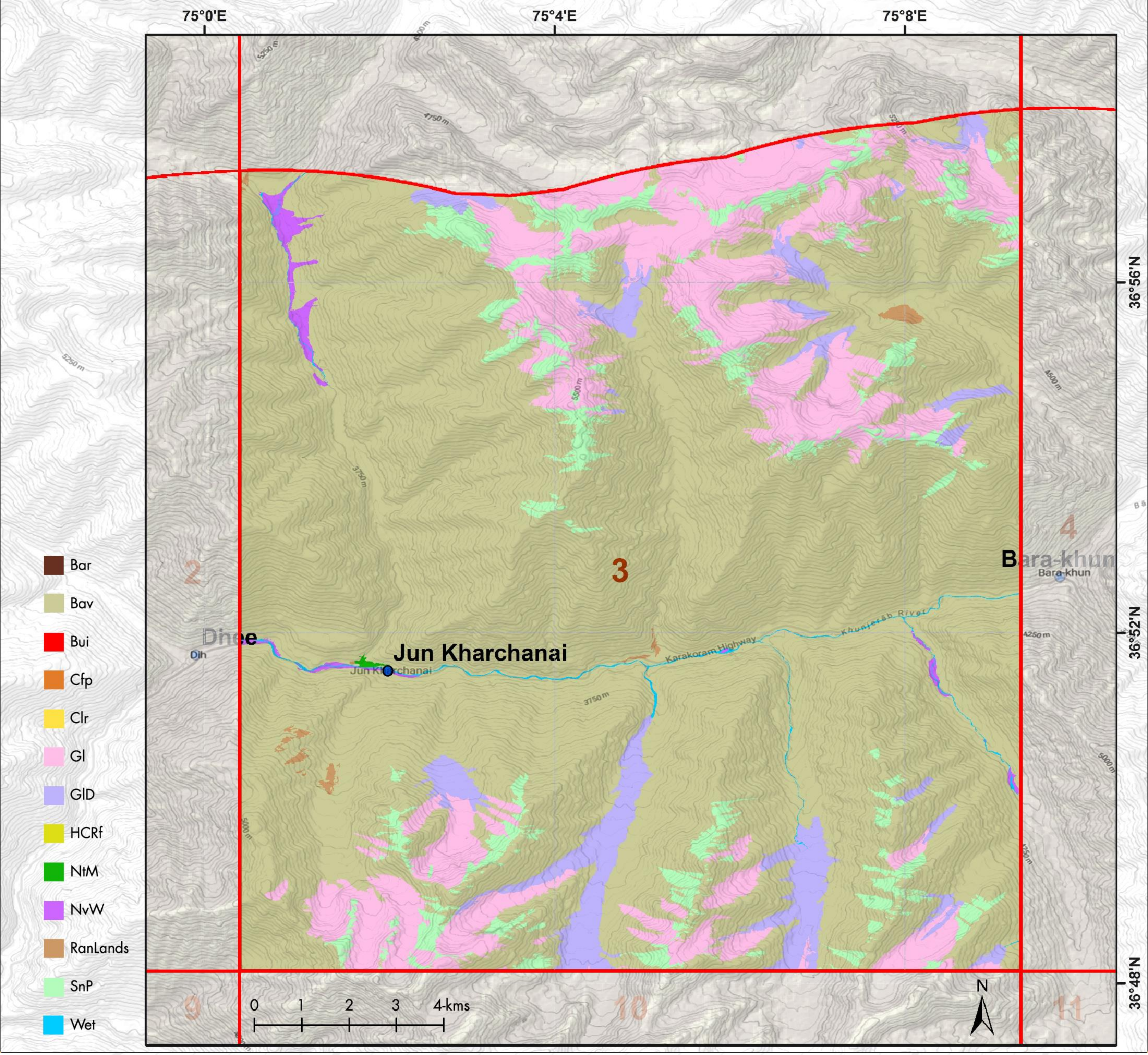
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



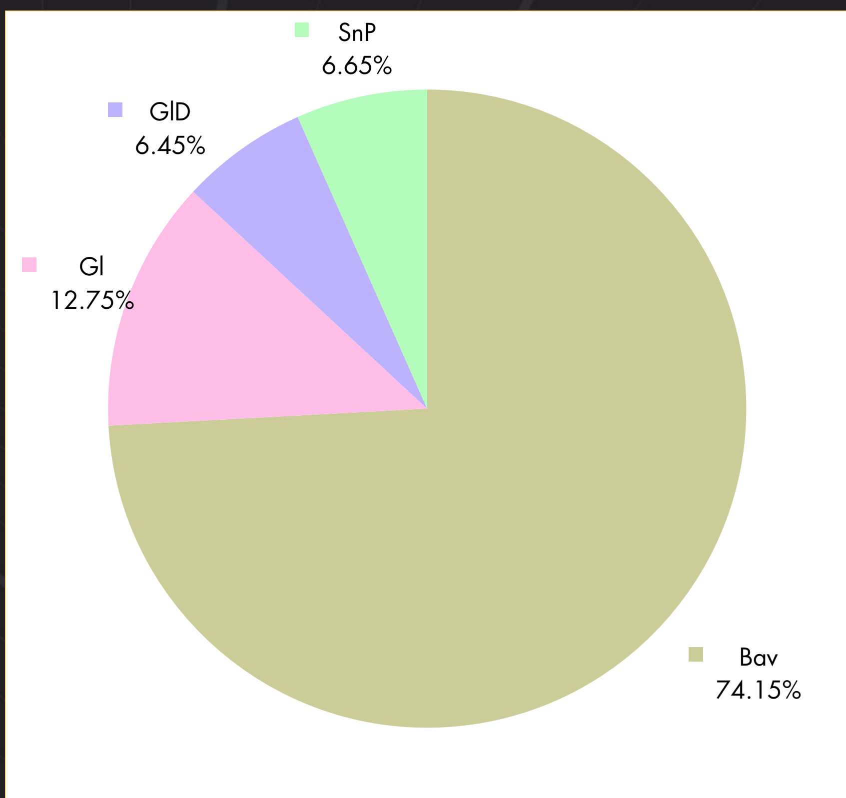
Map zone on the facing page.


75°0'E
75°4'E
75°8'E
36°56'N
36°52'N
36°48'N
2
3
4
9
10
11
Dhee
Dih
Jun Kharchanai
Jun Kharchanai
Bara-khun
Bara-khun
Karakoram Highway
Khunjerab River
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

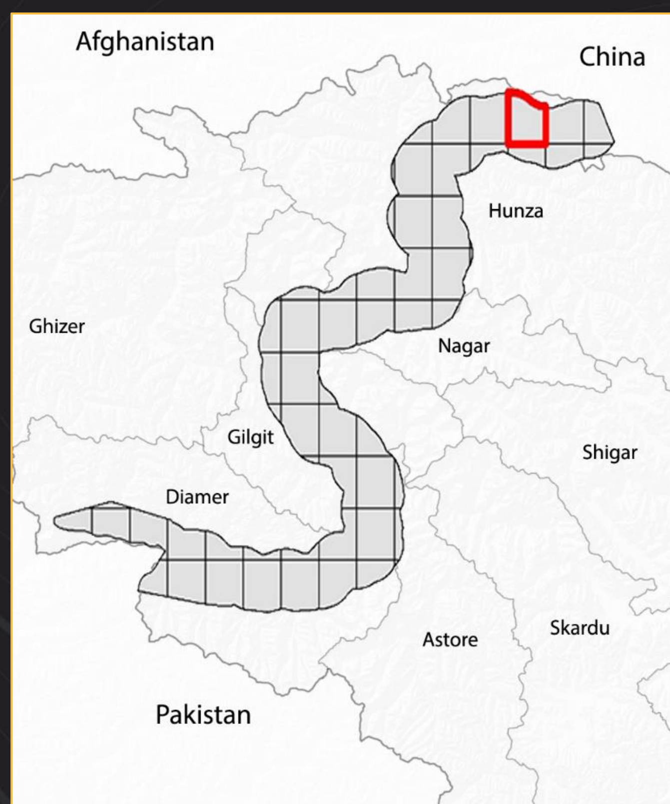
Land Use and Land Cover (LULC) Statistics Map of Zone 04

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	74.15	155.473
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	0	0
Gl		Glacier	12.75	26.724
GlD		Glacier with Debris	6.45	13.530
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0	0
NvW		Natural Vegetation in Wet Area	0.41	0.862
RanLands		Range Land	0.13	0.271
SnP		Snow Permanent	6.59	13.947
Wet		Wet Areas	0.37	0.780
Total Area (Sq km)				**211.587**

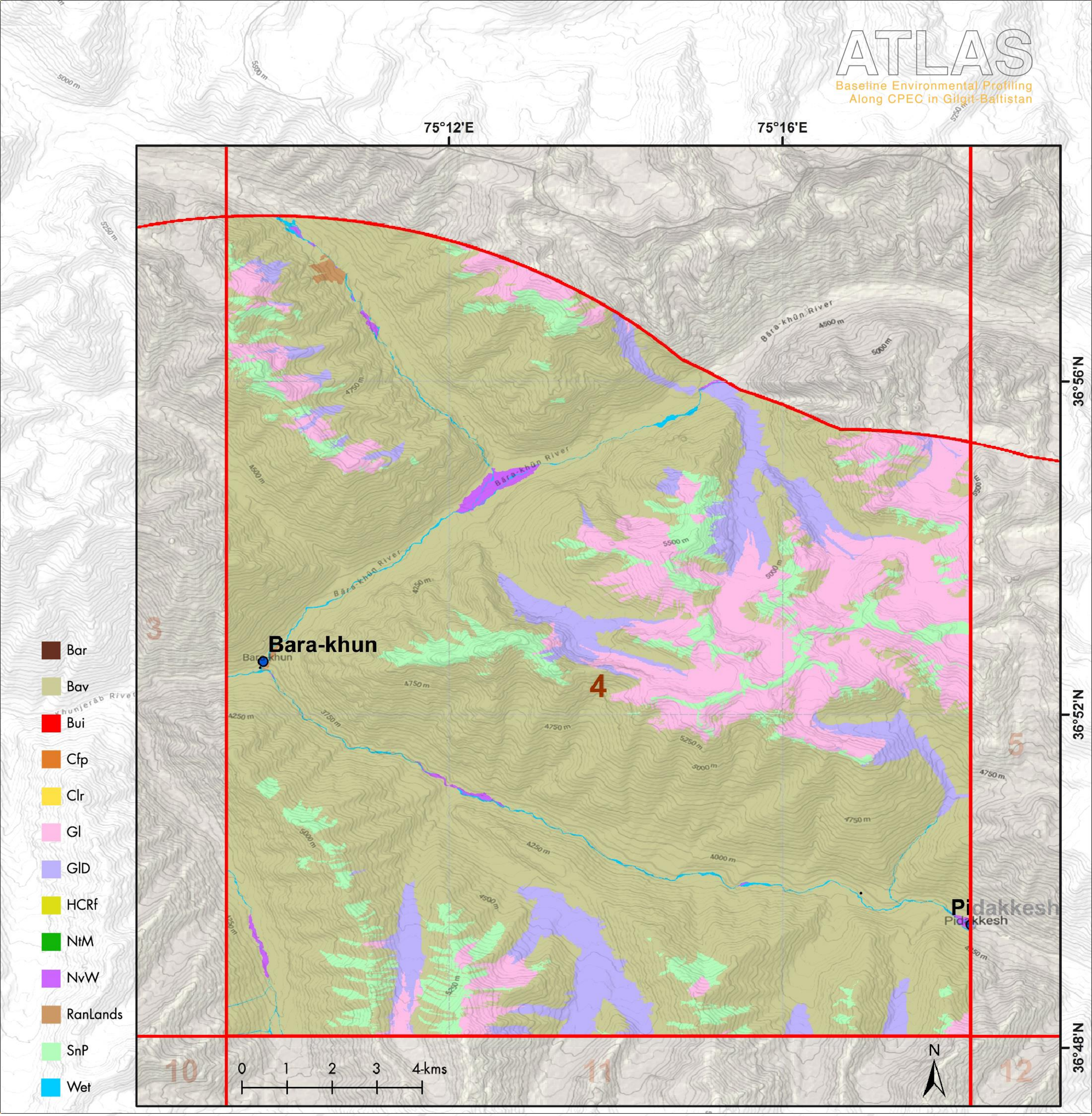
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



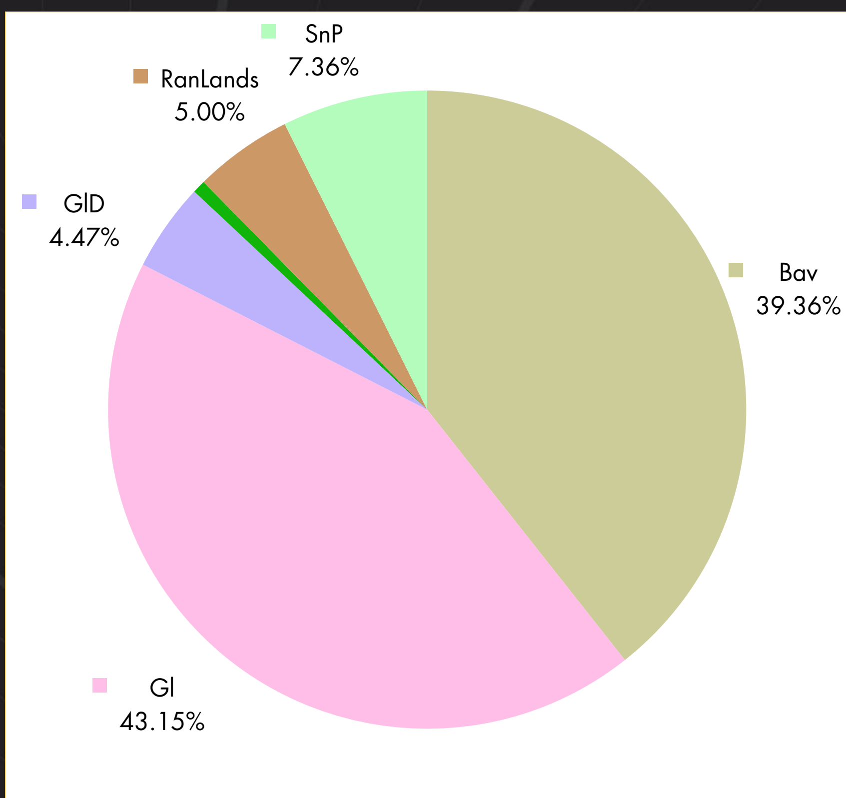
Map zone on the facing page.


75°12'E
75°16'E
36°56'N
36°52'N
36°48'N
Bara-khun
Pidakkesh
Bāra-khūn River
4
3
5
10
11
12
0 1 2 3 4-kms
N
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet

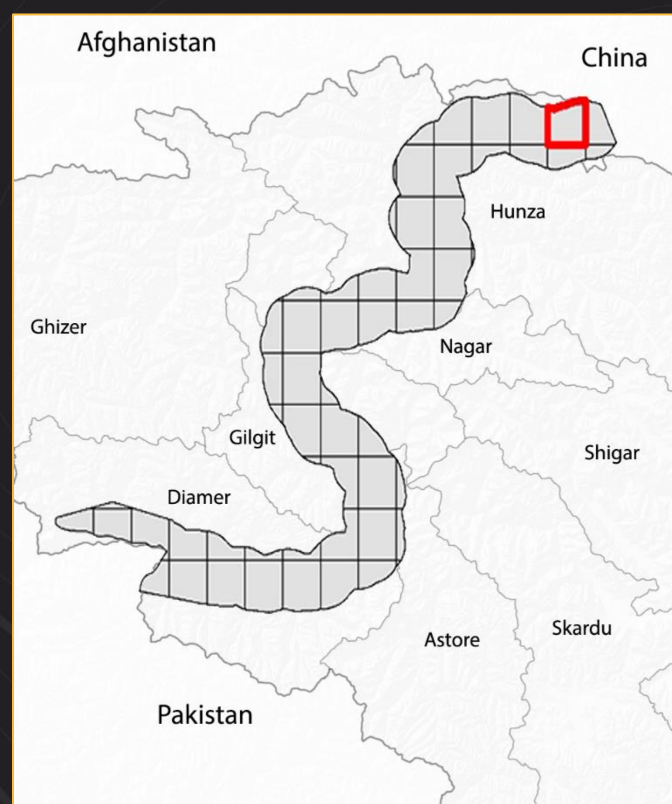
Land Use and Land Cover (LULC) Statistics Map of Zone 05

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	39.36	73.869
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	43.15	80.979
GlD		Glacier with Debris	4.45	8.387
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0.66	1.241
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	5.00	9.380
SnP		Snow Permanent	7.36	13.819
Wet		Wet Areas	0.40	0.753
Total Area (Sq km)				**188.428**

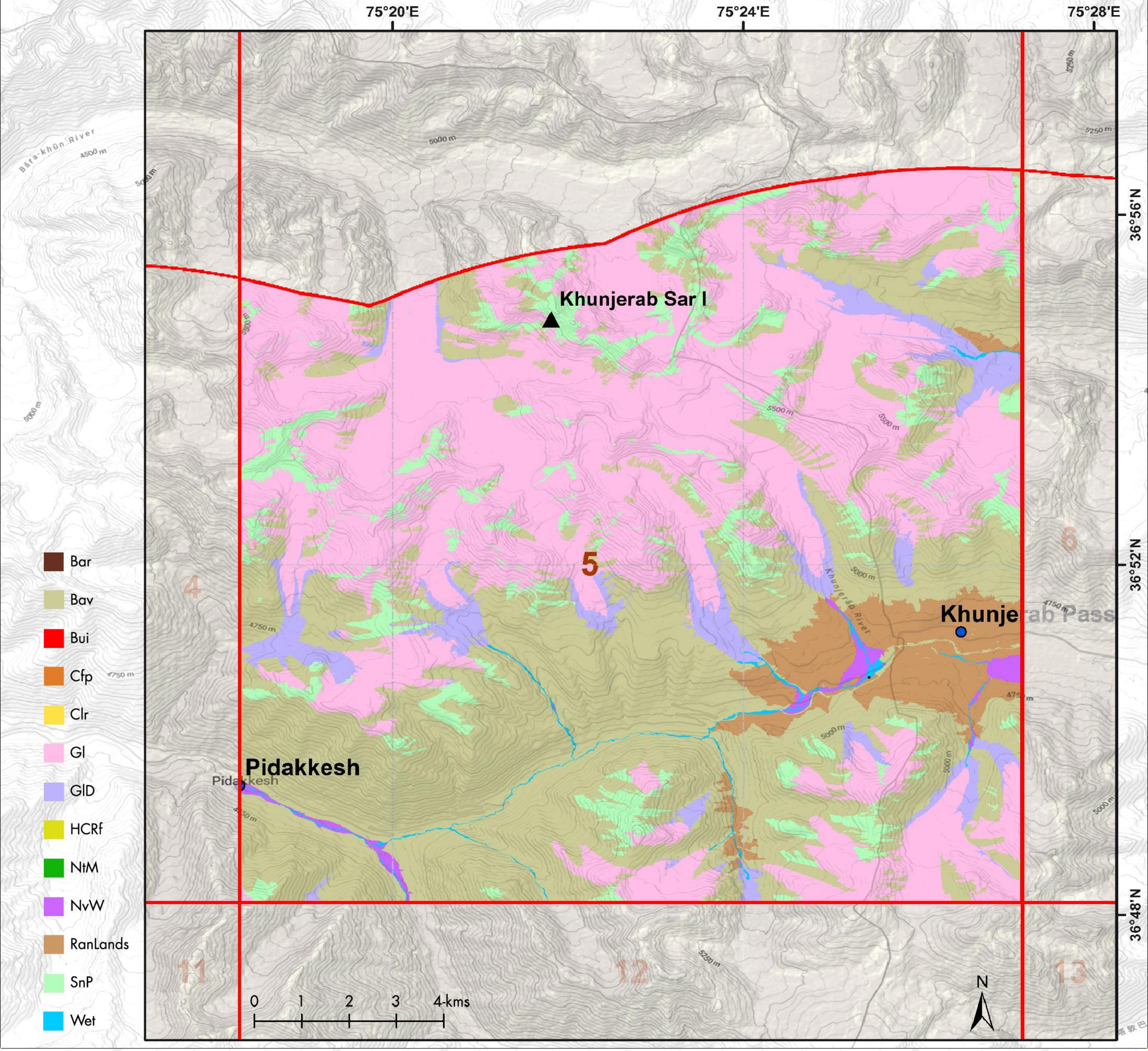
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



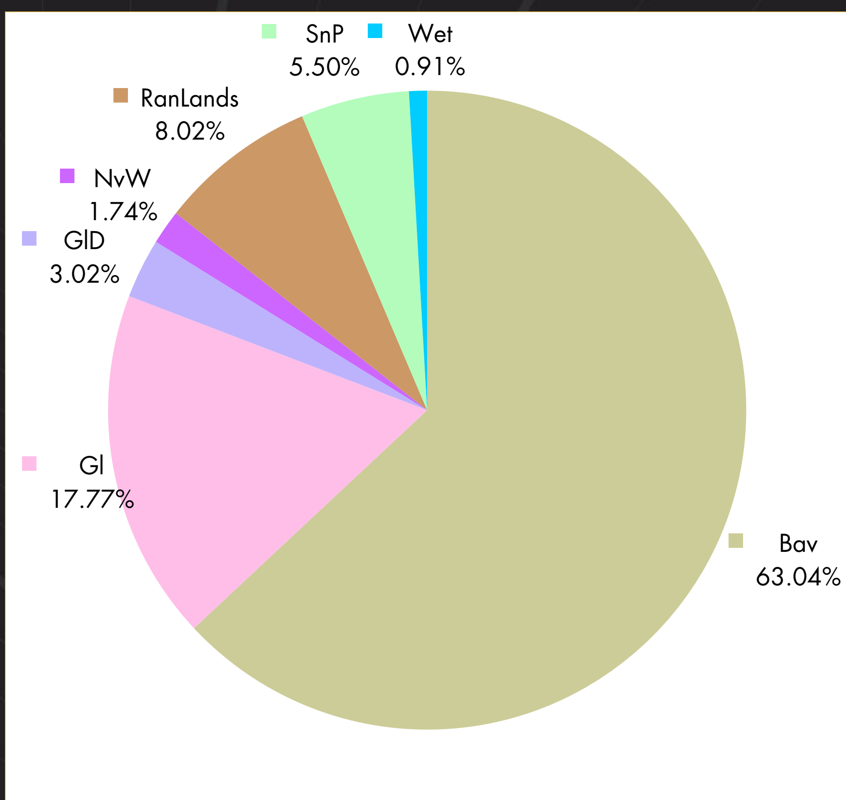
Map zone on the facing page.


75°20'E
75°24'E
75°28'E
36°56'N
36°52'N
36°48'N
Khunjerab Sar I
5
Khunjerab Pass
Pidakkesh
4
6
11
12
13
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

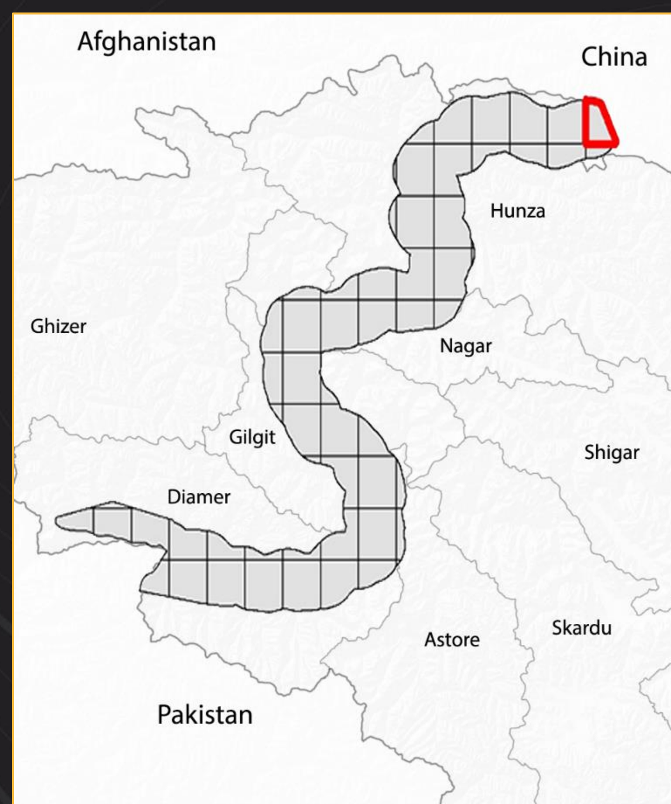
Land Use and Land Cover (LULC) Statistics Map of Zone 06

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	63.04	75.749
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	0	0
Gl		Glacier	17.77	21.348
GlD		Glacier with Debris	3.02	3.635
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0	0
NvW		Natural Vegetation in Wet Area	1.74	2.088
RanLands		Range Land	8.02	9.635
SnP		Snow Permanent	5.50	6.610
Wet		Wet Areas	0.91	1.093
Total Area (Sq km)				**120.158**

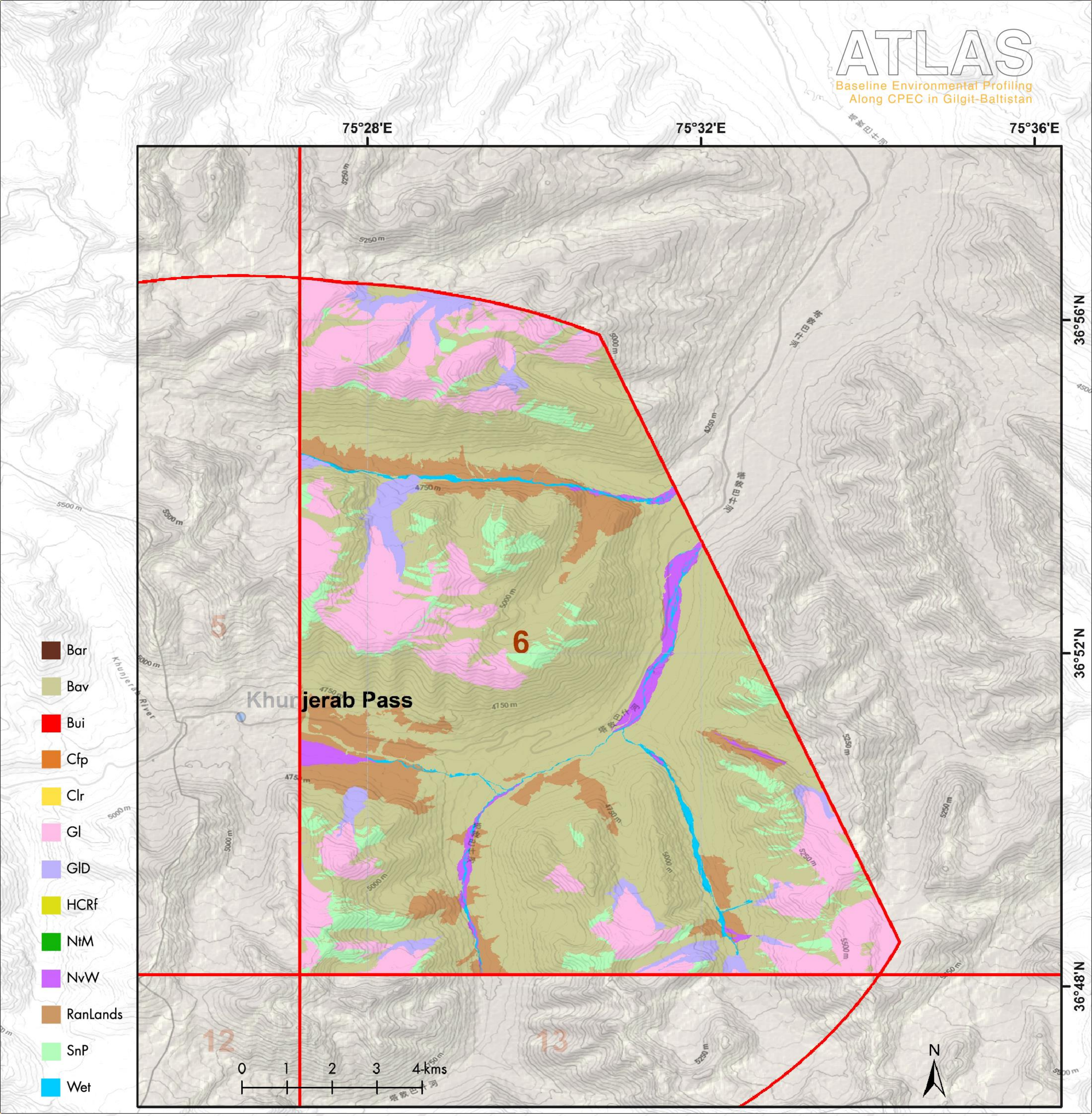
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

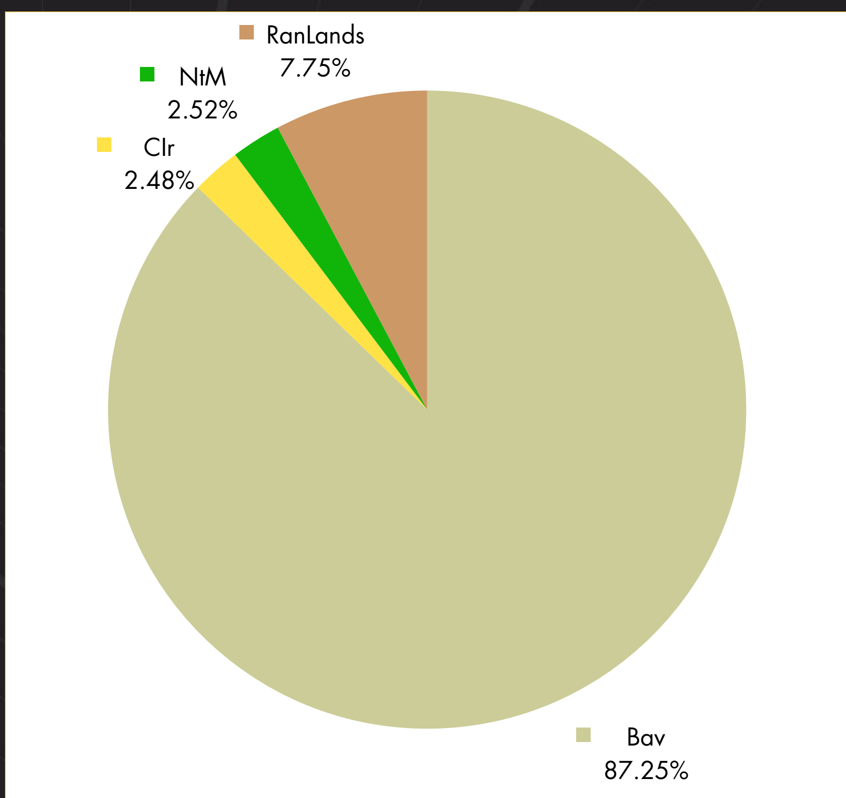


ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
75°28'E
75°32'E
75°36'E
36°56'N
36°52'N
36°48'N
5
6
12
13
Khunjerab Pass
Khunjerab River
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4 kms
N

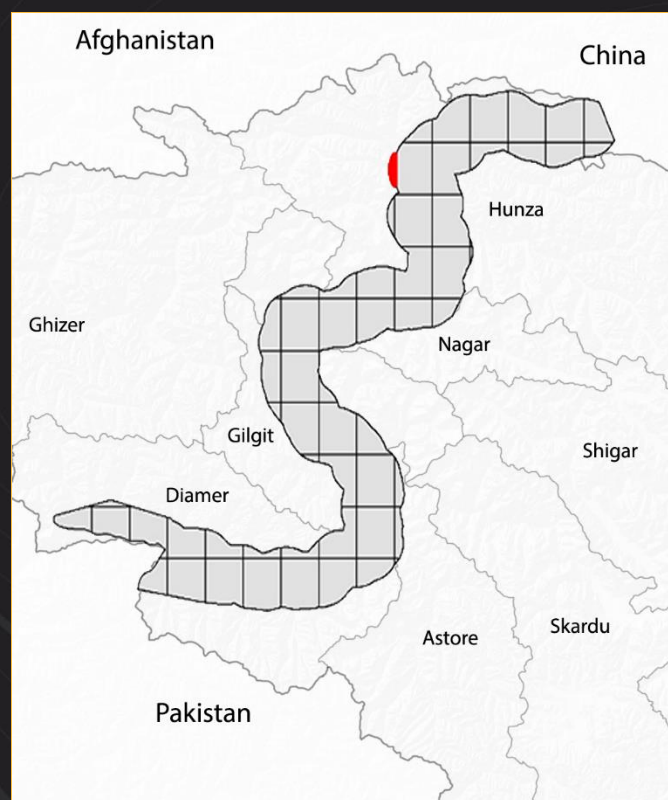
Land Use and Land Cover (LULC) Statistics Map of Zone 07

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	87.25	6.949
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	2.47	0.197
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	2.51	0.201
NvW		Natural Vegetation in Wet Area	0.07	0.005
RanLands		Range Land	7.75	0.618
SnP		Snow Permanent	0	0
Wet		Wet Areas	0.17	0.014
Total Area (Sq km)				**7.984**

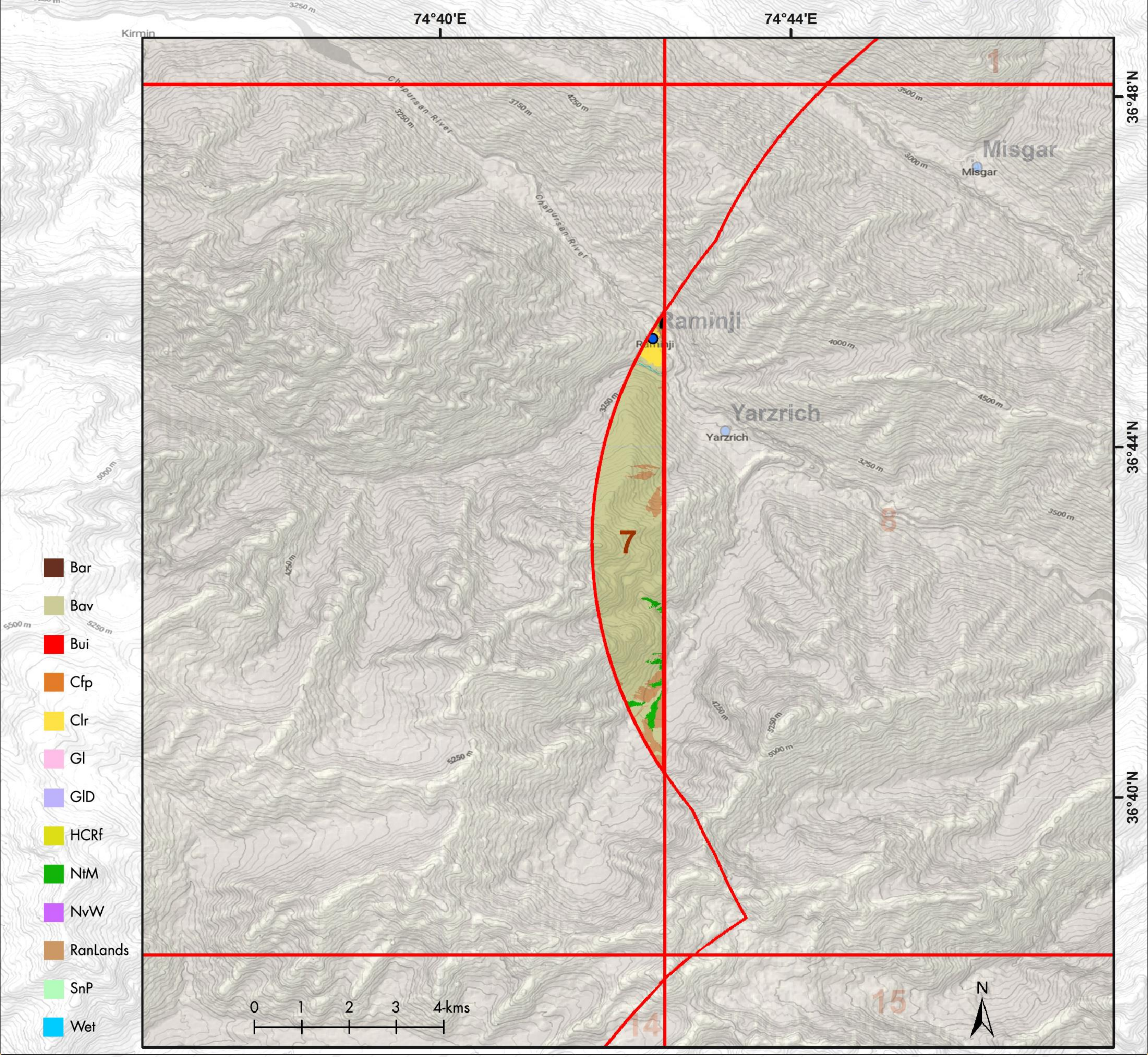
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



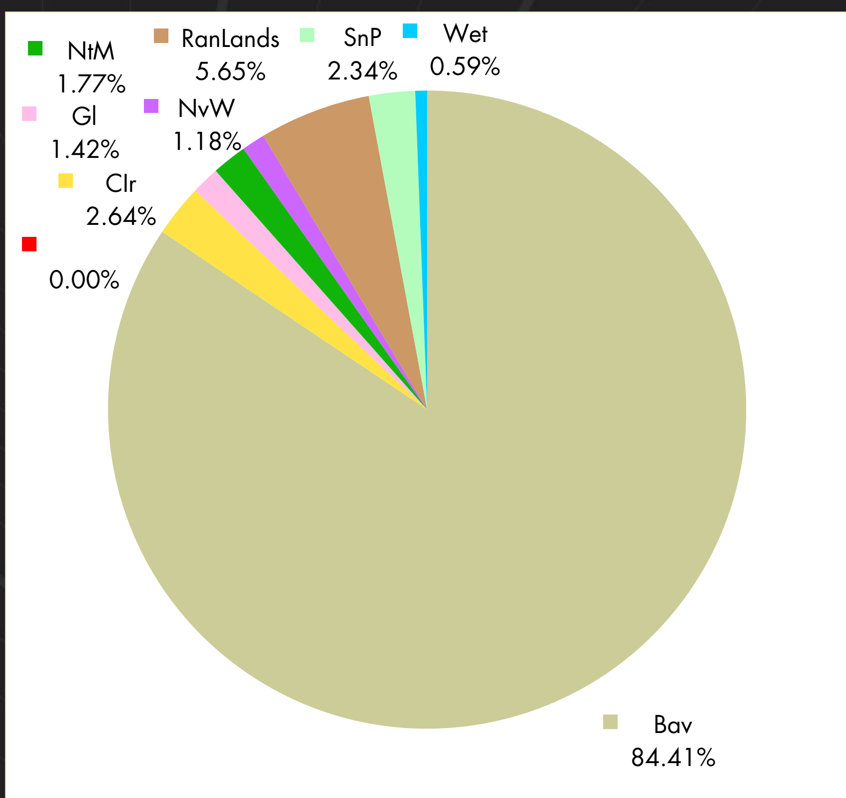
Map zone on the facing page.


74°40'E
74°44'E
36°48'N
36°44'N
36°40'N
Kirmin
Chapursan River
Misgar
Raminji
Yarzrich
1
7
8
14
15
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4 kms
N

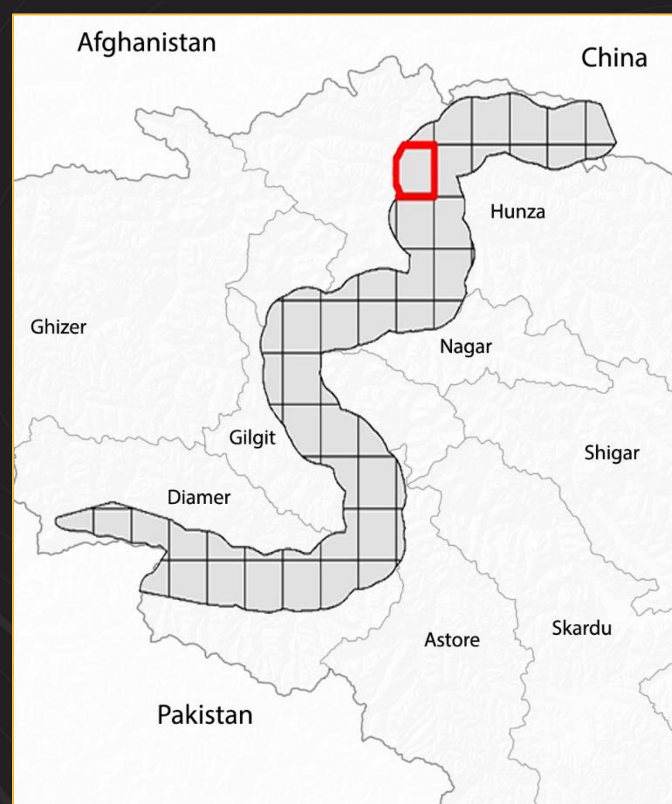
Land Use and Land Cover (LULC) Statistics Map of Zone 08

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0.20	0.471
Bav		Bare Area with Sparse Natural Vegetation	84.41	197.507
Bui		Built-up	0.24	0.569
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	2.63	6.179
Gl		Glacier	1.41	3.317
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	1.76	4.142
NvW		Natural Vegetation in Wet Area	1.17	2.752
RanLands		Range Land	5.63	13.227
SnP		Snow Permanent	2.33	5.473
Wet		Wet Areas	0.59	1.392
Total Area (Sq km)				**235.029**

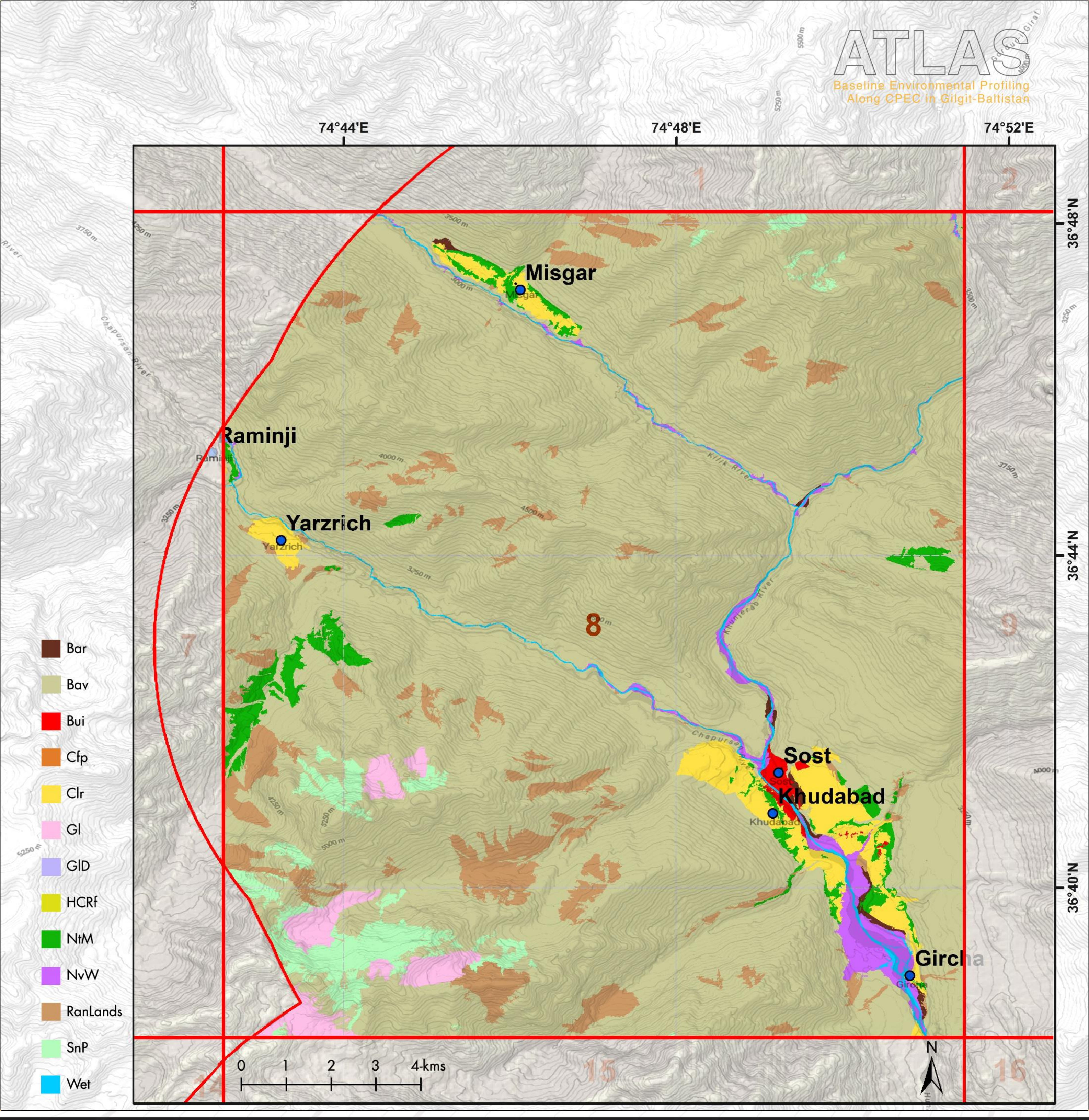
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



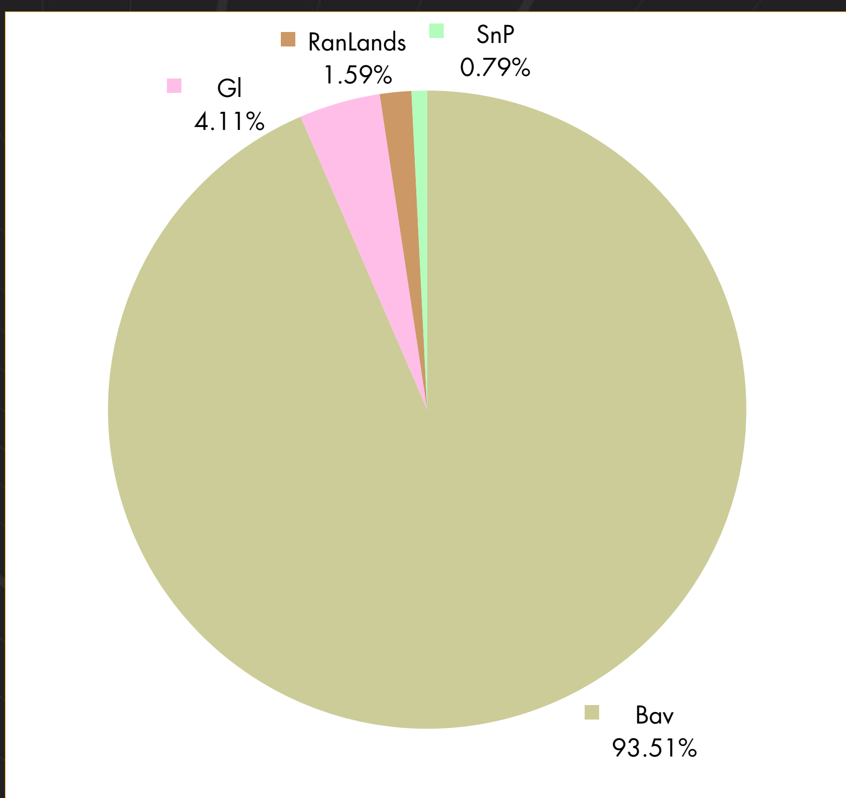
Map zone on the facing page.


74°44'E
74°48'E
74°52'E
36°48'N
36°44'N
36°40'N
1
2
7
8
9
14
15
16
Misgar
Raminji
Yarzrich
Sost
Khudabad
Gircha
Kilik River
Khunjerab River
Chapursan River
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

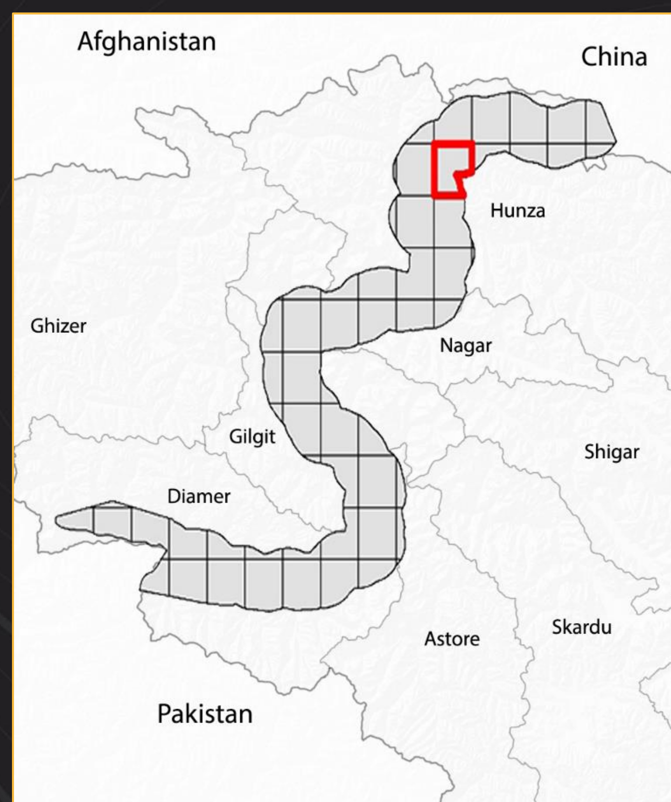
Land Use and Land Cover (LULC) Statistics Map of Zone 09

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	93.51	196.803
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	0	0
Gl		Glacier	4.11	8.653
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0.03	0.056
NvW		Natural Vegetation in Wet Area	0.16	0.344
RanLands		Range Land	1.59	3.353
SnP		Snow Permanent	0.78	1.654
Wet		Wet Areas	0.33	0.694
Total Area (Sq km)				**211.557**

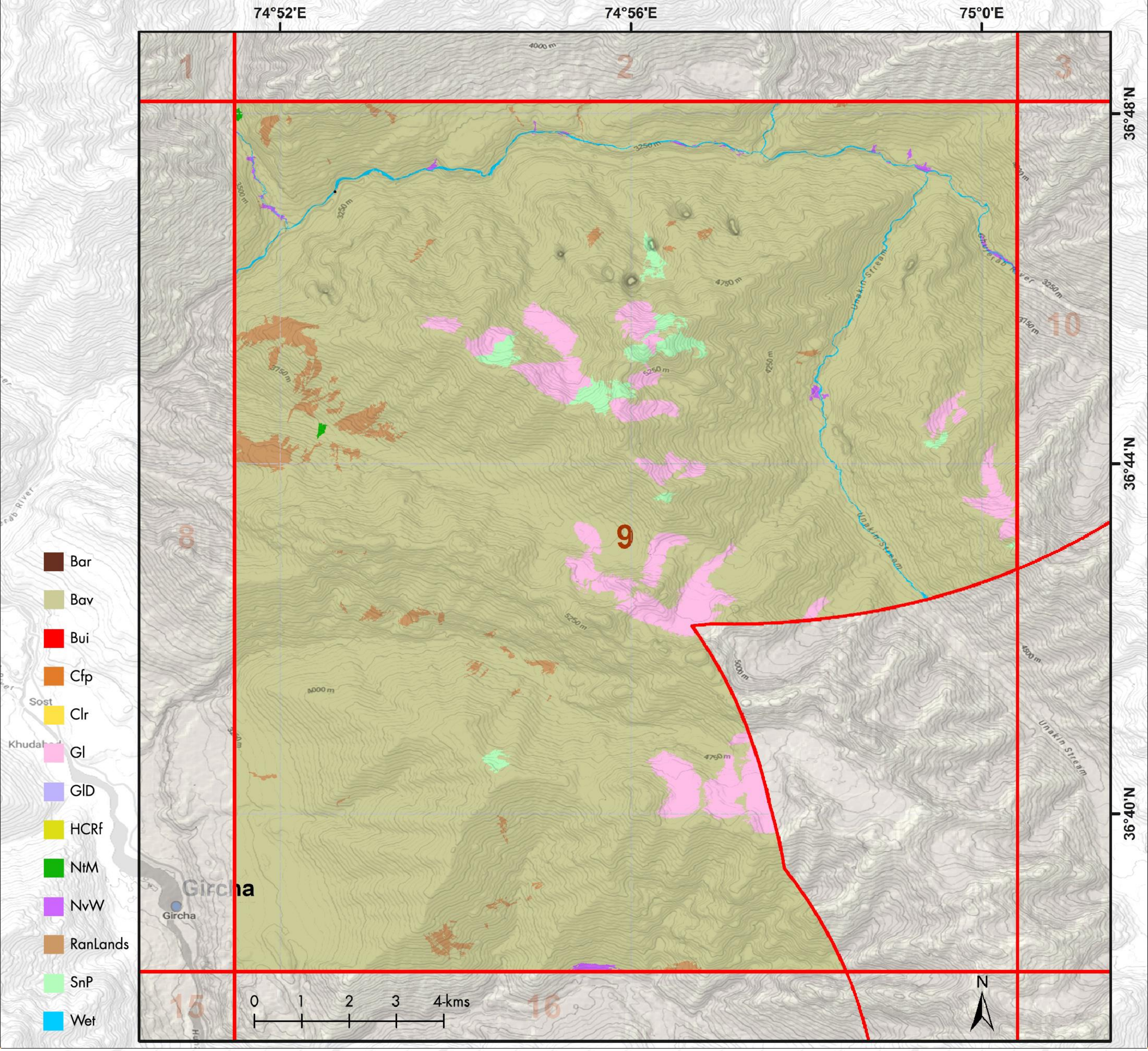
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



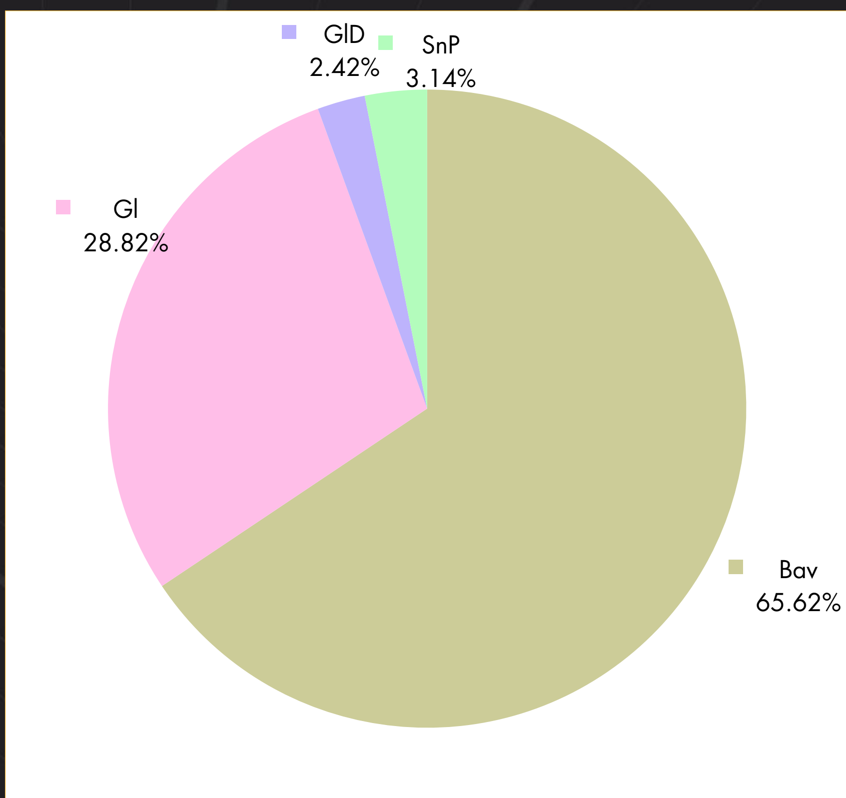
Map zone on the facing page.


74°52'E
74°56'E
75°0'E
36°48'N
36°44'N
36°40'N
1
2
3
8
9
10
15
16
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
Unakin Stream
Sost
Gircha
0
1
2
3
4-kms
N

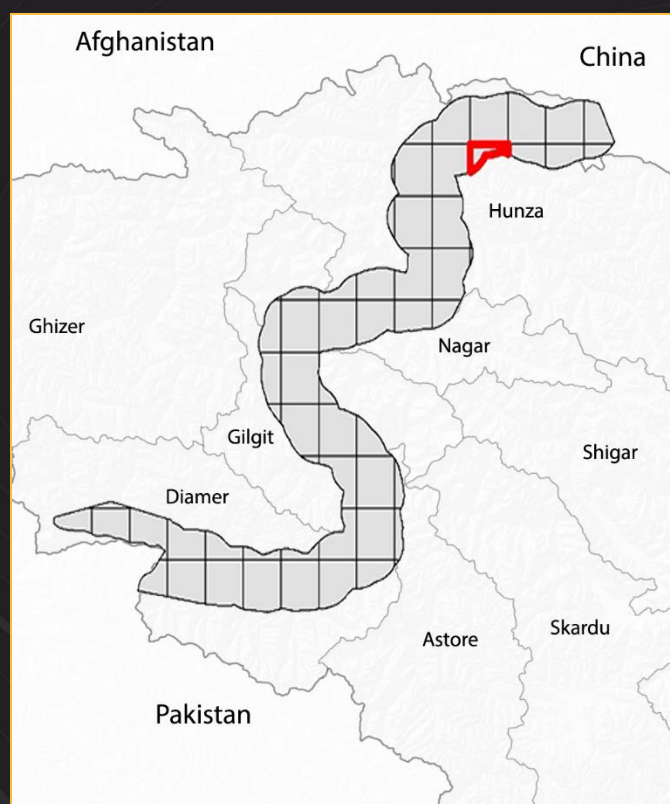
Land Use and Land Cover (LULC) Statistics Map of Zone 10

Legend	*Class Code*	*Abbreviation*	*Percentage (%)*	*Area (Sq Km)*
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	65.62	44.099
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	28.82	19.373
GlD		Glacier with Debris	2.42	1.627
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0	0
NvW		Natural Vegetation in Wet Area	0.18	0.120
RanLands		Range Land	0	0
SnP		Snow Permanent	3.14	2.110
Wet		Wet Areas	0.15	0.098
Total Area (Sq km)				**67.427**

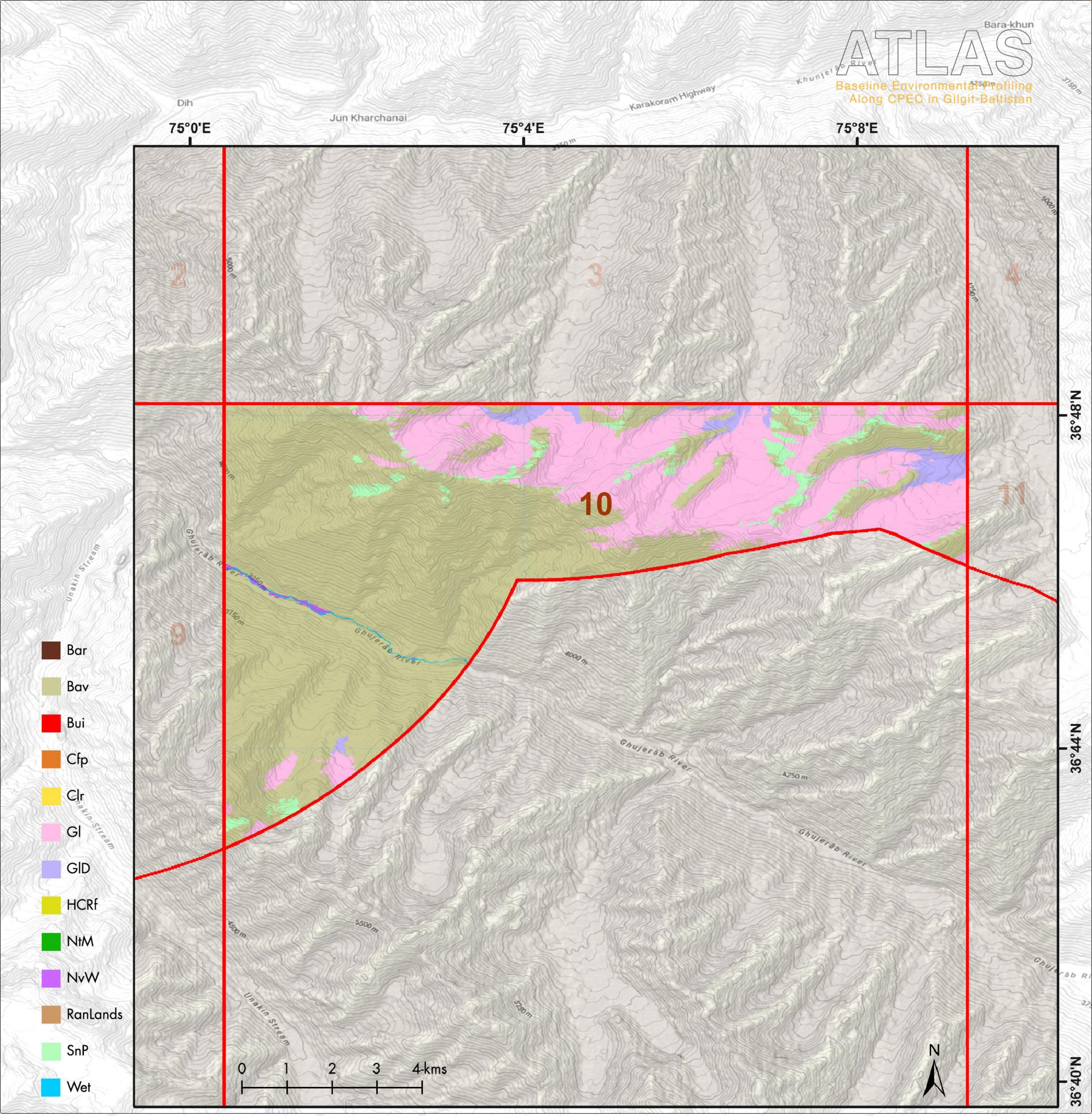
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



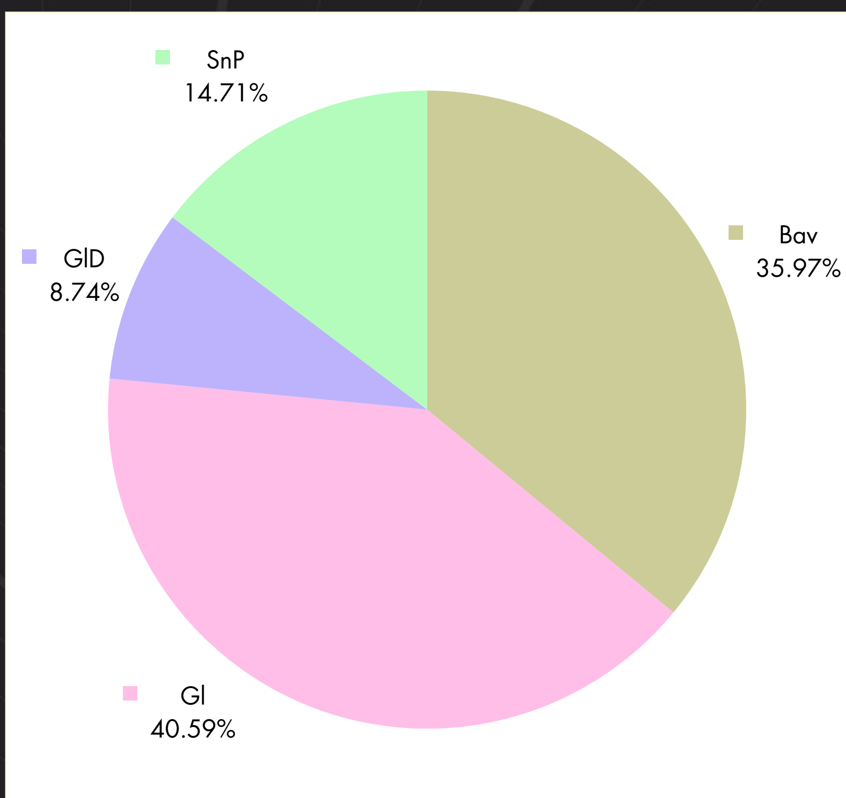
Map zone on the facing page.


ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
Bara-khun
Khunjerab River
Karakoram Highway
Dih
Jun Kharchanai
75°0'E
75°4'E
75°8'E
36°48'N
36°44'N
36°40'N
2
3
4
9
10
11
Ghujerab River
Unakin Stream
4000 m
4250 m
5500 m
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4 kms
N

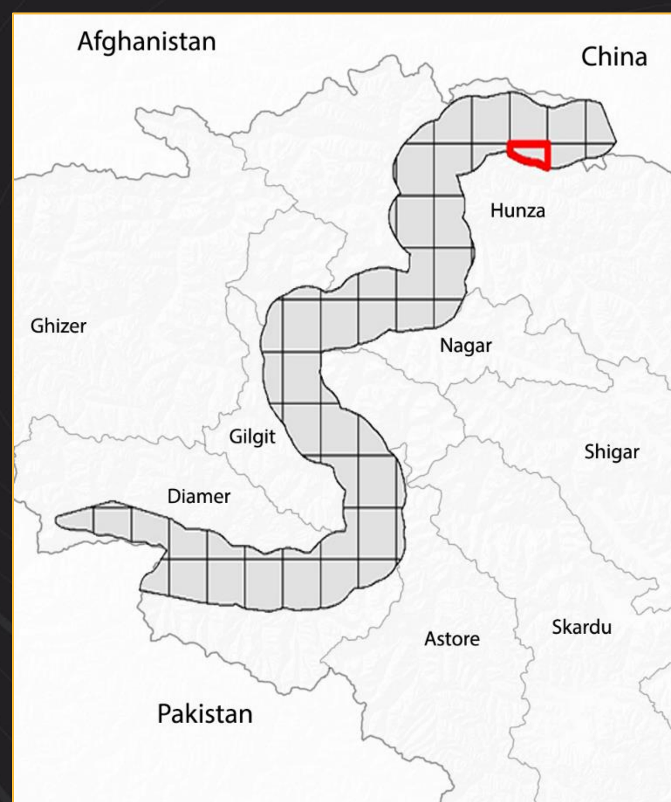
Land Use and Land Cover (LULC) Statistics Map of Zone 11

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	35.97	29.707
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	40.59	33.524
GlD		Glacier with Debris	8.74	7.221
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0	0
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	0	0
SnP		Snow Permanent	14.71	12.147
Wet		Wet Areas	0.10	0.081
Total Area (Sq km)				**82.681**

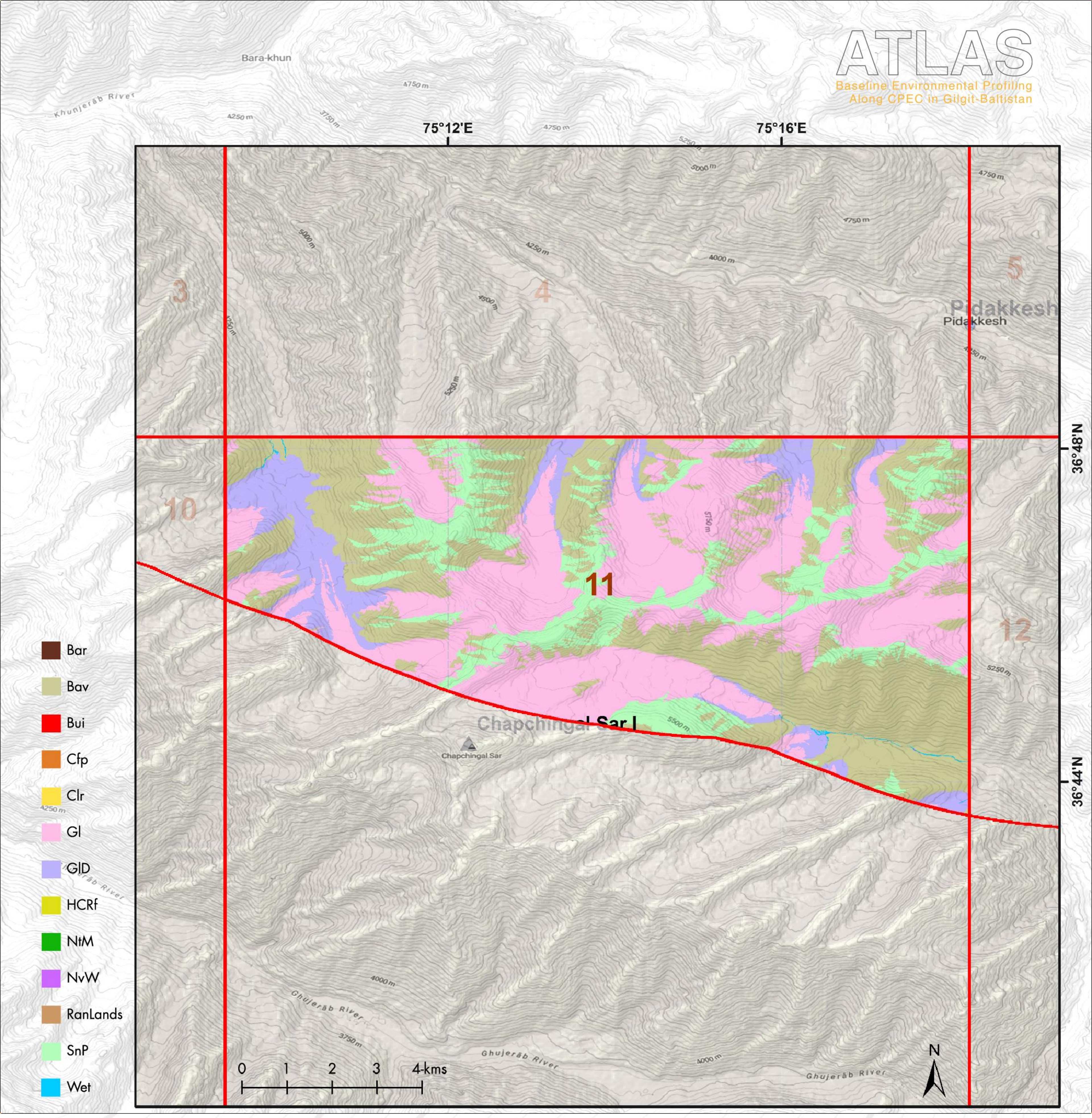
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



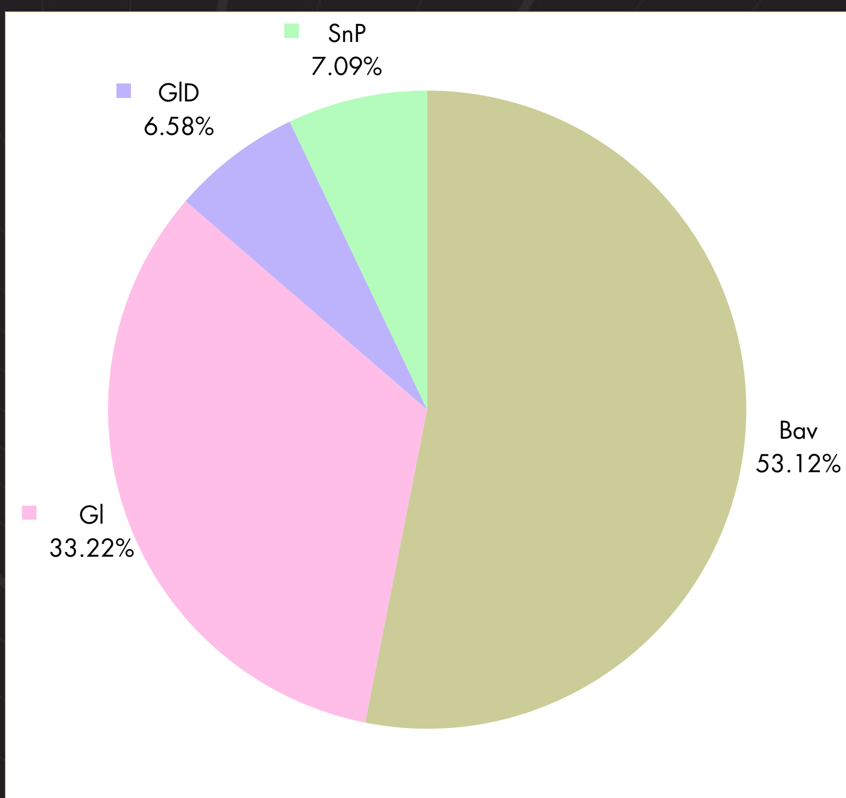
Map zone on the facing page.


75°12'E
75°16'E
36°48'N
36°44'N
3
4
5
10
11
12
Pidakkesh
Chapchingal Sar
Bara-khun
Khunjerāb River
Ghujerāb River
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

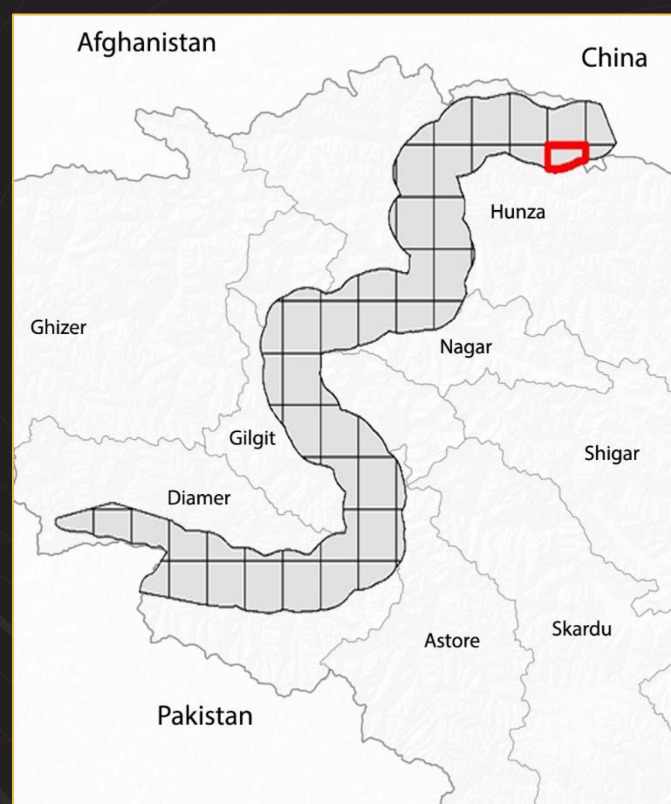
Land Use and Land Cover (LULC) Statistics Map of Zone 12

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	53.12	52.918
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	0	0
Gl		Glacier	33.22	33.105
GlD		Glacier with Debris	6.58	6.559
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0	0
NvW		Natural Vegetation in Wet Area	0.043	0.043
RanLands		Range Land	0	0
SnP		Snow Permanent	7.09	7.059
Wet		Wet Areas	0.32	0.325
Total Area (Sq km)				**99.836**

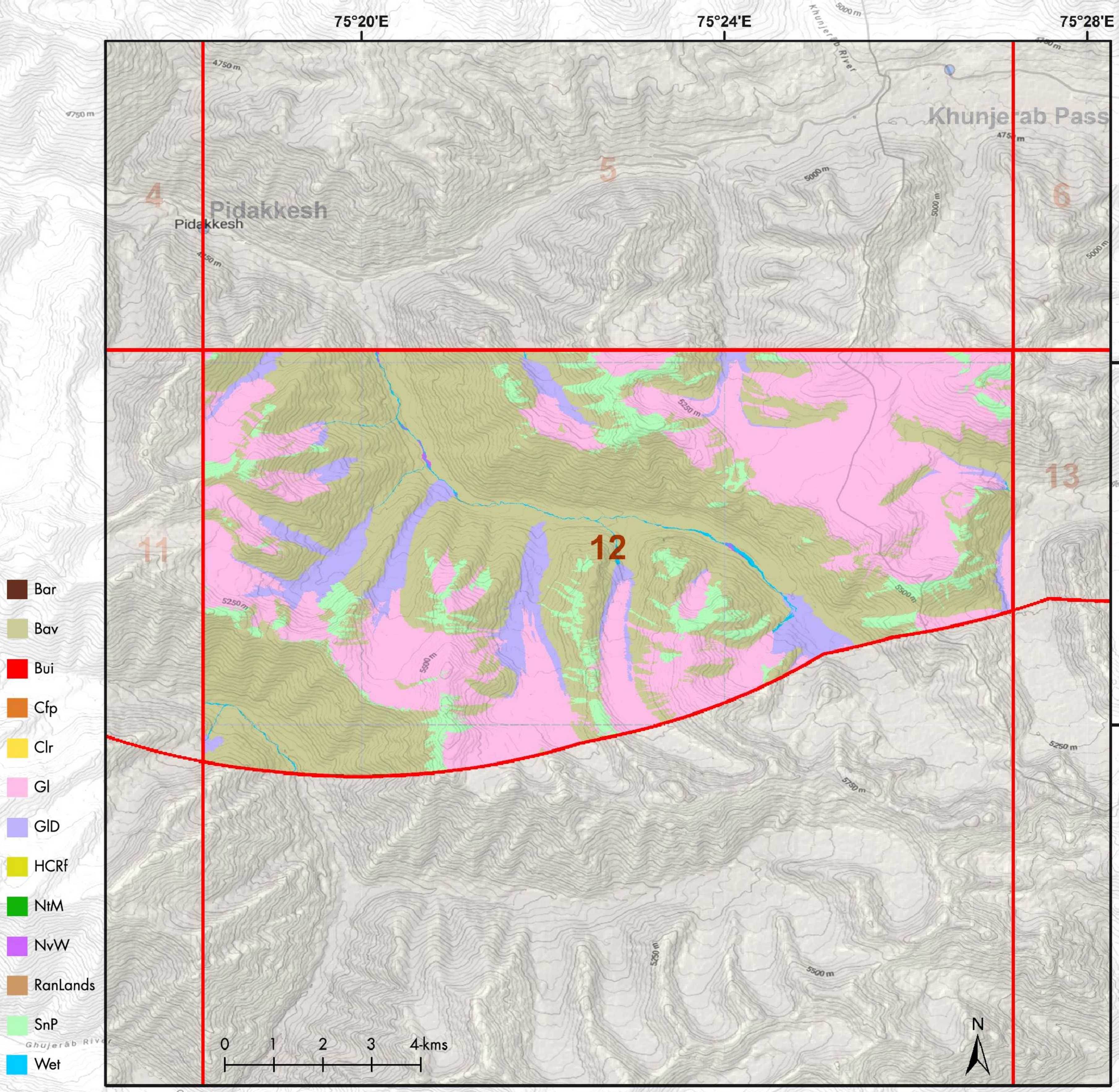
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



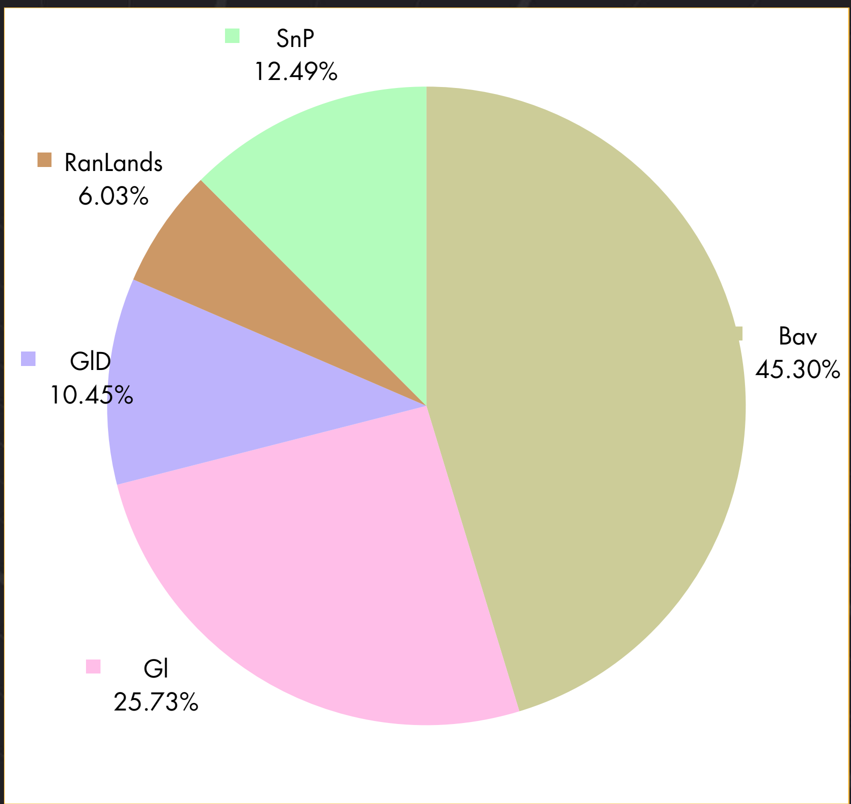
Map zone on the facing page.


75°20'E
75°24'E
75°28'E
36°48'N
36°44'N
Khunjerab Pass
Khunjerab River
Pidakkesh
4
5
6
11
12
13
4750 m
5000 m
5250 m
5500 m
5750 m
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
Ghujerab River
0
1
2
3
4-kms
N

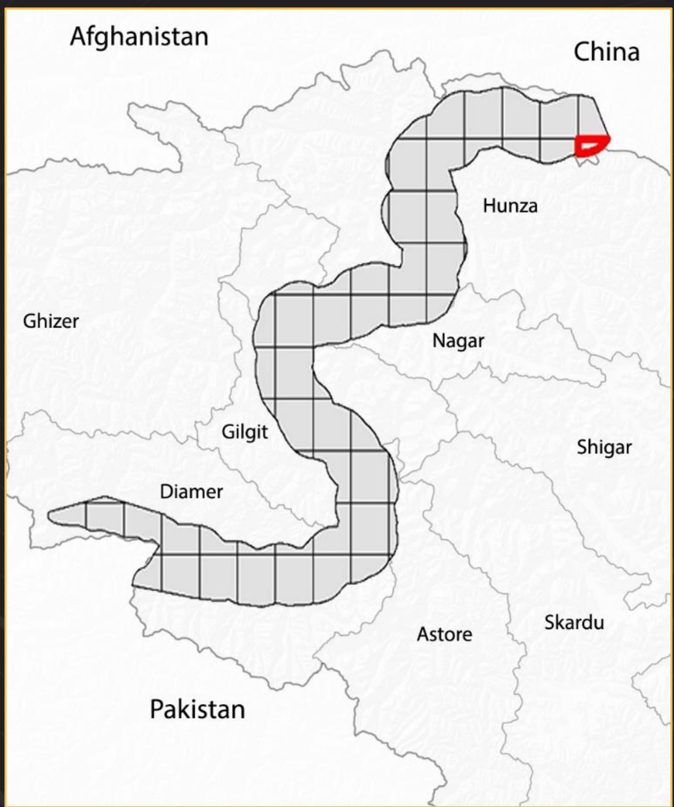
Land Use and Land Cover (LULC) Statistics Map of Zone 13

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	45.30	17.906
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	25.73	10.170
GlD		Glacier with Debris	10.45	4.132
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0	0
NvW		Natural Vegetation in Wet Area	1.09	0.436
RanLands		Range Land	5.95	2.385
SnP		Snow Permanent	12.49	4.937
Wet		Wet Areas	0.38	0.153
Total Area (Sq km)				**40.119**

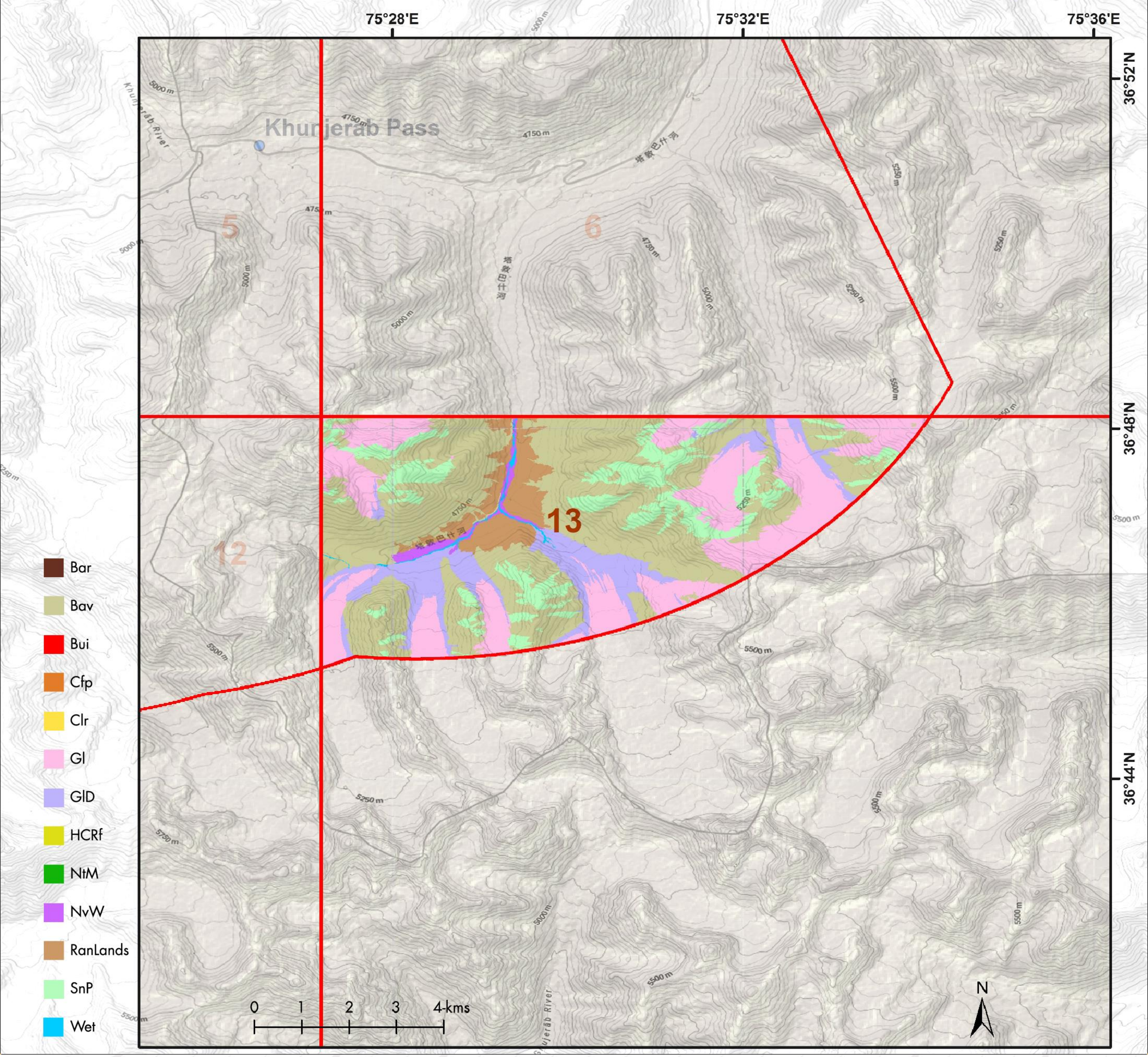
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



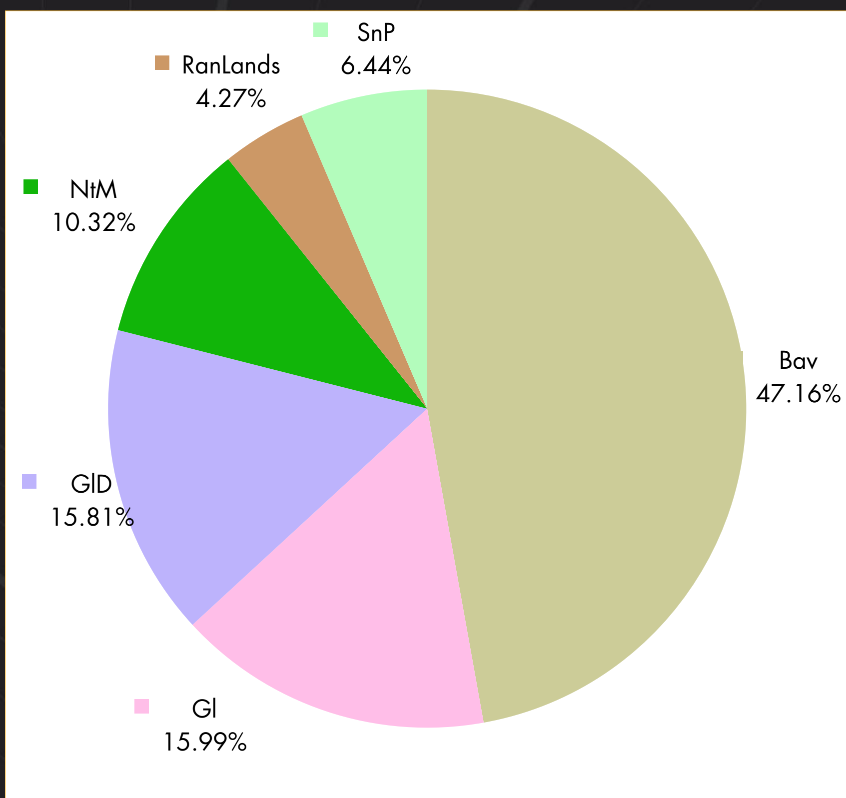
Map zone on the facing page.


75°28'E
75°32'E
75°36'E
36°52'N
36°48'N
36°44'N
Khunjerab Pass
Khunjerab River
Gujerab River
5
6
12
13
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

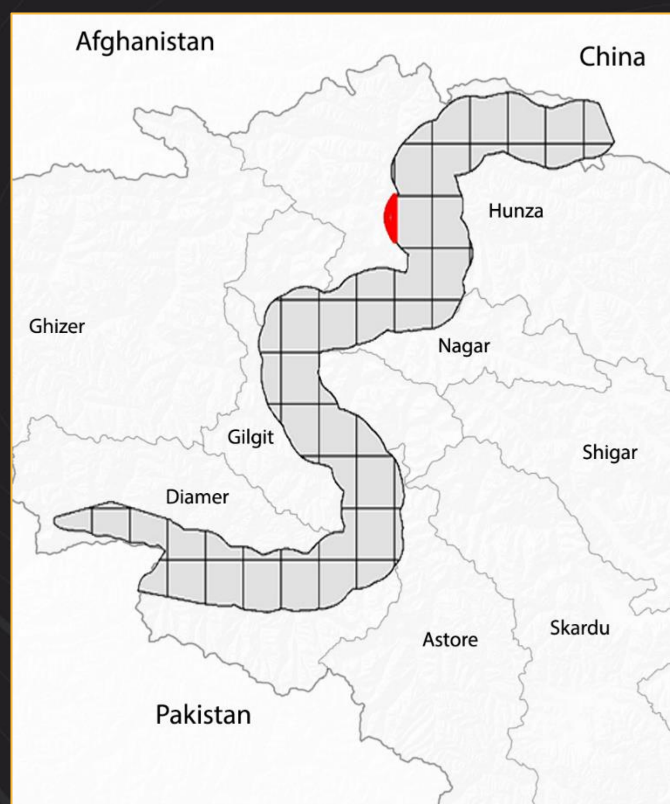
Land Use and Land Cover (LULC) Statistics Map of Zone 14

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	47.16	12.315
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	15.99	4.175
GlD		Glacier with Debris	15.81	4.128
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	10.32	2.695
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	4.27	1.116
SnP		Snow Permanent	6.44	1.682
Wet		Wet Areas	0.06	0.015
Total Area (Sq km)				**26.126**

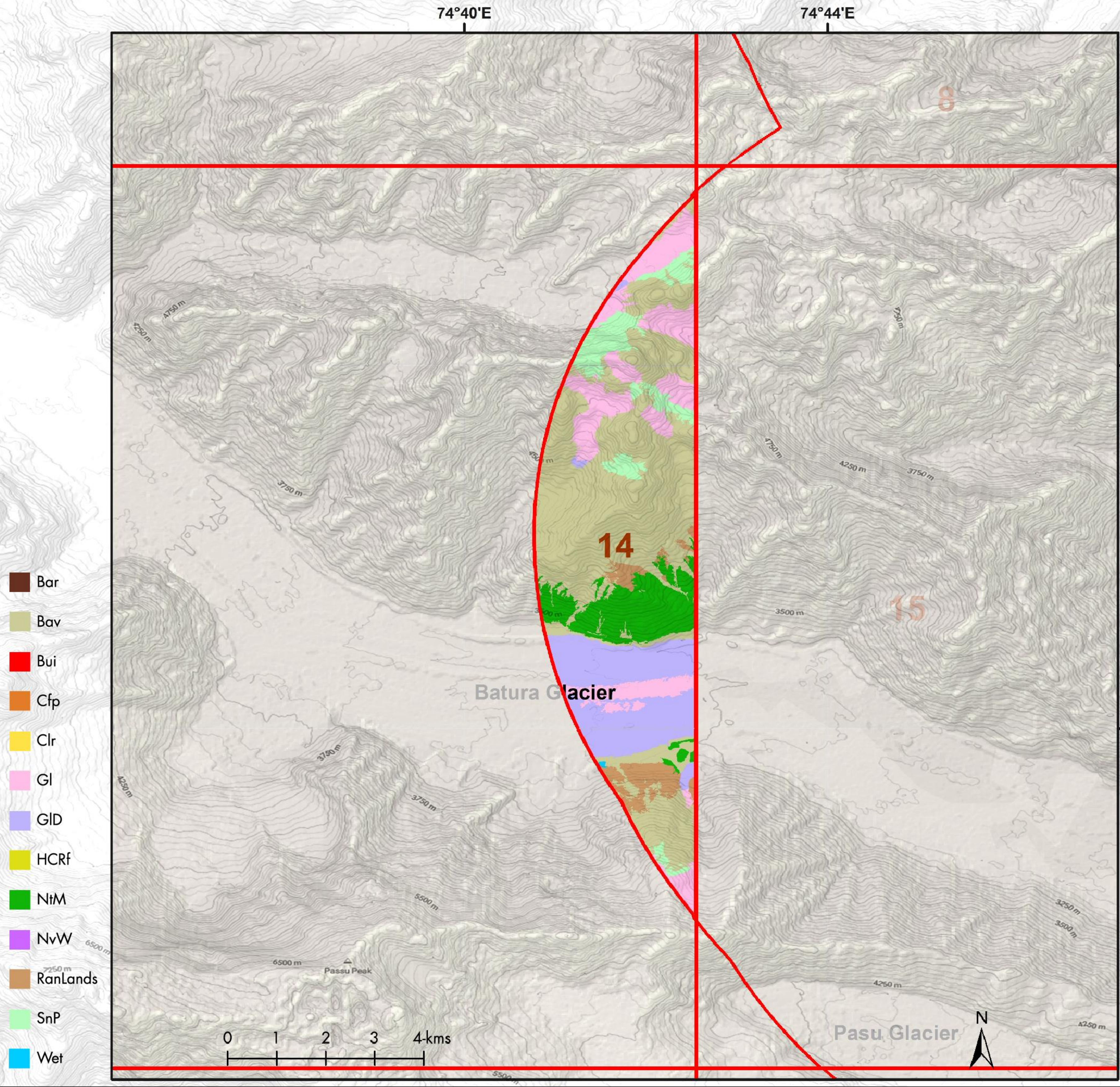
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



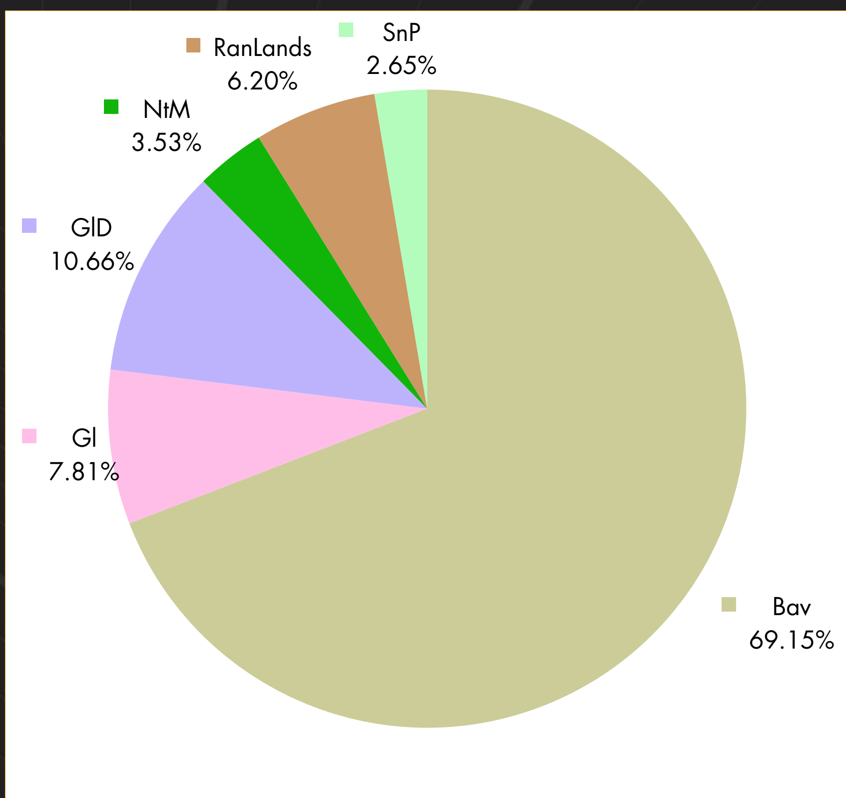
Map zone on the facing page.


74°40'E
74°44'E
36°36'N
36°32'N
8
14
15
Batura Glacier
Pasu Glacier
Passu Peak
N
0
1
2
3
4-kms
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet

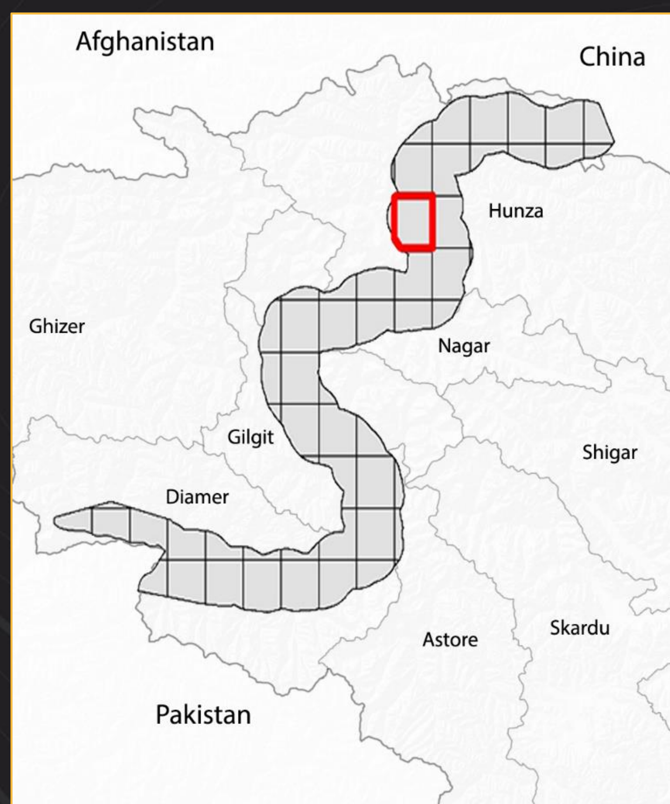
Land Use and Land Cover (LULC) Statistics Map of Zone 15

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0.13	0.316
Bav		Bare Area with Sparse Natural Vegetation	69.15	163.986
Bui		Built-up	0.06	0.152
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0.57	1.376
Gl		Glacier	7.81	18.529
GlD		Glacier with Debris	10.66	25.293
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	3.46	8.368
NvW		Natural Vegetation in Wet Area	0.58	1.403
RanLands		Range Land	6.09	14.706
SnP		Snow Permanent	2.60	6.281
Wet		Wet Areas	0.48	1.164
Total Area (Sq km)				**241.574**

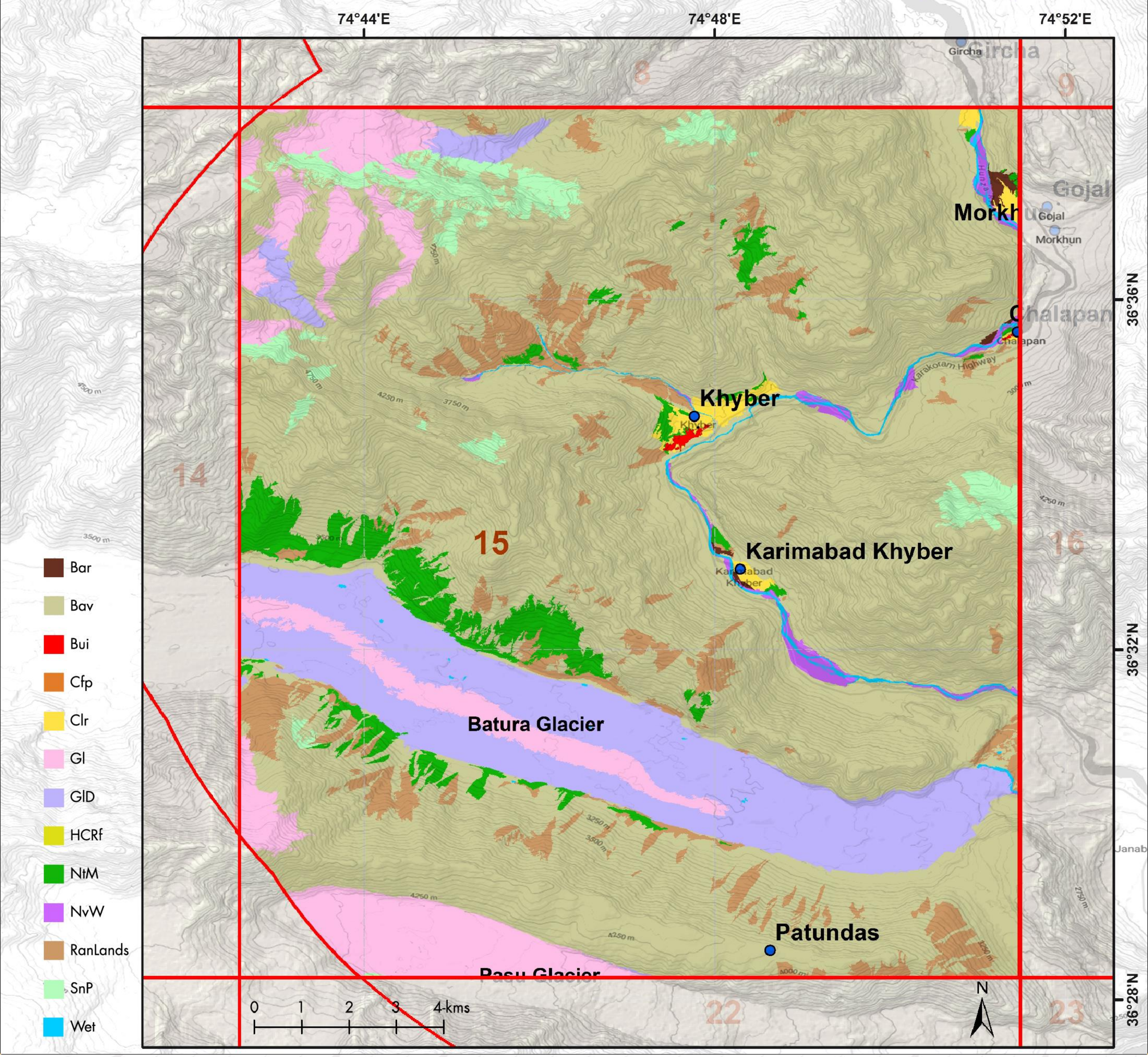
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



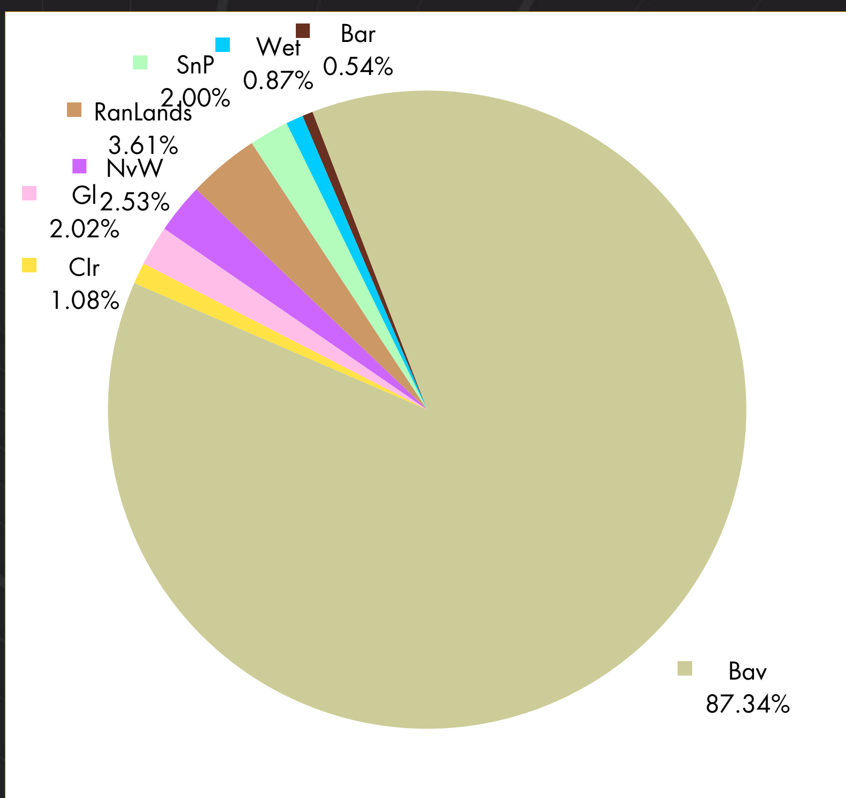
Map zone on the facing page.


74°44'E
74°48'E
74°52'E
36°36'N
36°32'N
36°28'N
8
9
14
15
16
22
23
Gircha
Gojal
Morkhun
Chalapan
Khyber
Karimabad Khyber
Karakoram Highway
Batura Glacier
Patundas
Pasu Glacier
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4 kms
N

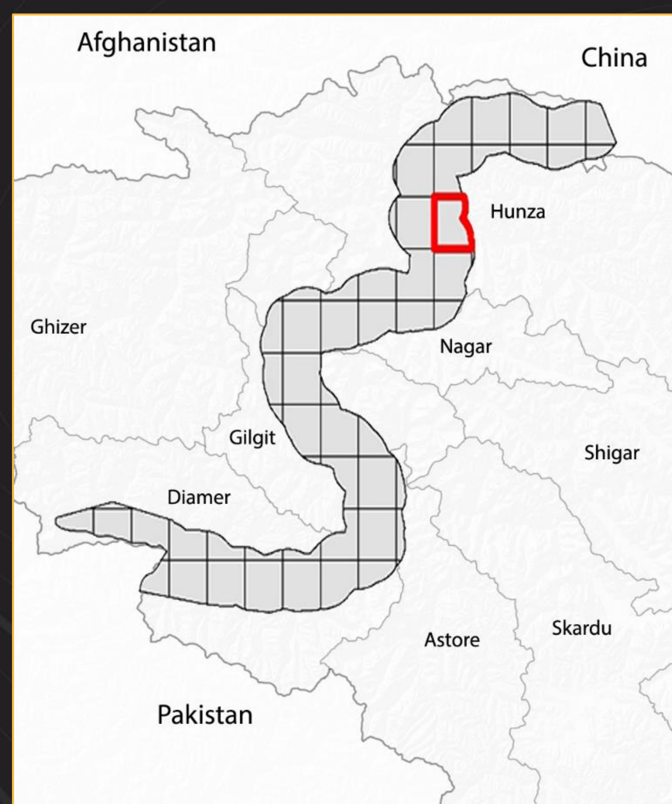
Land Use and Land Cover (LULC) Statistics Map of Zone 16

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0.54	1.149
Bav		Bare Area with Sparse Natural Vegetation	87.34	186.246
Bui		Built-up	0.07	0.158
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	1.07	2.307
Gl		Glacier	2.02	4.316
GlD		Glacier with Debris	0.17	0.365
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0.48	1.025
NvW		Natural Vegetation in Wet Area	2.52	5.404
RanLands		Range Land	3.61	7.688
SnP		Snow Permanent	1.99	4.272
Wet		Wet Areas	0.87	1.860
Total Area (Sq km)				**214.790**

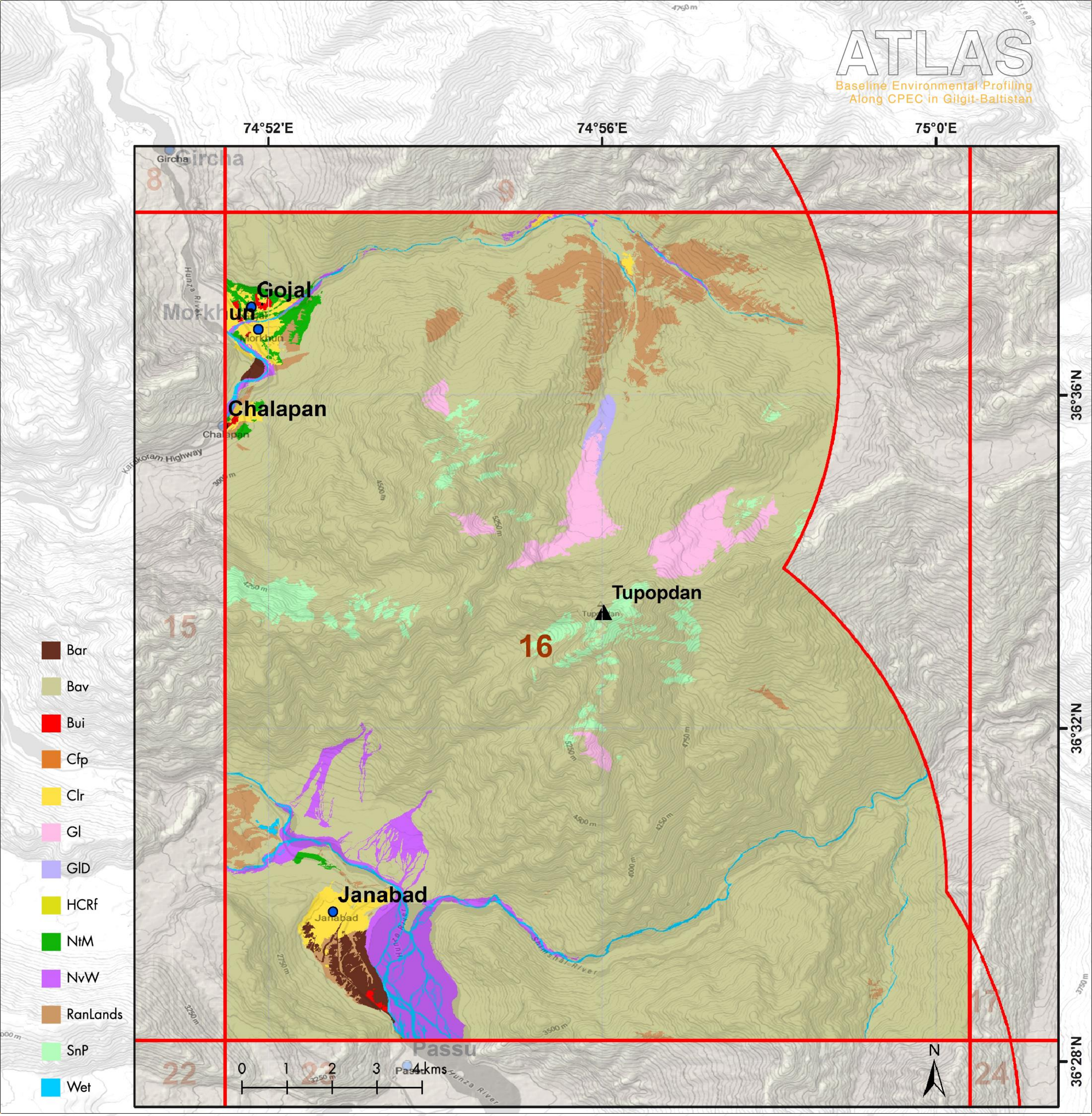
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



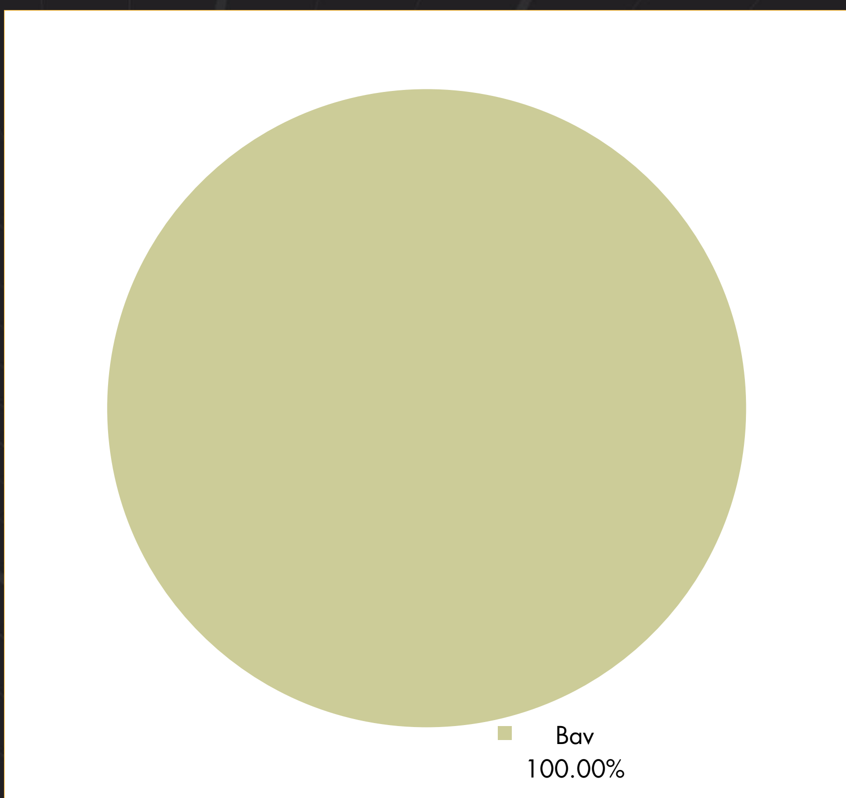
Map zone on the facing page.


ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
74°52'E
74°56'E
75°0'E
36°36'N
36°32'N
36°28'N
Gojal
Morkhun
Chalapan
Karakoram Highway
Tupopdan
16
Janabad
Passu
Shimshal River
Hunza River
Gircha
8
9
15
17
22
24
0 1 2 3 4 kms
N
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet

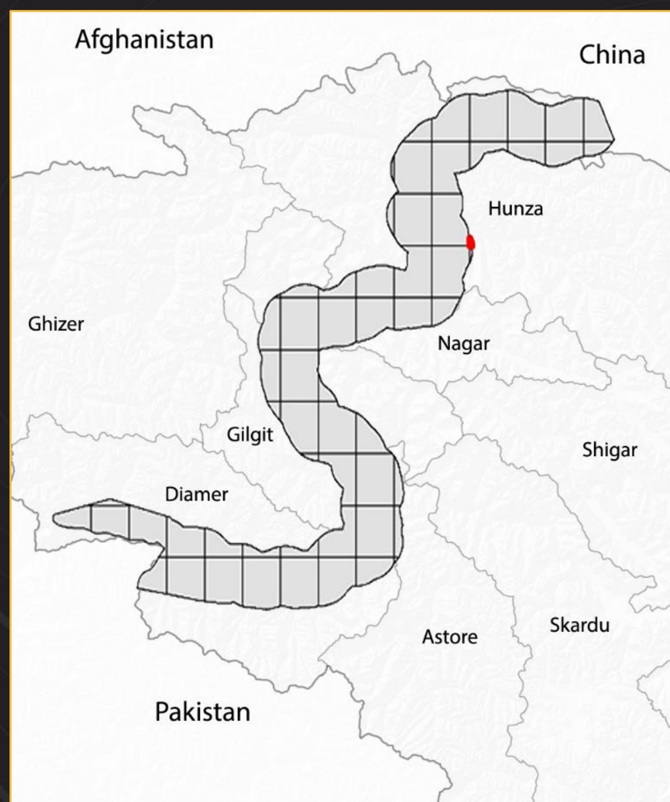
Land Use and Land Cover (LULC) Statistics Map of Zone 17

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	100.00	1.007
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	0	0
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0	0
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	0	0
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
Total Area (Sq km)				**1.007**

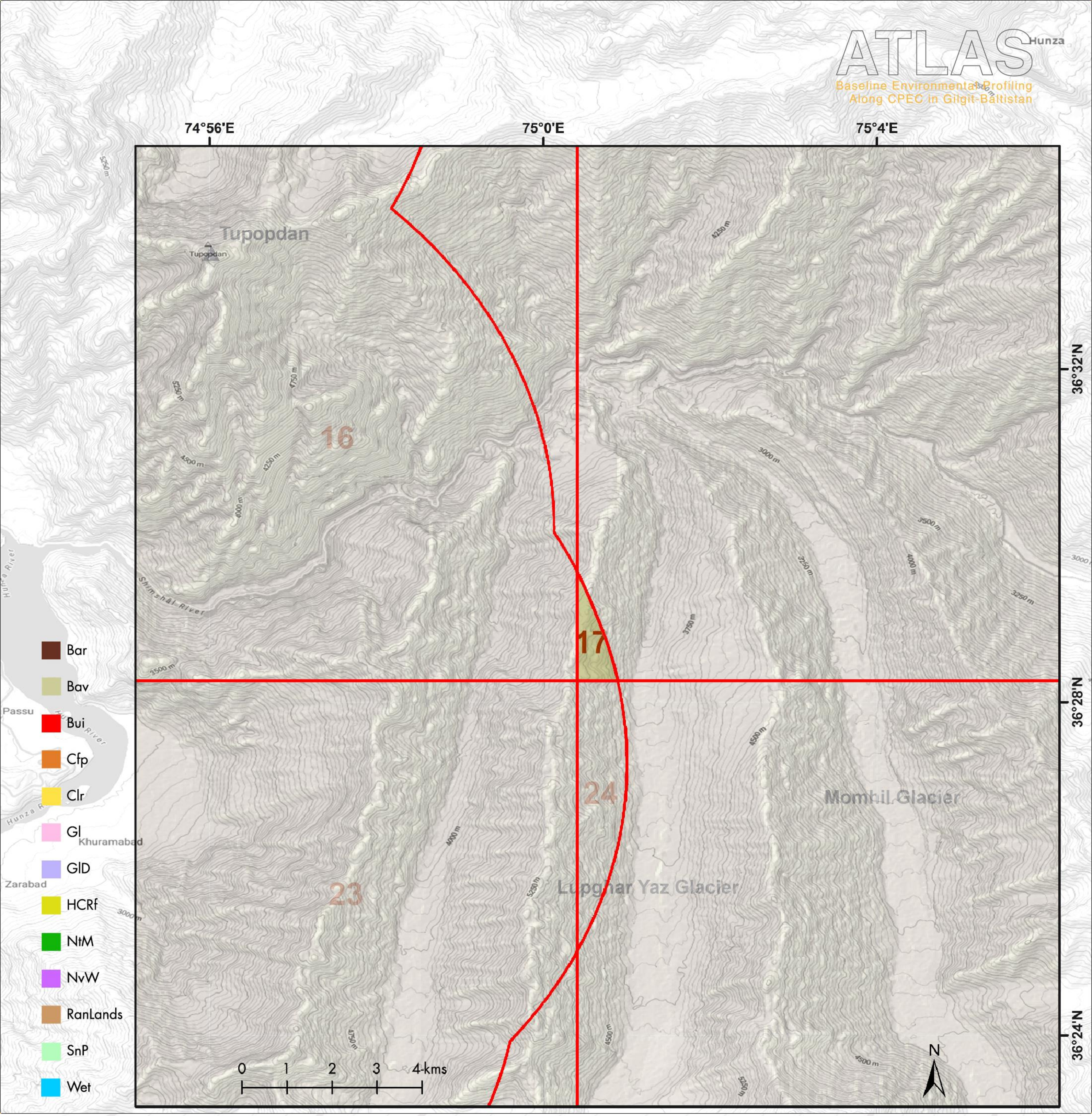
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

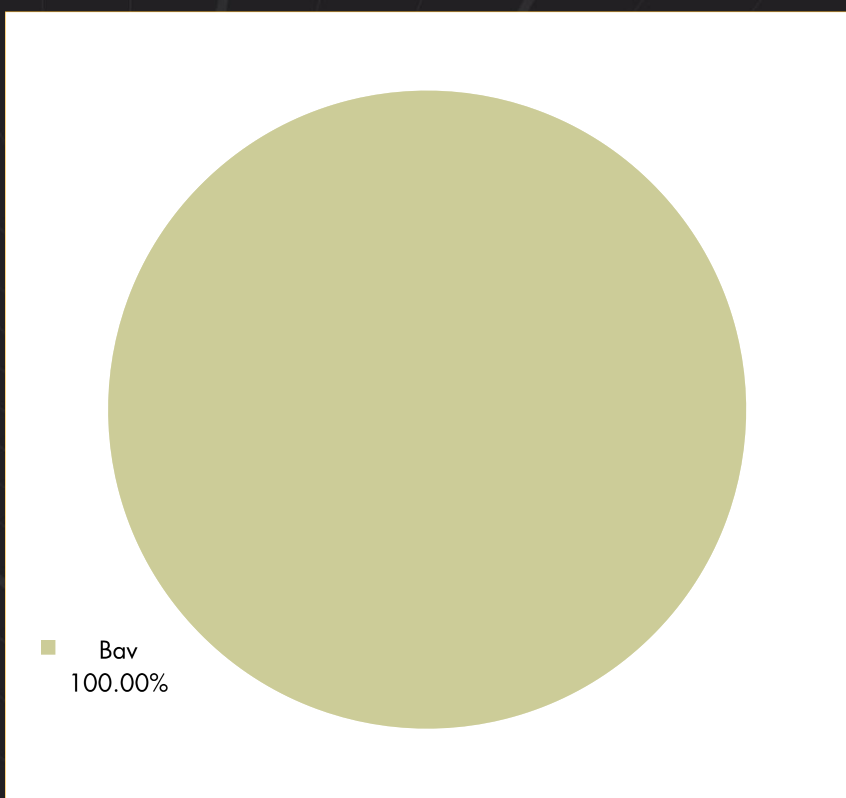


ATLAS Hunza
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
74°56'E
75°0'E
75°4'E
36°32'N
36°28'N
36°24'N
Tupopdan
16
17
23
24
Shimshal River
Mombil Glacier
Lupghar Yaz Glacier
Passu
Khuramabad
Zarabad
Hunza River
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4 kms
N

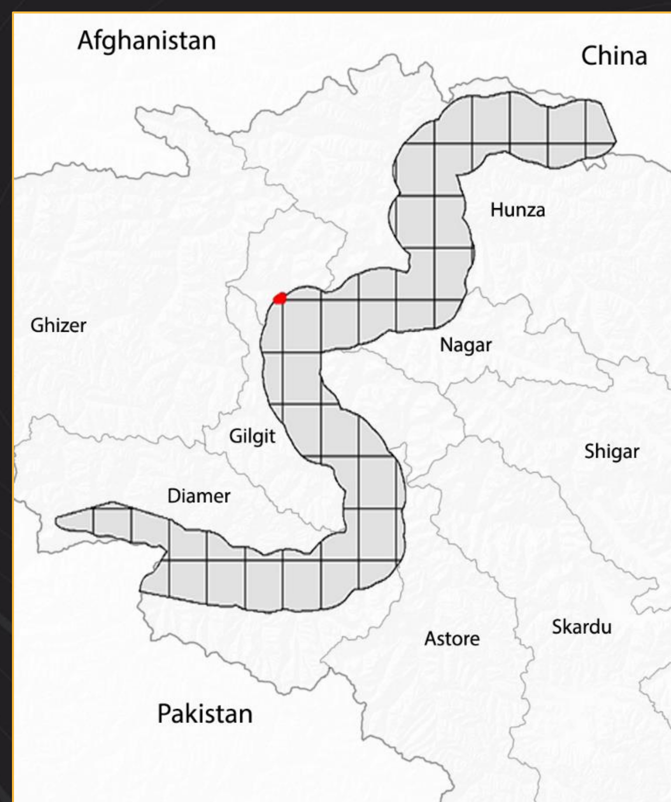
Land Use and Land Cover (LULC) Statistics Map of Zone 18

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	100.00	1.827
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	0	0
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0	0
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	0	0
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
Total Area (Sq km)				**1.827**

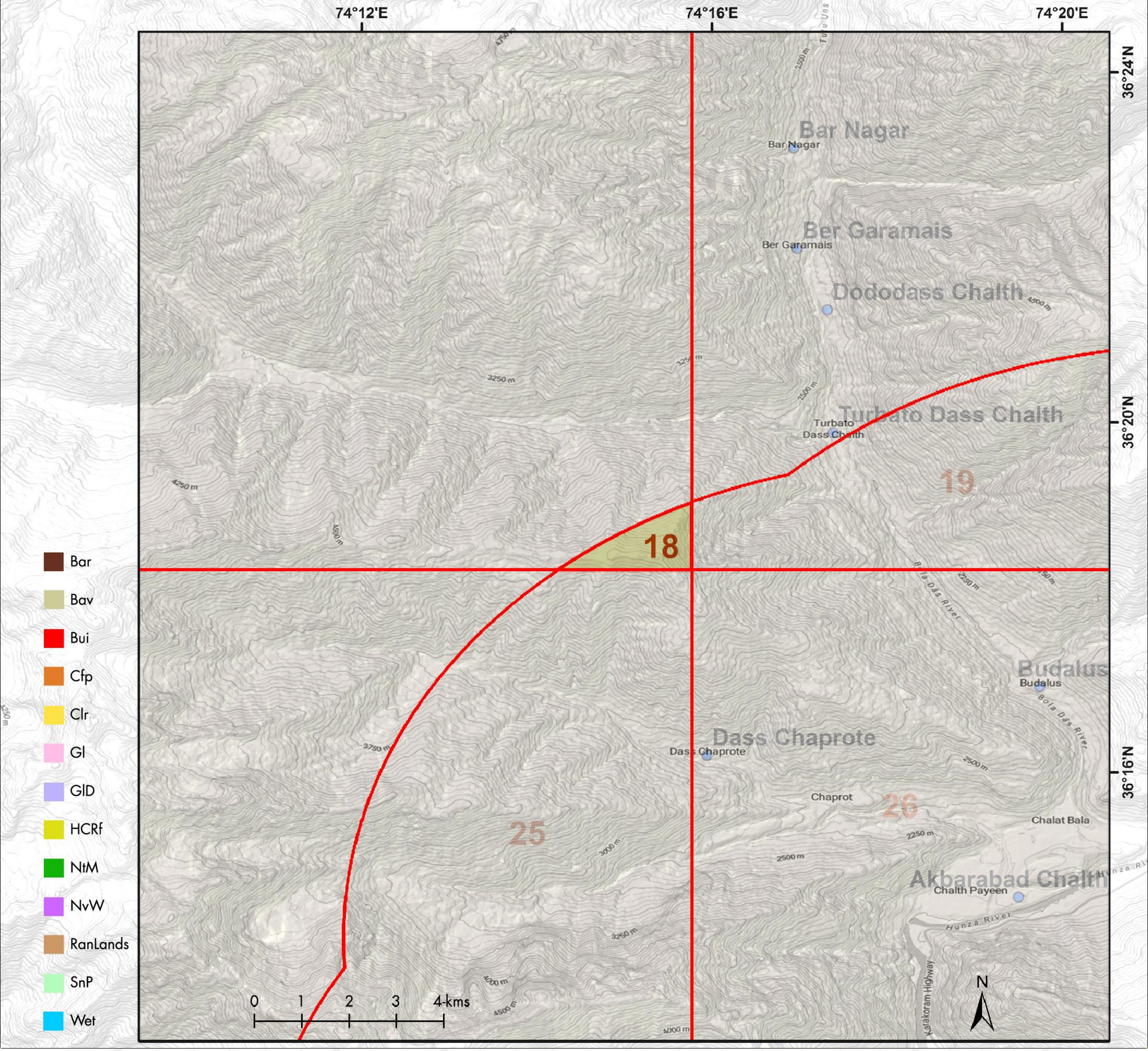
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



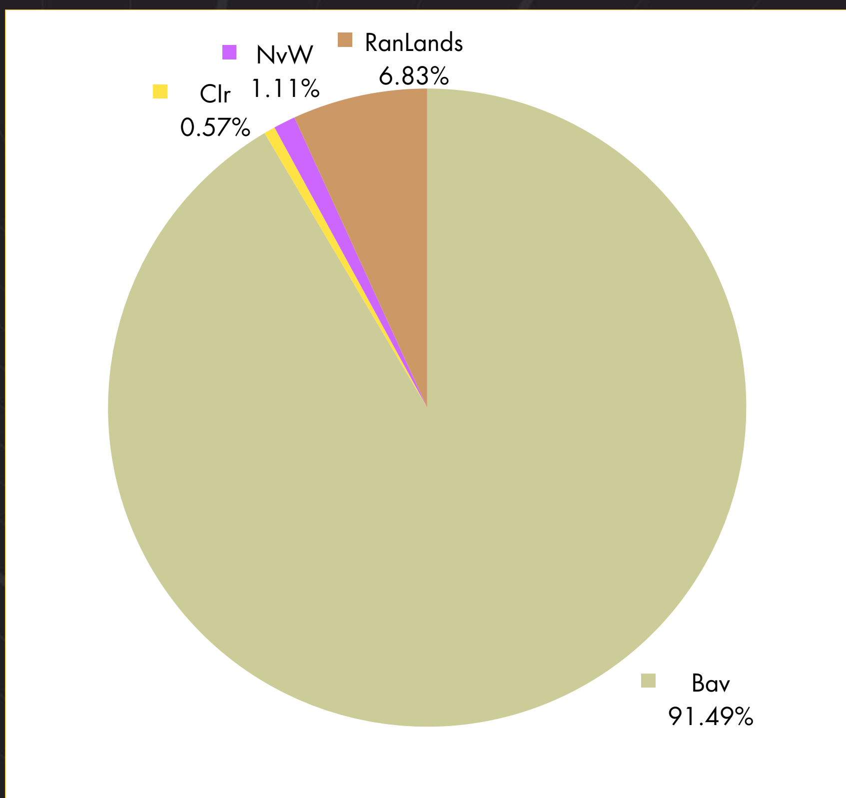
Map zone on the facing page.


74°12'E
74°16'E
74°20'E
36°24'N
36°20'N
36°16'N
Bar Nagar
Ber Garamais
Dododass Chalth
Turbato Dass Chalth
19
18
Budalus
Dass Chaprote
Chaprot
26
25
Chalat Bala
Akbarabad Chalth
Chalth Payeen
Hunza River
Bola Das River
Karakoram Highway
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

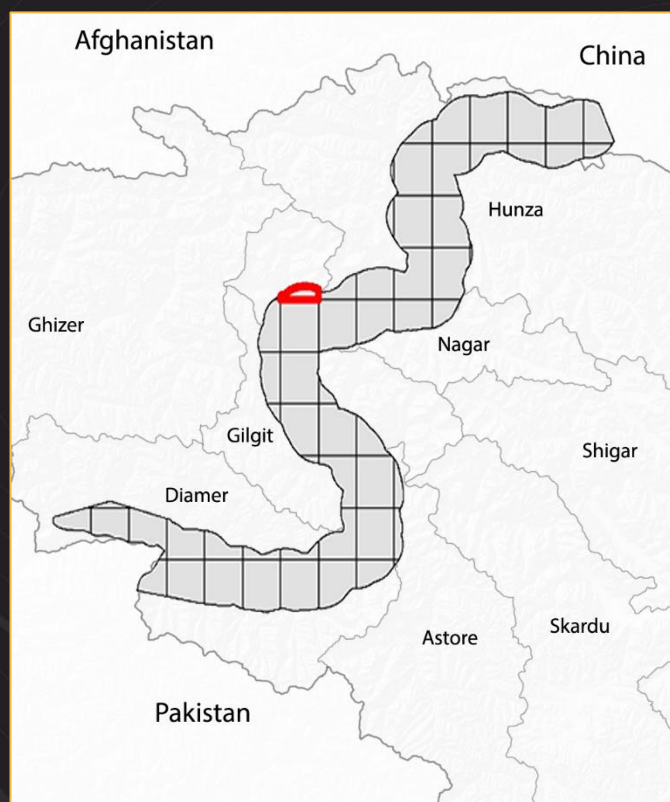
Land Use and Land Cover (LULC) Statistics Map of Zone 19

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	91.49	46.001
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	0.57	0.288
Gl		Glacier	0.23	0.119
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0	0
NvW		Natural Vegetation in Wet Area	1.10	0.558
RanLands		Range Land	6.83	3.434
SnP		Snow Permanent	0.43	0.218
Wet		Wet Areas	0.17	0.084
Total Area (Sq km)				**50.702**

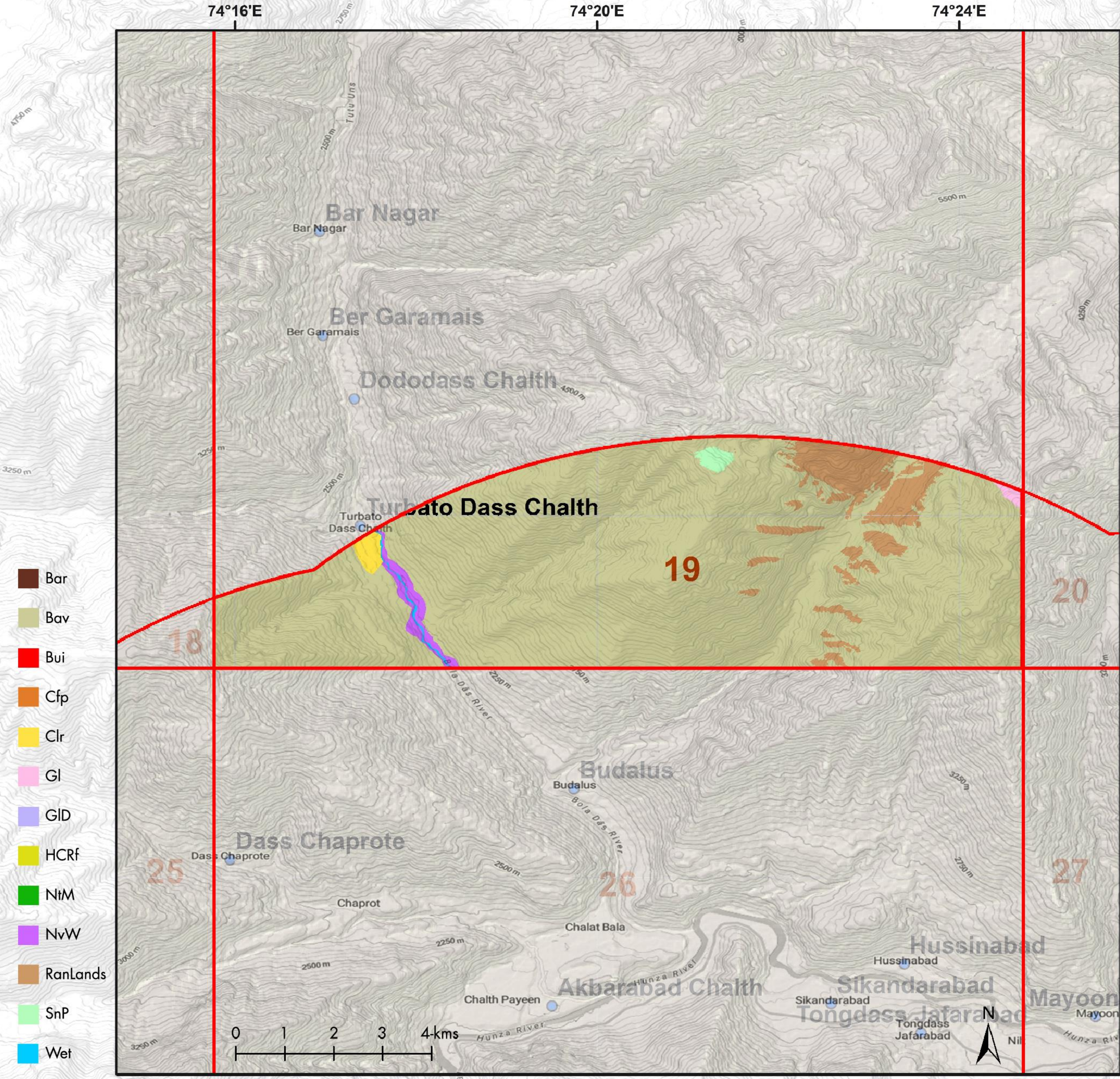
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



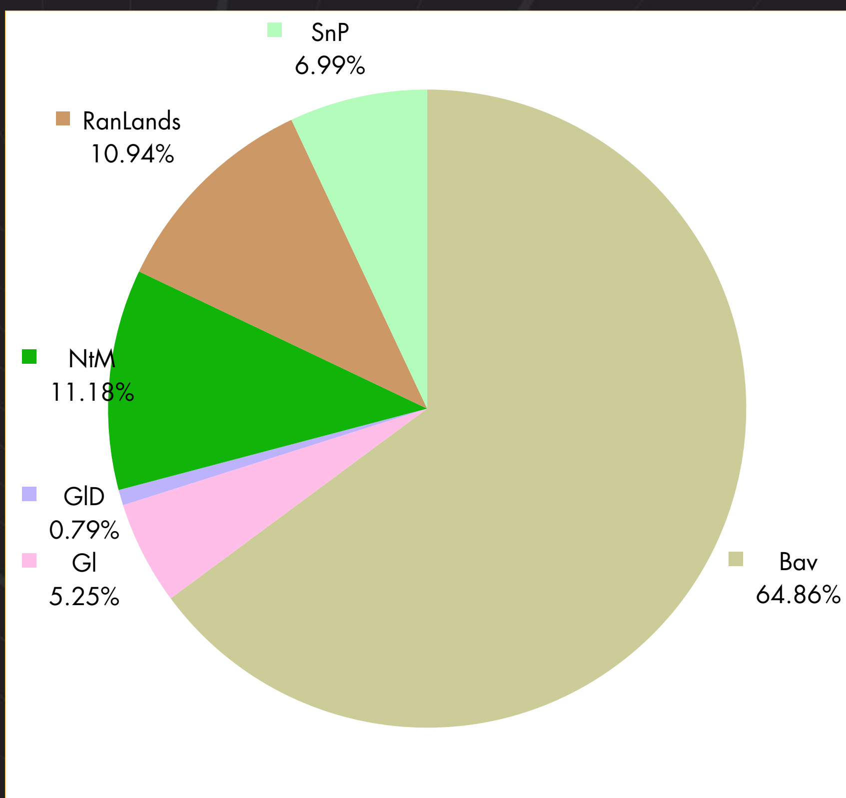
Map zone on the facing page.


74°16'E
74°20'E
74°24'E
36°24'N
36°20'N
36°16'N
Bar Nagar
Ber Garamais
Dododass Chalth
Turbato Dass Chalth
19
18
20
25
26
27
Budalus
Bola Das River
Dass Chaprote
Chaprot
Chalat Bala
Hussinabad
Sikandarabad
Tongdass Jafarabad
Akbarabad Chalth
Chalth Payeen
Mayoon
Hunza River
0 1 2 3 4 kms
N
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet

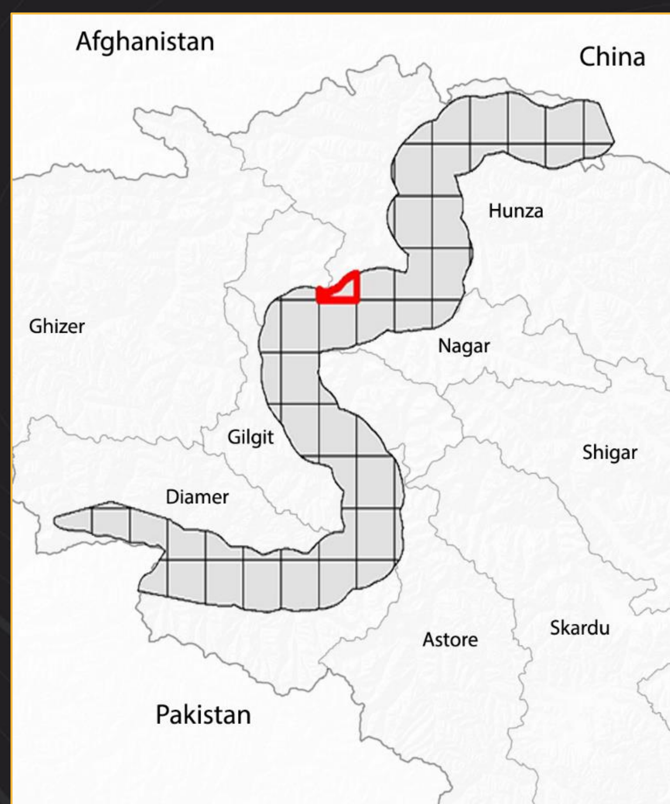
Land Use and Land Cover (LULC) Statistics Map of Zone 20

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	64.86	45.723
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	5.25	3.699
GlD		Glacier with Debris	0.79	0.555
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	11.18	7.879
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	10.94	7.711
SnP		Snow Permanent	6.99	4.929
Wet		Wet Areas	0	0
Total Area (Sq km)				**70.496**

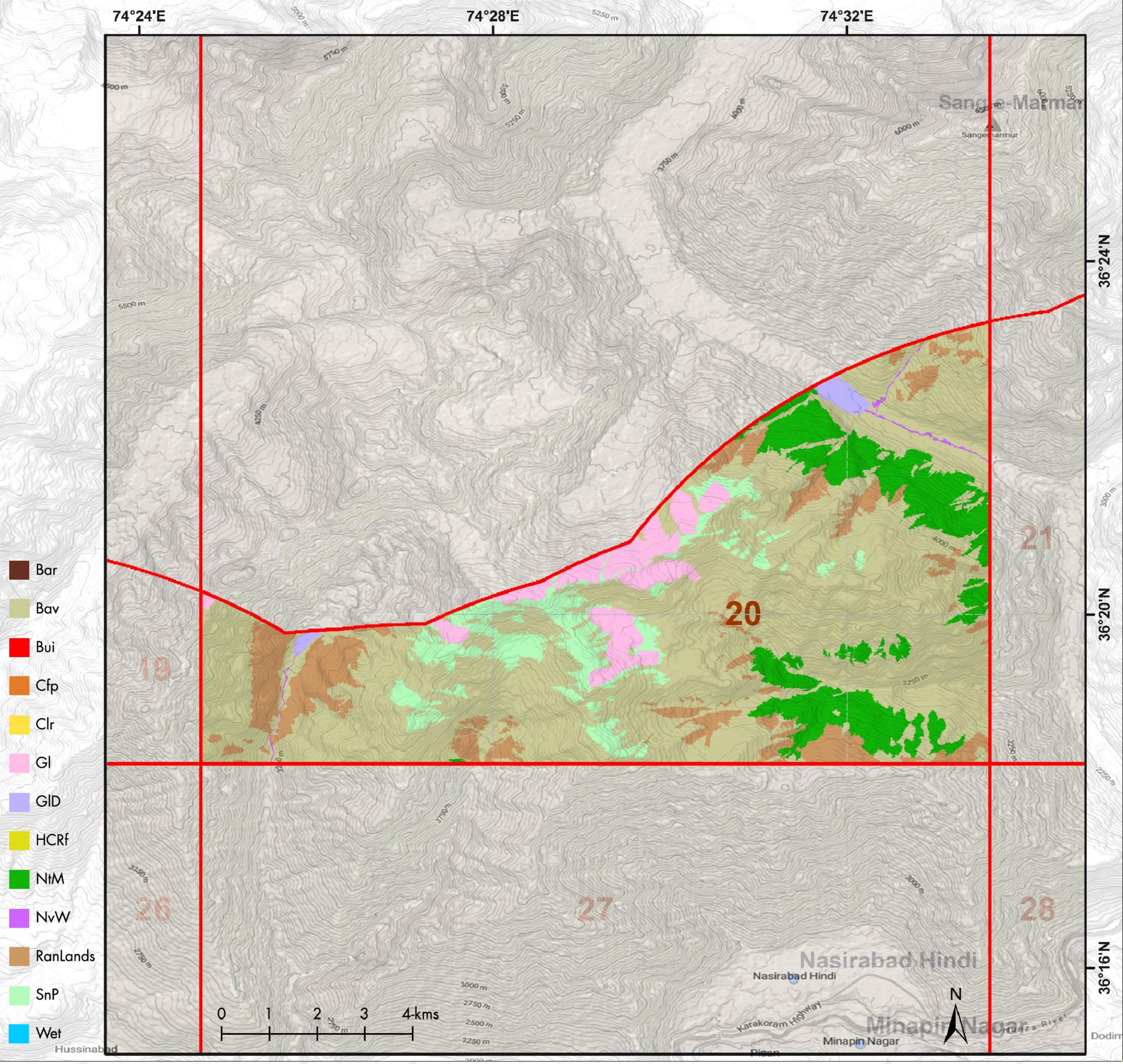
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



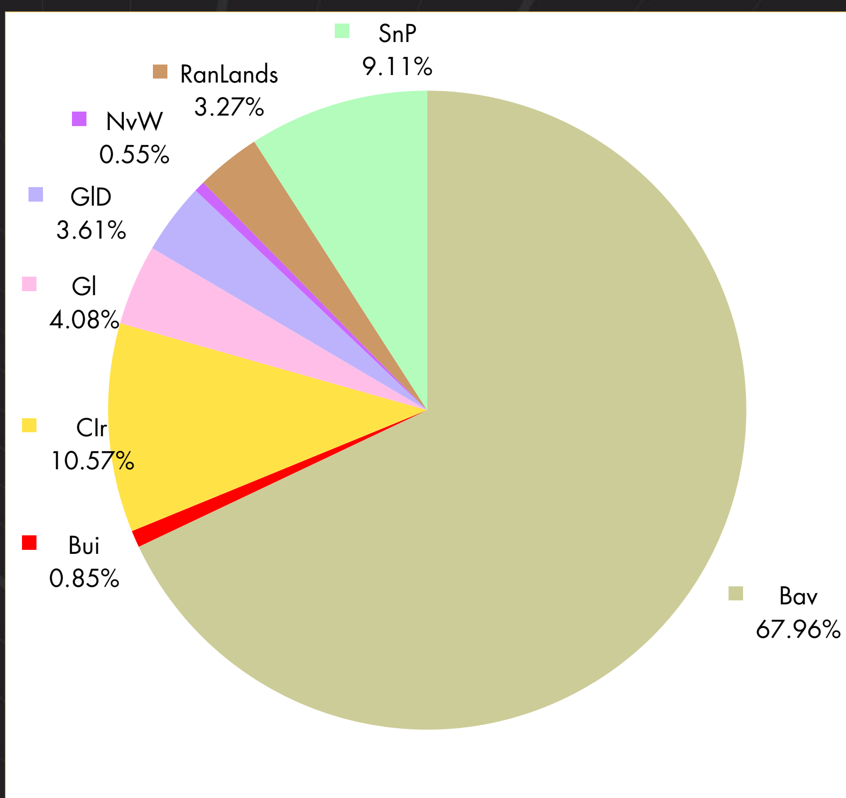
Map zone on the facing page.


74°24'E
74°28'E
74°32'E
36°24'N
36°20'N
36°16'N
Sang-e-Marmar
Sangemarmur
Hachindar Chhish
19
20
21
26
27
28
Nasirabad Hindi
Nasirabad Hindi
Karakoram Highway
Minapin Nagar
Minapin Nagar
Hunza River
Hussinabad
Dodim
Pisan
N
0 1 2 3 4 kms
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet

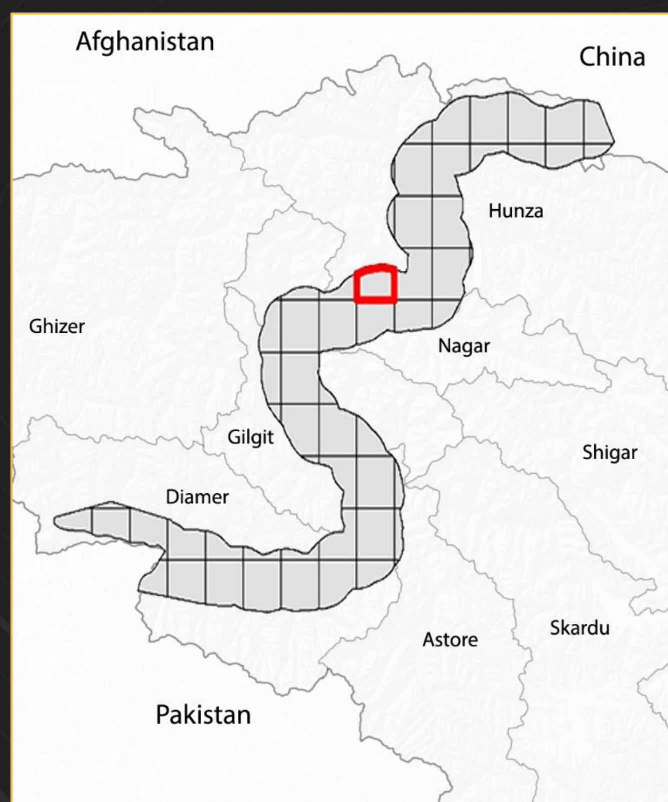
Land Use and Land Cover (LULC) Statistics Map of Zone 21

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	67.96	97.292
Bui		Built-up	0.85	1.220
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	10.57	15.133
Gl		Glacier	4.08	5.836
GlD		Glacier with Debris	3.61	5.161
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0.44	0.631
NvW		Natural Vegetation in Wet Area	0.55	0.789
RanLands		Range Land	3.27	4.674
SnP		Snow Permanent	9.05	13.046
Wet		Wet Areas	0.26	0.375
Total Area (Sq km)				**144.157**

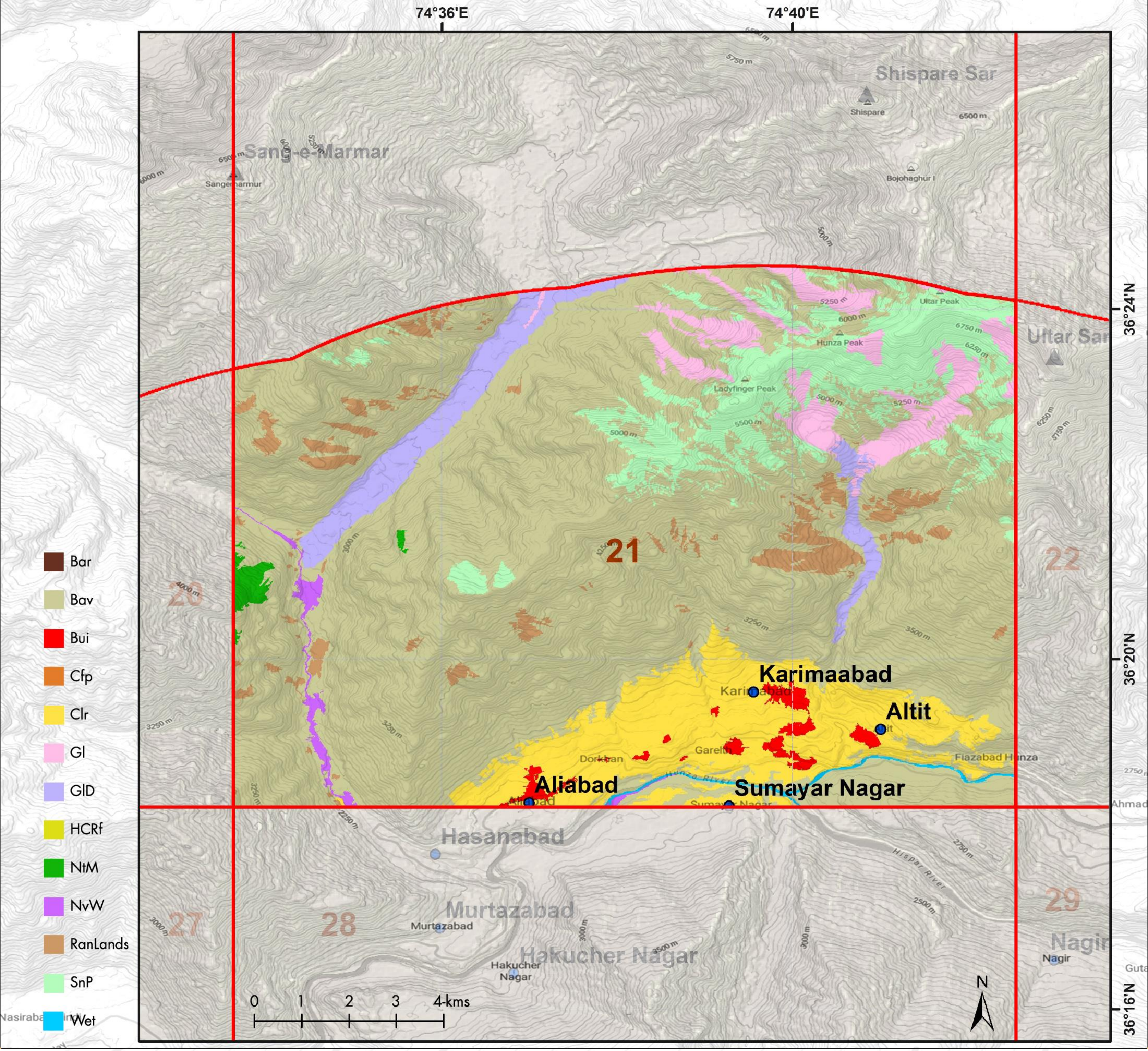
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



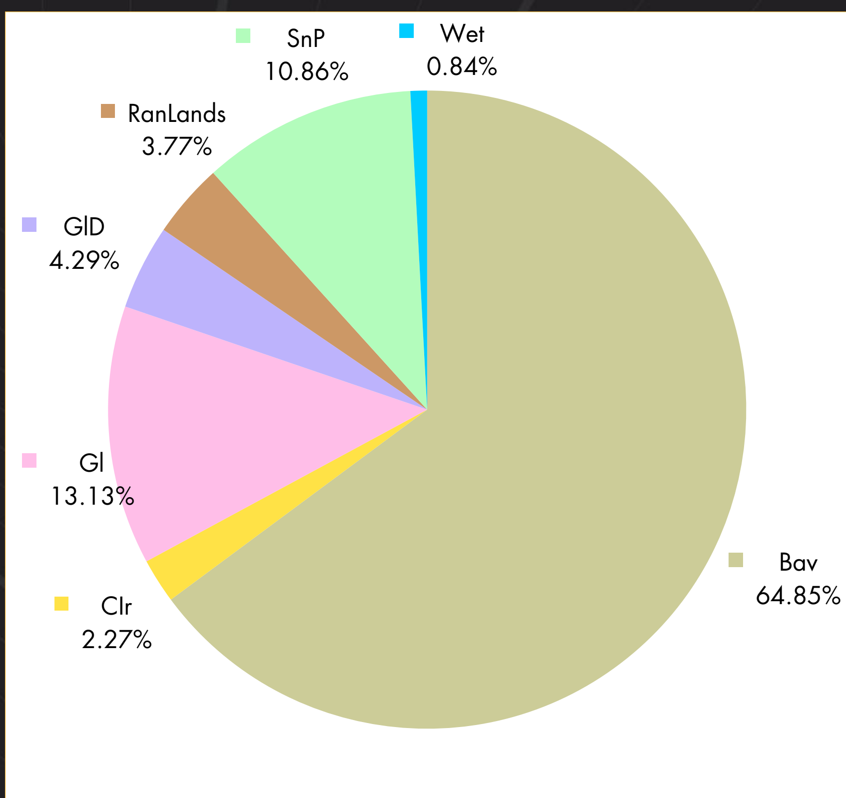
Map zone on the facing page.


74°36'E
74°40'E
36°24'N
36°20'N
36°16'N
Shispare Sar
Shispare
Sang-e-Marmar
Bojohaghur I
Ultar Peak
Hunza Peak
Ultar Sar
Ladyfinger Peak
21
20
22
27
28
29
Karimaabad
Altit
Aliabad
Sumayar Nagar
Dorkhan
Garelth
Fiazabad Hunza
Hasanabad
Murtazabad
Hakucher Nagar
Nagir
Hispar River
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4-kms
N

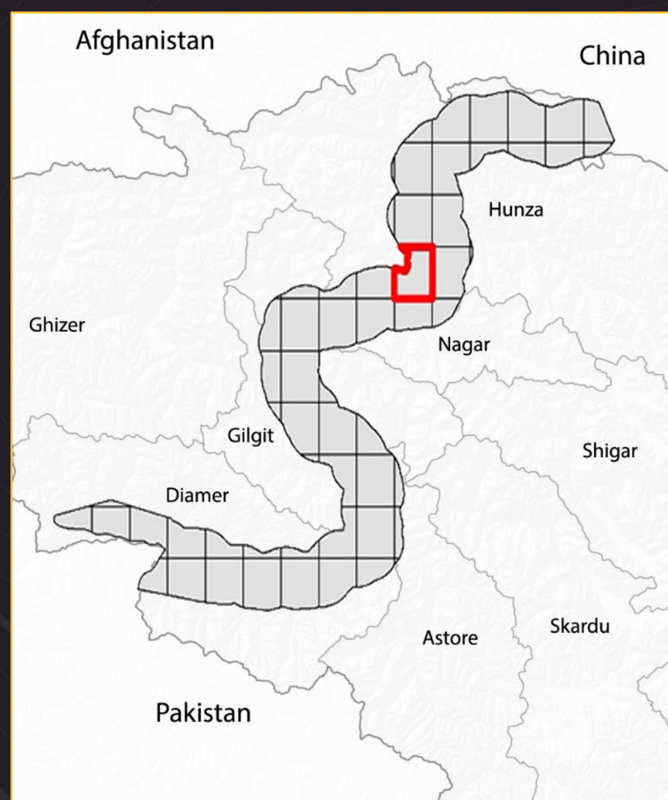
Land Use and Land Cover (LULC) Statistics Map of Zone 22

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	64.85	136.509
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	2.26	4.772
Gl		Glacier	13.13	27.631
GlD		Glacier with Debris	4.29	9.033
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0.02	0.051
NvW		Natural Vegetation in Wet Area	0.07	0.154
RanLands		Range Land	3.77	7.944
SnP		Snow Permanent	10.86	22.856
Wet		Wet Areas	0.84	1.769
Total Area (Sq km)				**210.719**

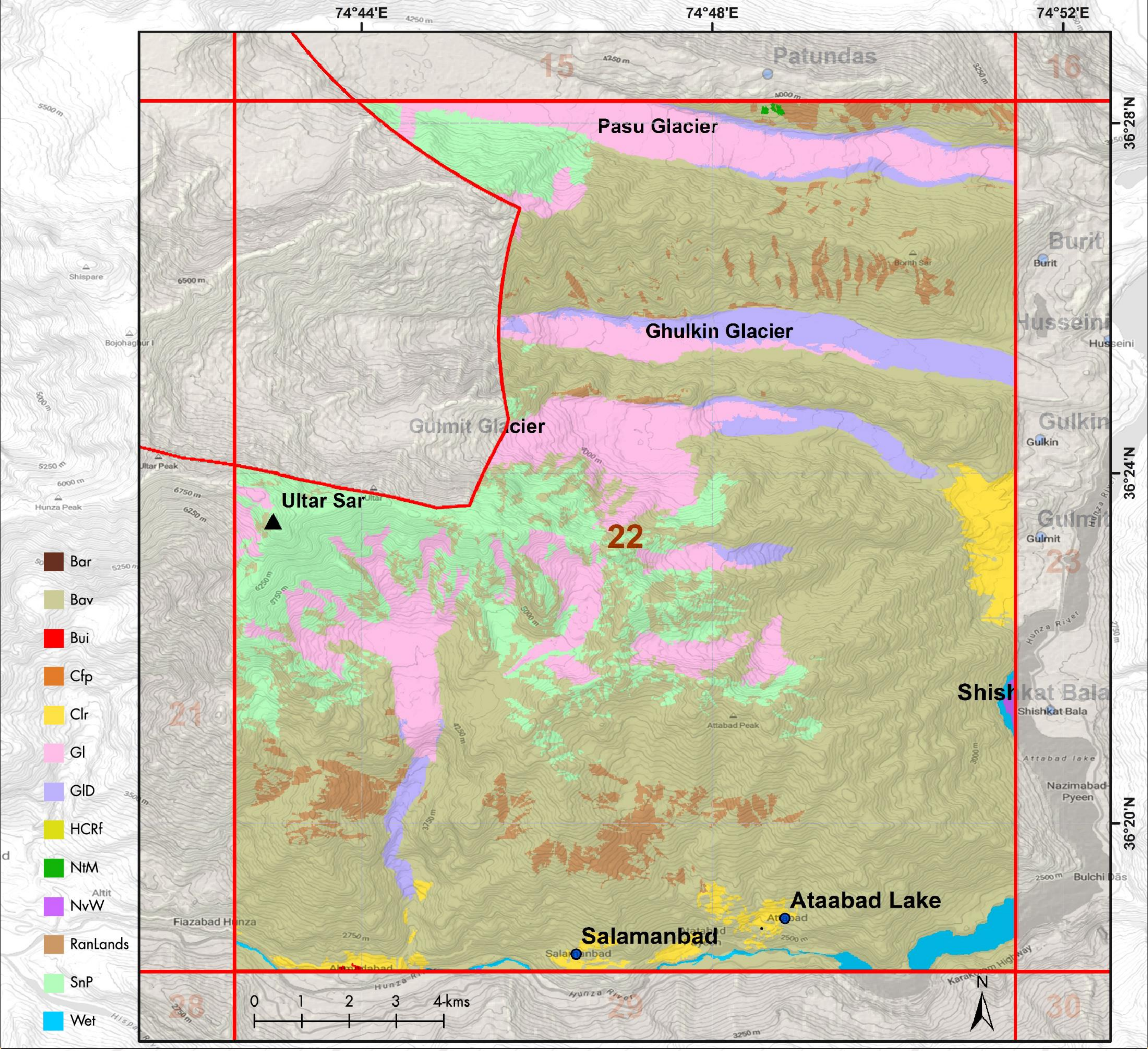
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



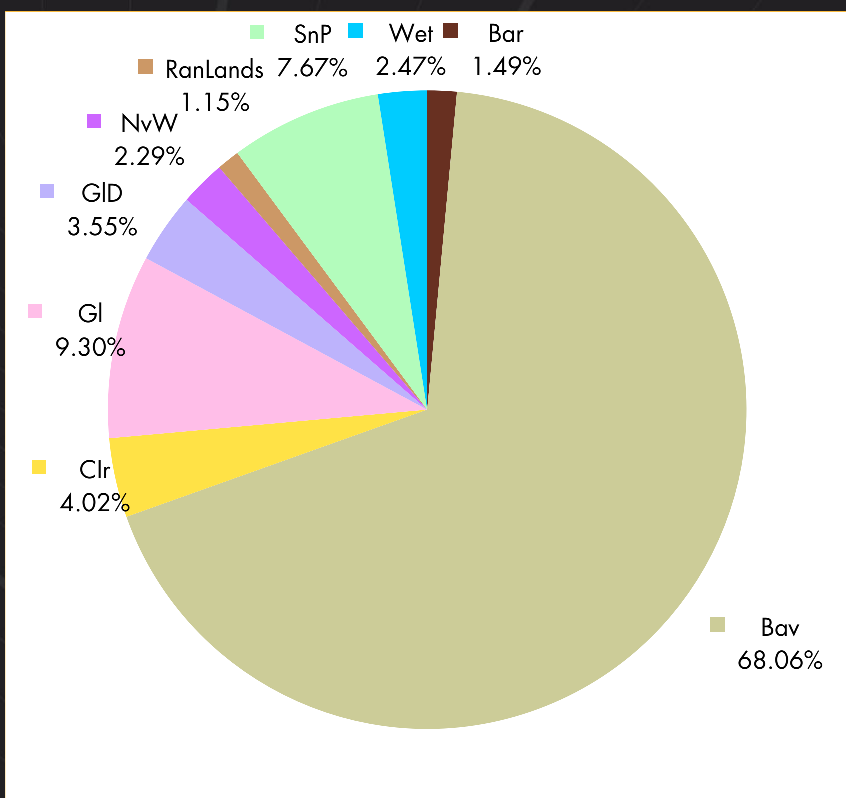
Map zone on the facing page.


74°44'E
74°48'E
74°52'E
36°28'N
36°24'N
36°20'N
Patundas
15
16
Pasu Glacier
Burit
Borith Sar
Ghulkin Glacier
Husseini
Gulkin
Gulmit Glacier
Gulmit
Ultar Sar
22
23
21
Shishkat Bala
Attabad Peak
Attabad lake
Nazimabad-Pyeen
Bulchi Dās
Ataabad Lake
Salamanbad
Fiazabad Hunza
Hunza River
Karakoram Highway
28
29
30
Shispare
Bojohaghur I
Ultar Peak
Hunza Peak
Altit
Janabad
0 1 2 3 4-kms
N
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet

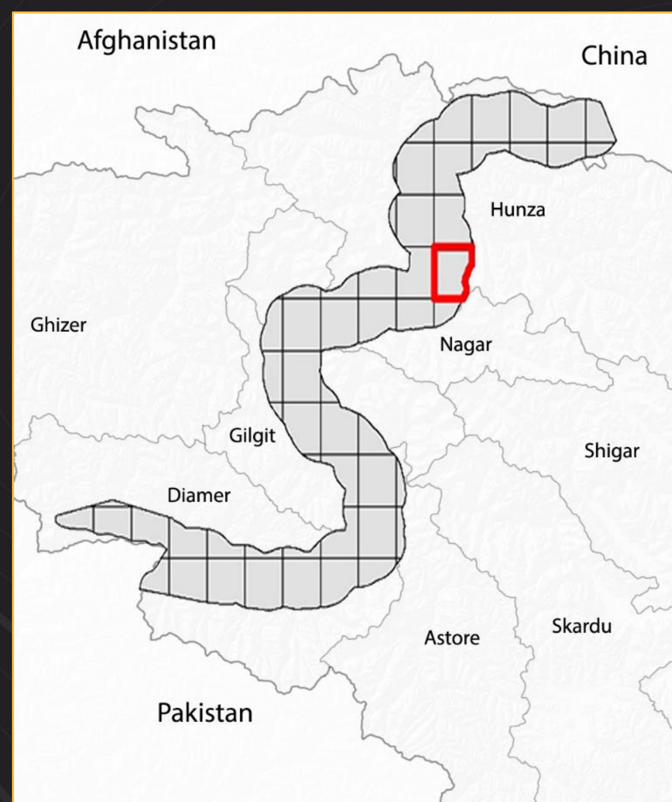
Land Use and Land Cover (LULC) Statistics Map of Zone 23

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	1.49	3.300
Bav		Bare Area with Sparse Natural Vegetation	68.06	150.929
Bui		Built-up	0.09	0.210
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	4.01	8.911
Gl		Glacier	9.30	20.616
GlD		Glacier with Debris	3.55	7.881
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0.04	0.096
NvW		Natural Vegetation in Wet Area	2.29	5.076
RanLands		Range Land	1.15	2.559
SnP		Snow Permanent	7.67	16.999
Wet		Wet Areas	2.47	5.481
		Total Area (Sq km)		**222.058**

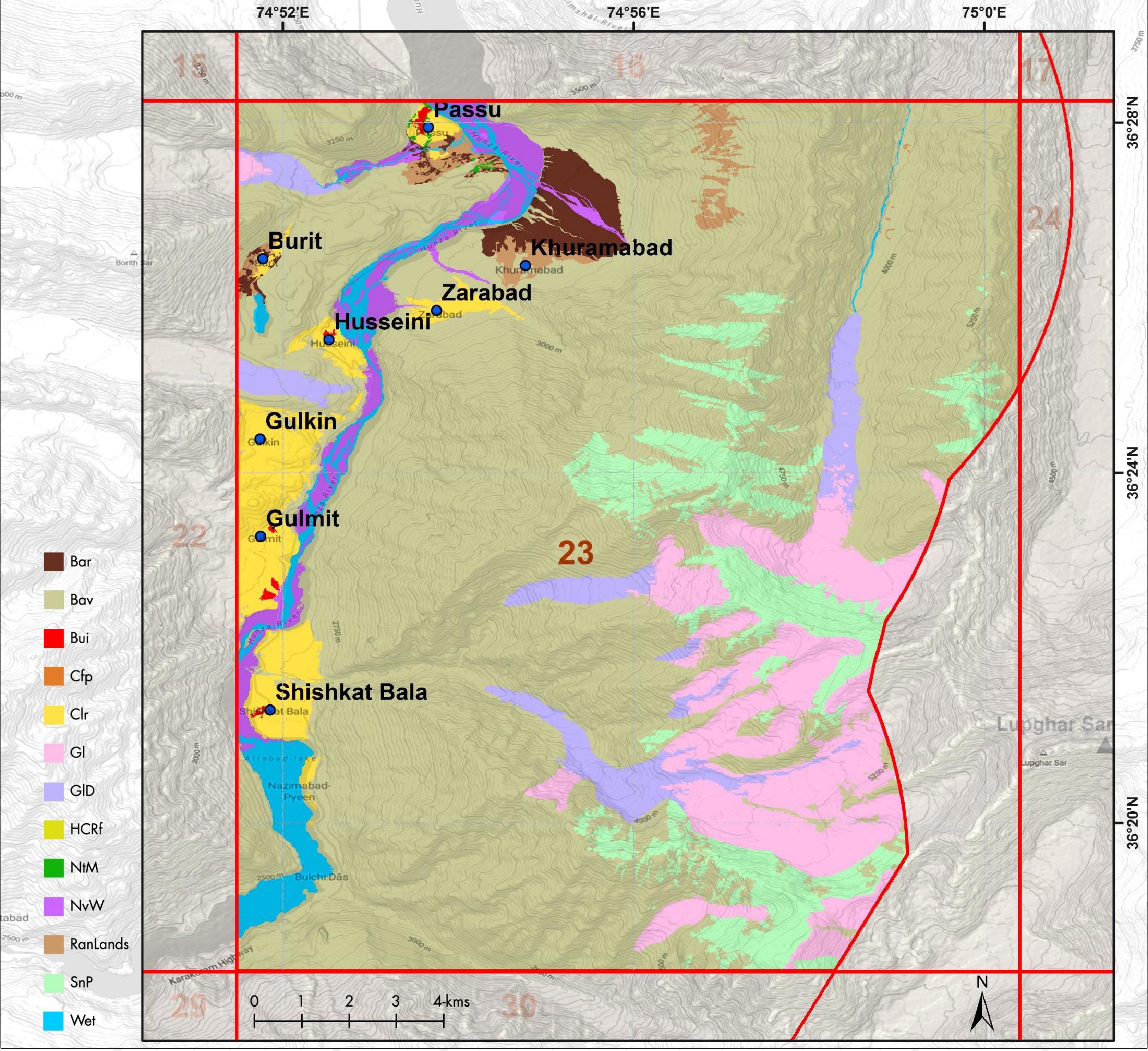
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



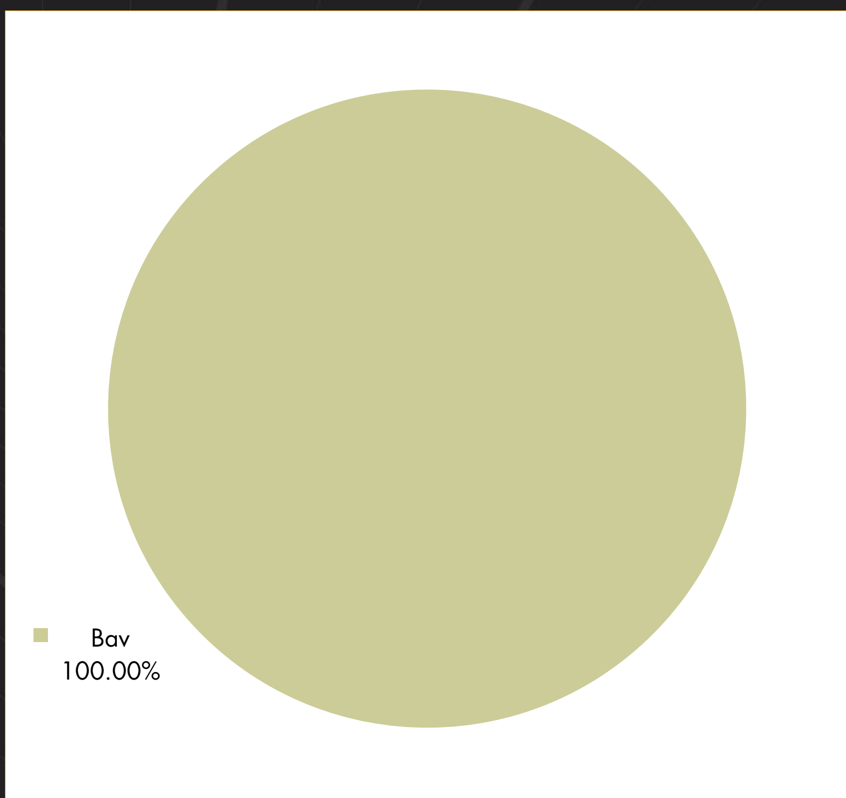
Map zone on the facing page.


74°52'E
74°56'E
75°0'E
36°28'N
36°24'N
36°20'N
15
16
17
22
23
24
29
30
Passu
Burit
Khuramabad
Zarabad
Husseini
Gulkin
Gulmit
Shishkat Bala
Nazimabad-Pyeen
Bulchi Dās
Attabad lake
Janabad
Hunza River
Shimshal River
Karakoram Highway
Lupghar Sar
Borith Sar
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4-kms
N

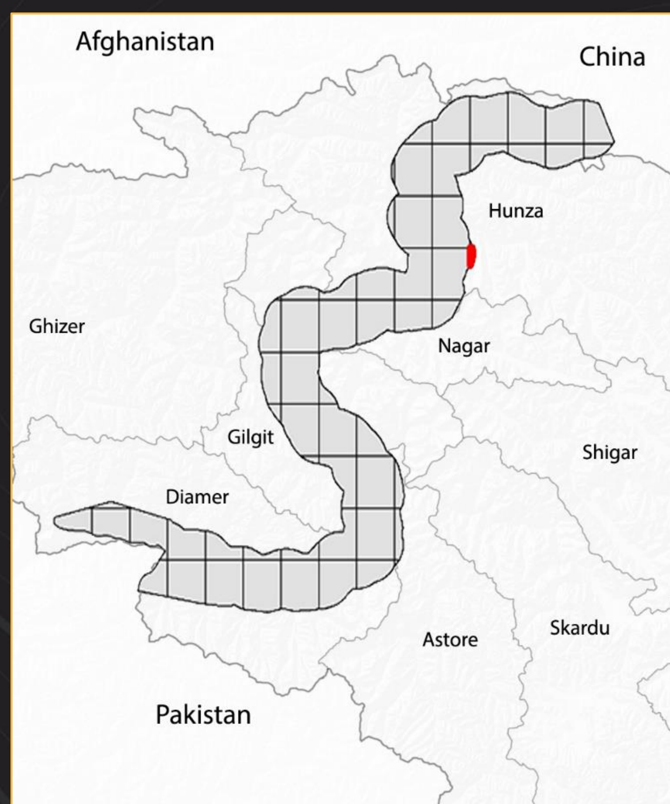
Land Use and Land Cover (LULC) Statistics Map of Zone 24

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	100.00	4.130
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	0	0
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0	0
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	0	0
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
Total Area (Sq km)				**4.130**

LULC Statistic of Zone on the facing page.

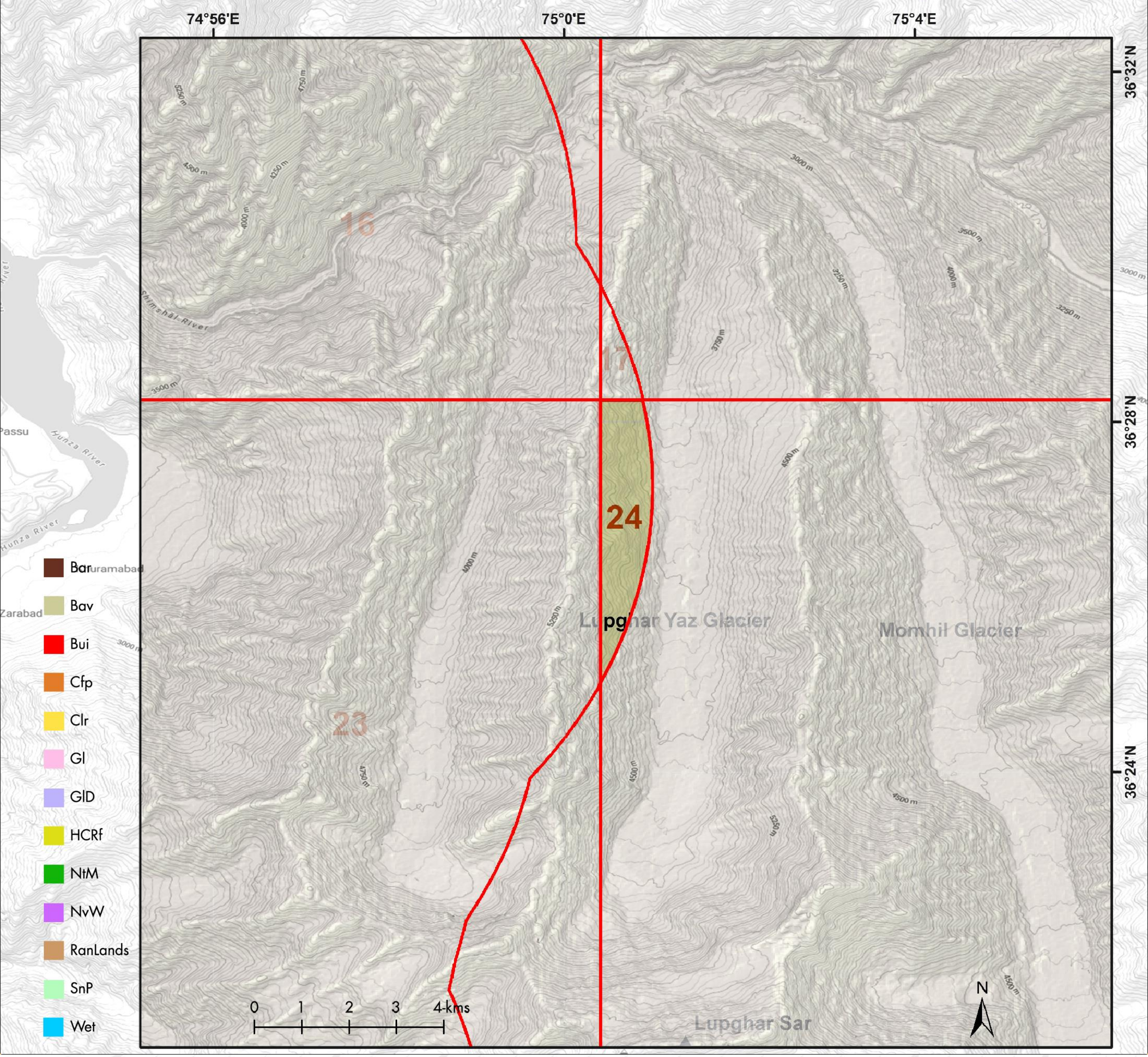


Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

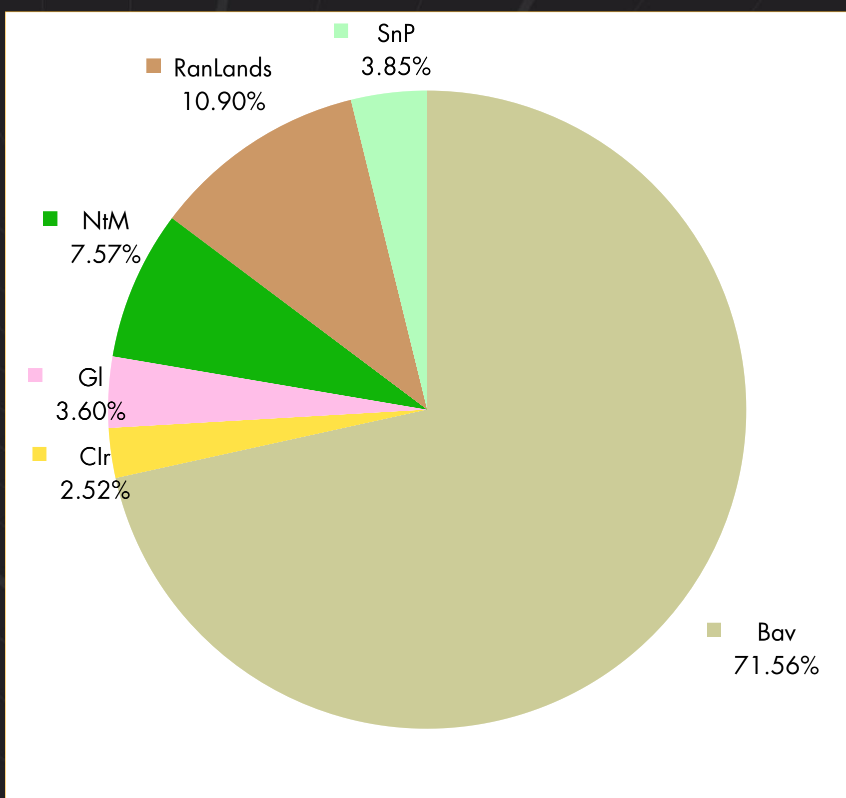
ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan



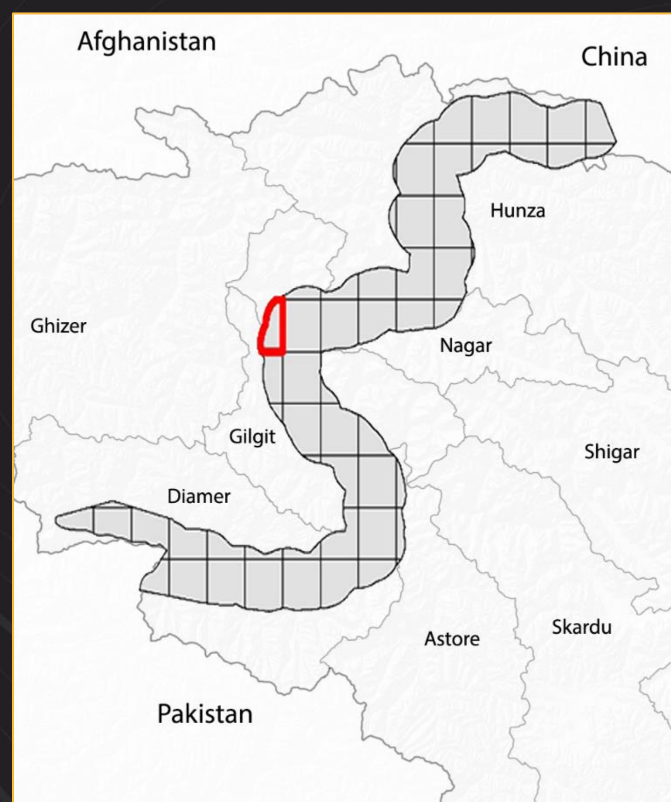
Land Use and Land Cover (LULC) Statistics Map of Zone 25

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	71.56	82.038
Bui		Built-up	0.02	0.025
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	2.51	2.894
Gl		Glacier	3.58	4.124
GlD		Glacier with Debris	0.47	0.548
HCRf		Herbaceous Crop Rainfed	0.09	0.106
NtM		Forest – Natural Vegetation and Trees	7.57	8.680
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	10.90	12.502
SnP		Snow Permanent	3.83	4.412
Wet		Wet Areas	0	0
Total Area (Sq km)				**115.329**

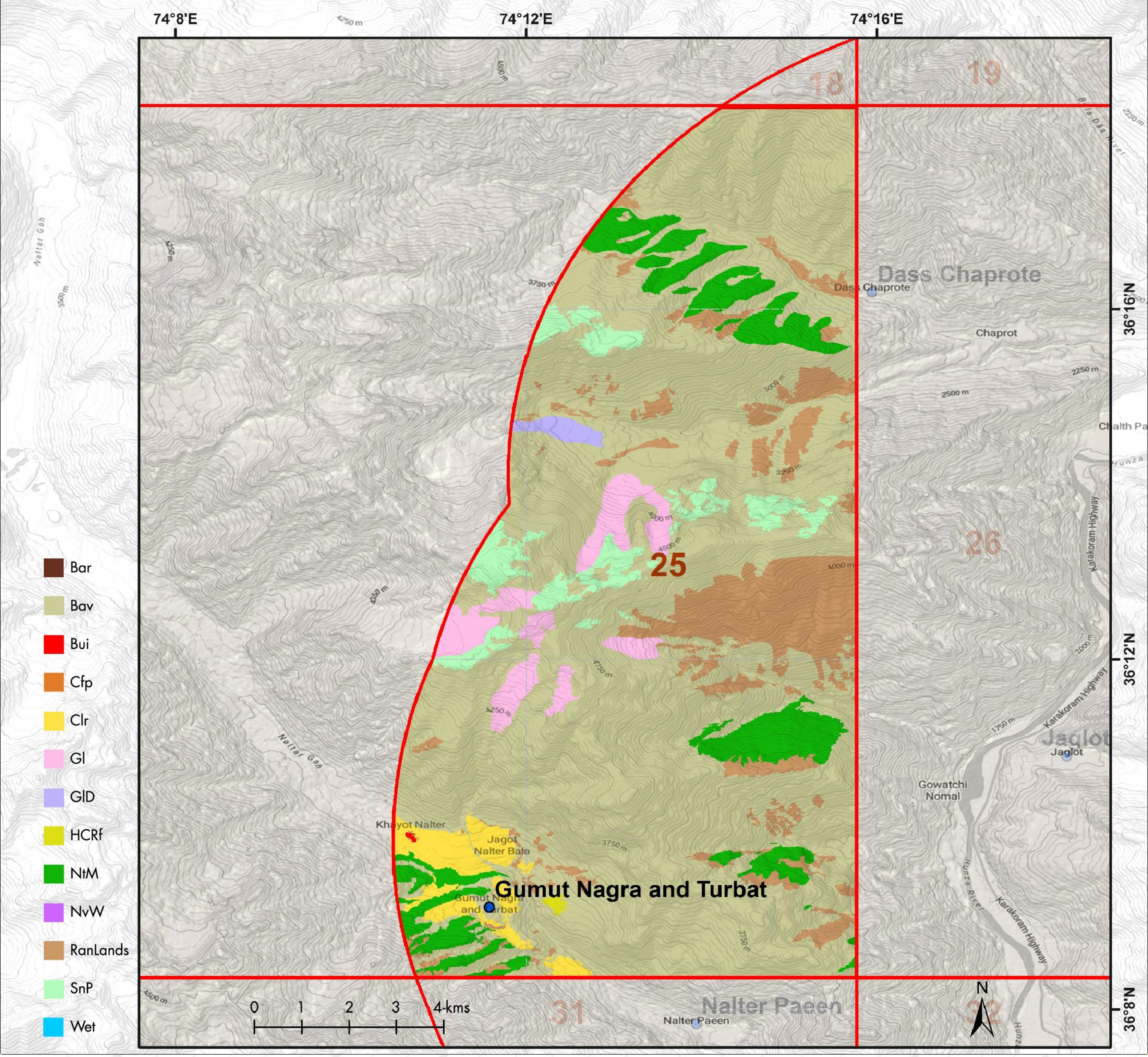
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



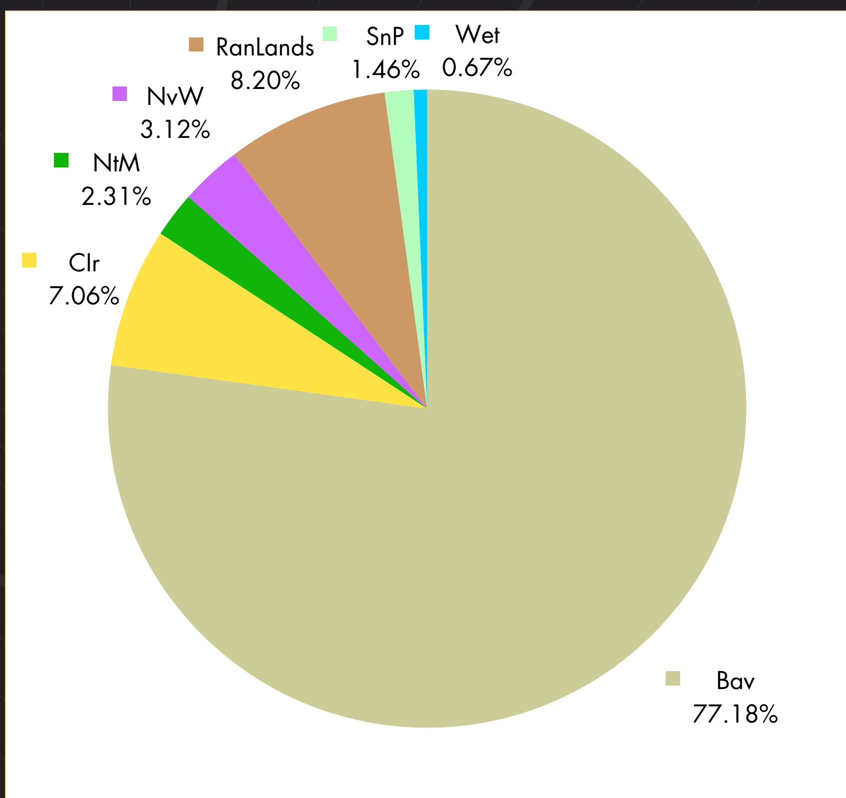
Map zone on the facing page.


74°8'E
74°12'E
74°16'E
36°16'N
36°12'N
36°8'N
18
19
25
26
31
32
Dass Chaprote
Dass Chaprote
Chaprot
Jaglot
Jaglot
Gowatchi Nomal
Nalter Paeen
Nalter Paeen
Khaiyot Nalter
Jagot Nalter Bala
Gumut Nagra and Turbat
Naltar Gah
Karakoram Highway
Hunza River
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4 kms
N

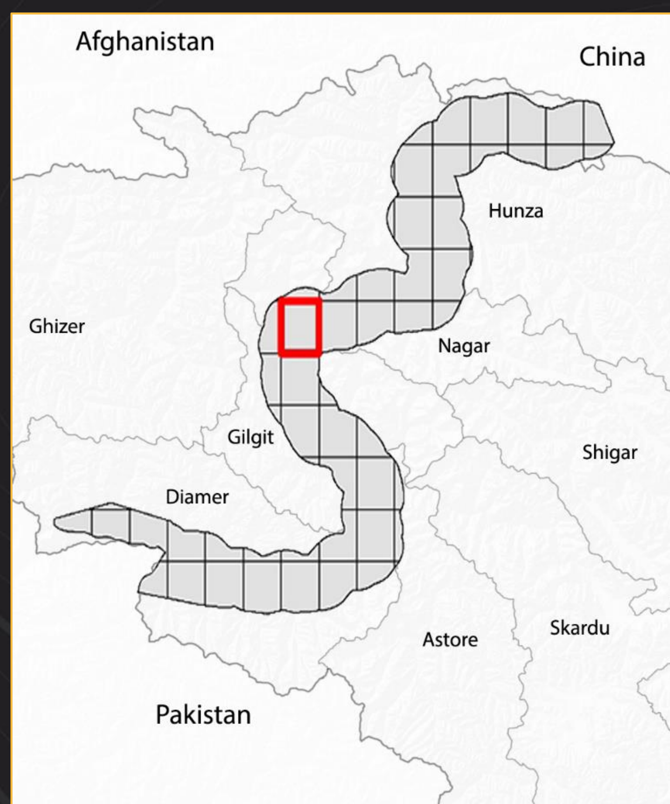
Land Use and Land Cover (LULC) Statistics Map of Zone 26

Legend	*Class Code*	*Abbreviation*	*Percentage (%)*	*Area (Sq Km)*
Bar		Bare Land	0.28	0.696
Bav		Bare Area with Sparse Natural Vegetation	77.18	188.603
Bui		Built-up	0.31	0.774
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	7.06	17.262
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	2.31	5.638
NvW		Natural Vegetation in Wet Area	3.10	7.619
RanLands		Range Land	8.20	20.027
SnP		Snow Permanent	1.45	3.561
Wet		Wet Areas	0.67	1.645
Total Area (Sq km)				**245.825**

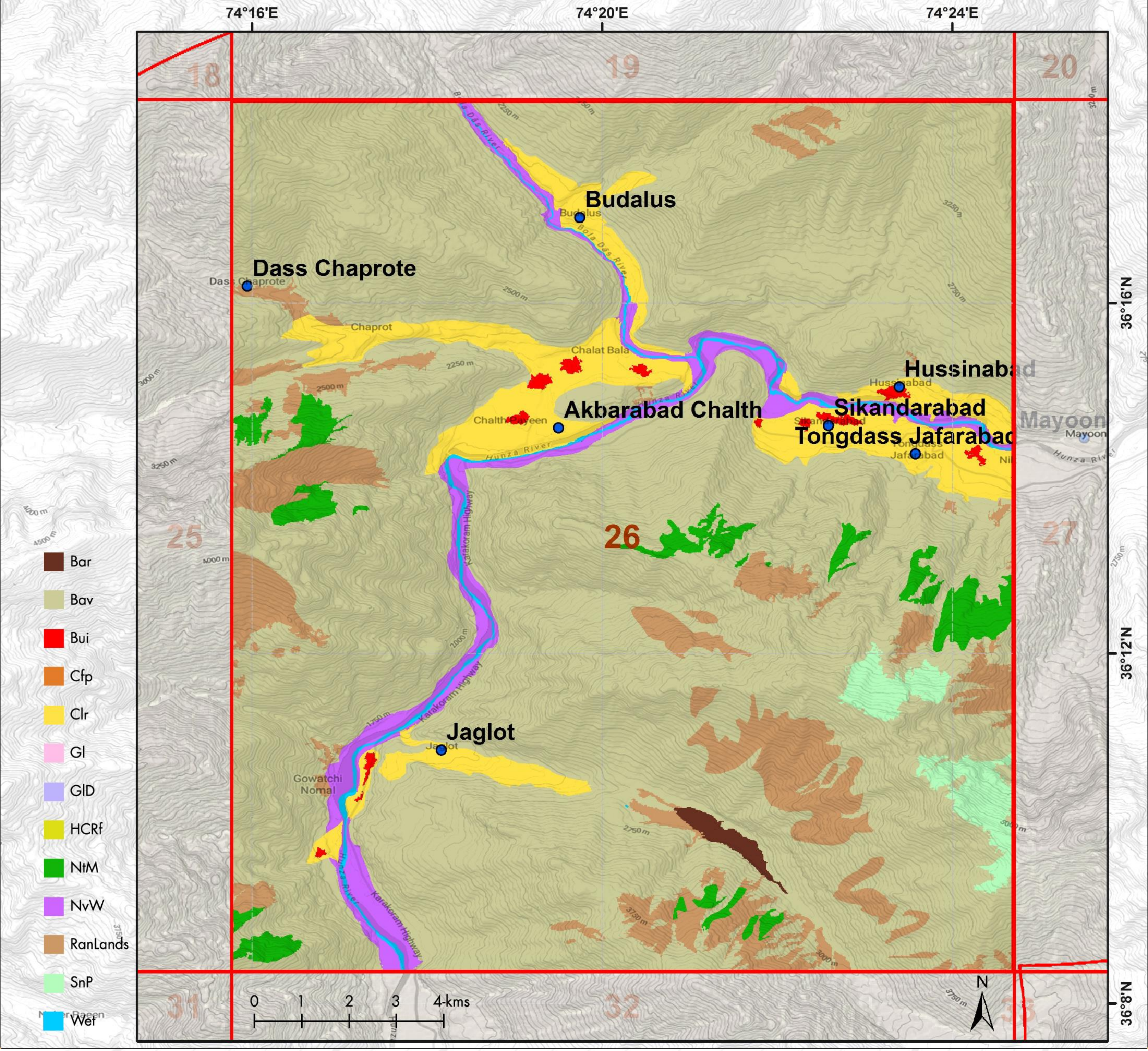
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



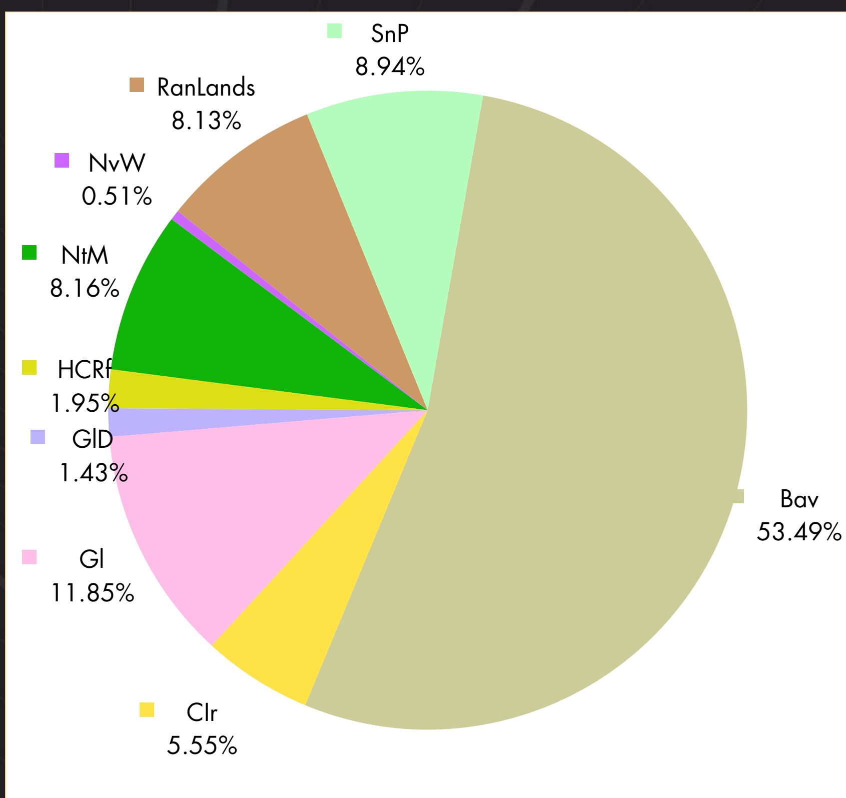
Map zone on the facing page.


74°16'E
74°20'E
74°24'E
36°16'N
36°12'N
36°8'N
18
19
20
25
26
27
31
32
Budalus
Dass Chaprote
Chaprot
Chalat Bala
Akbarabad Chalth
Chalth Payeen
Hunza River
Hussinabad
Sikandarabad
Tongdass Jafarabad
Mayoon
Jaglot
Gowatchi Nomal
Bola Das River
Karakoram Highway
Turbato Dass Chalth
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4 kms
N

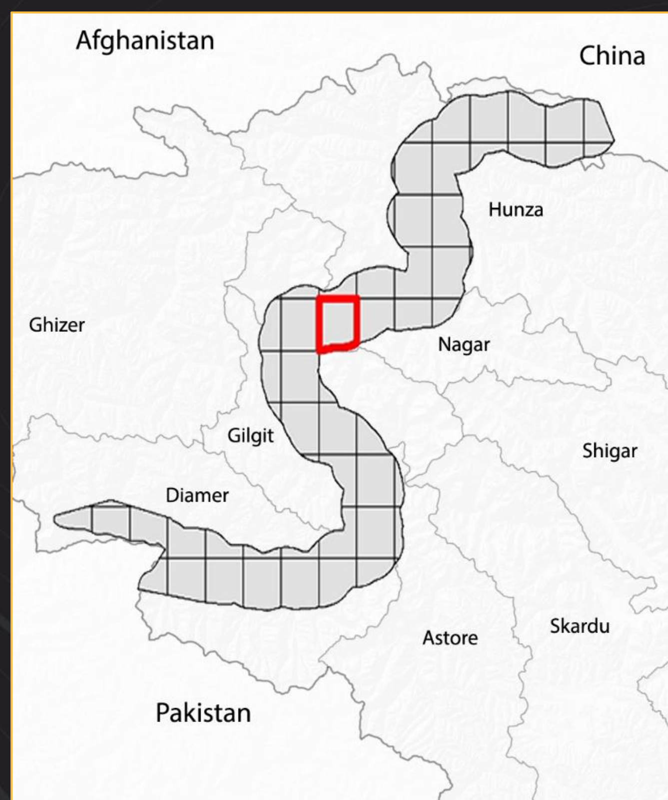
Land Use and Land Cover (LULC) Statistics Map of Zone 27

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0.04	0.094
Bav		Bare Area with Sparse Natural Vegetation	53.49	122.928
Bui		Built-up	0.38	0.888
Cfp		Crop in Flood Plain	0.00	0.000
CIr		Crop Irrigated	5.55	12.759
Gl		Glacier	11.75	27.230
GlD		Glacier with Debris	1.42	3.289
HCRf		Herbaceous Crop Rainfed	1.93	4.482
NtM		Forest – Natural Vegetation and Trees	8.16	18.743
NvW		Natural Vegetation in Wet Area	0.50	1.164
RanLands		Range Land	8.13	18.687
SnP		Snow Permanent	8.94	20.553
Wet		Wet Areas	0.39	0.899
Total Area (Sq km)				**231.716**

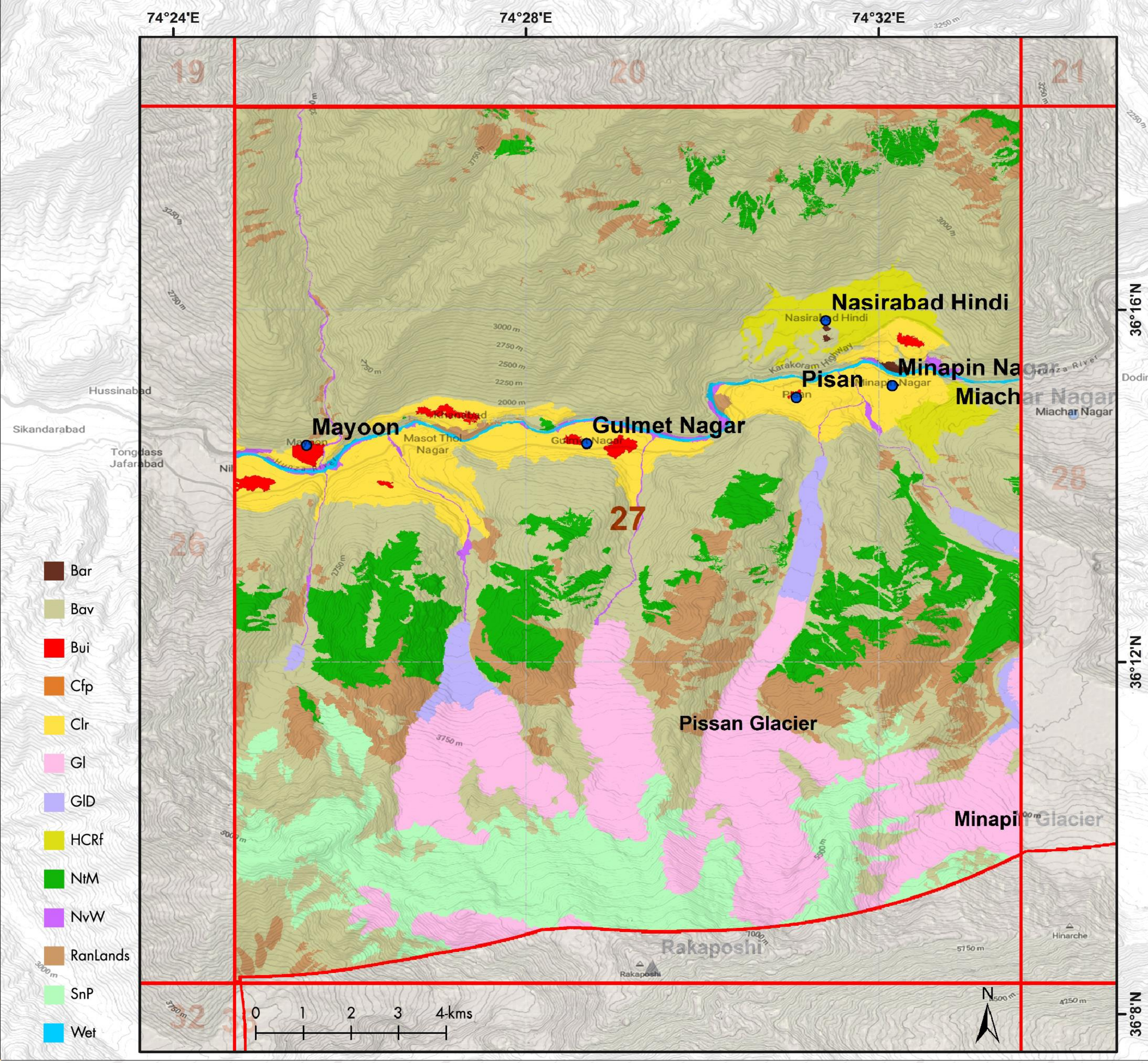
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



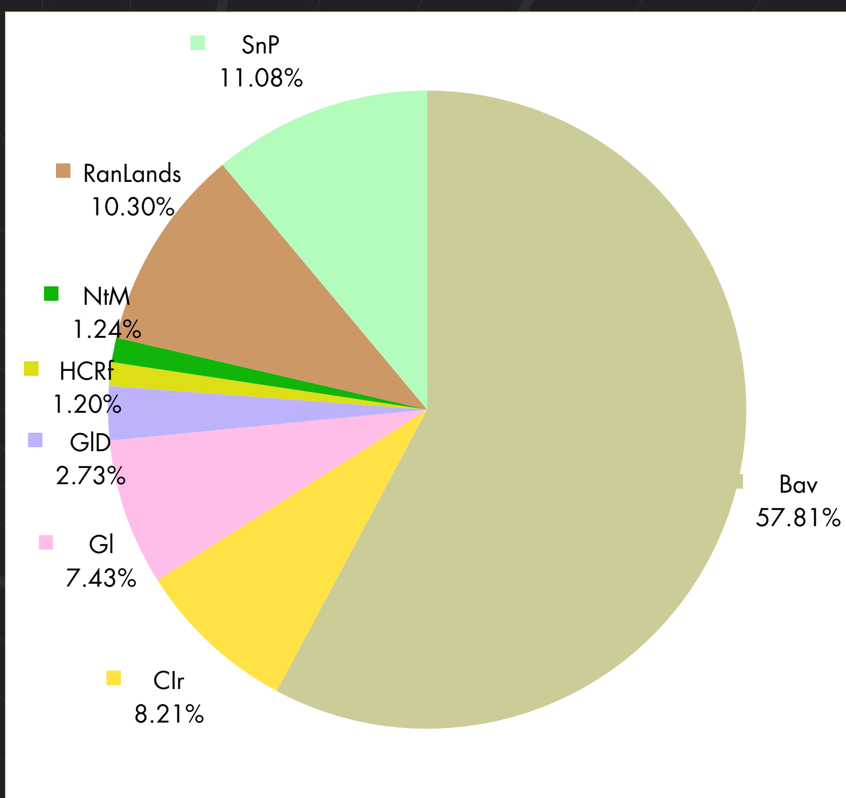
Map zone on the facing page.


74°24'E
74°28'E
74°32'E
36°16'N
36°12'N
36°8'N
19
20
21
26
27
28
32
Nasirabad Hindi
Minapin Nagar
Pisan
Miachar Nagar
Mayoon
Gulmet Nagar
Masot Thol Nagar
Karakoram Highway
Hunza River
Hussinabad
Sikandarabad
Tongdass Jafarabad
Dodim
Pissan Glacier
Minapin Glacier
Rakaposhi
Hinarche
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

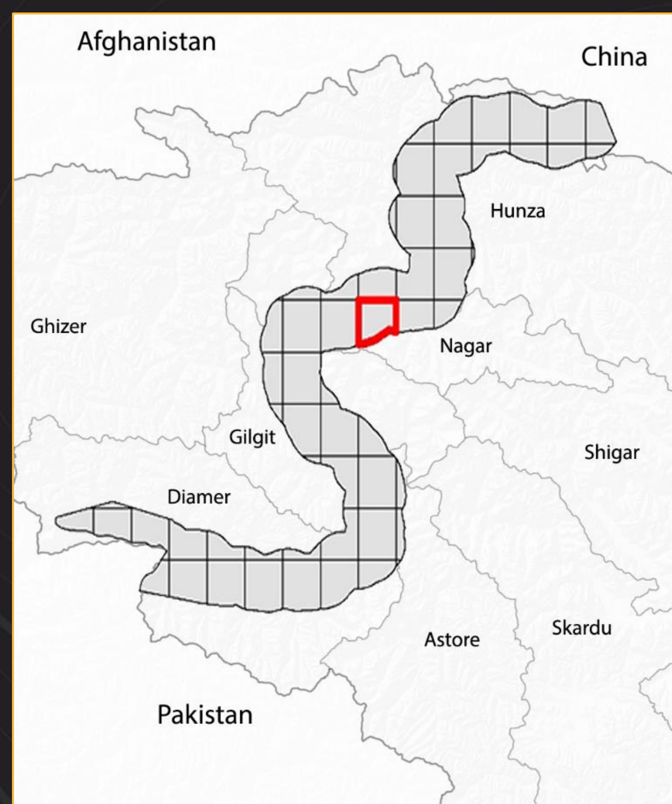
Land Use and Land Cover (LULC) Statistics Map of Zone 28

Legend	*Class Code*	*Abbreviation*	*Percentage (%)*	*Area (Sq Km)*
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	57.81	101.704
Bui		Built-up	0.37	0.663
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	8.21	14.452
Gl		Glacier	7.43	13.065
GlD		Glacier with Debris	2.71	4.809
HCRf		Herbaceous Crop Rainfed	1.18	2.103
NtM		Forest – Natural Vegetation and Trees	1.23	2.182
NvW		Natural Vegetation in Wet Area	0.13	0.226
RanLands		Range Land	10.30	18.119
SnP		Snow Permanent	10.97	19.491
Wet		Wet Areas	0.46	0.822
Total Area (Sq km)				**177.636**

LULC Statistic of Zone on the facing page.

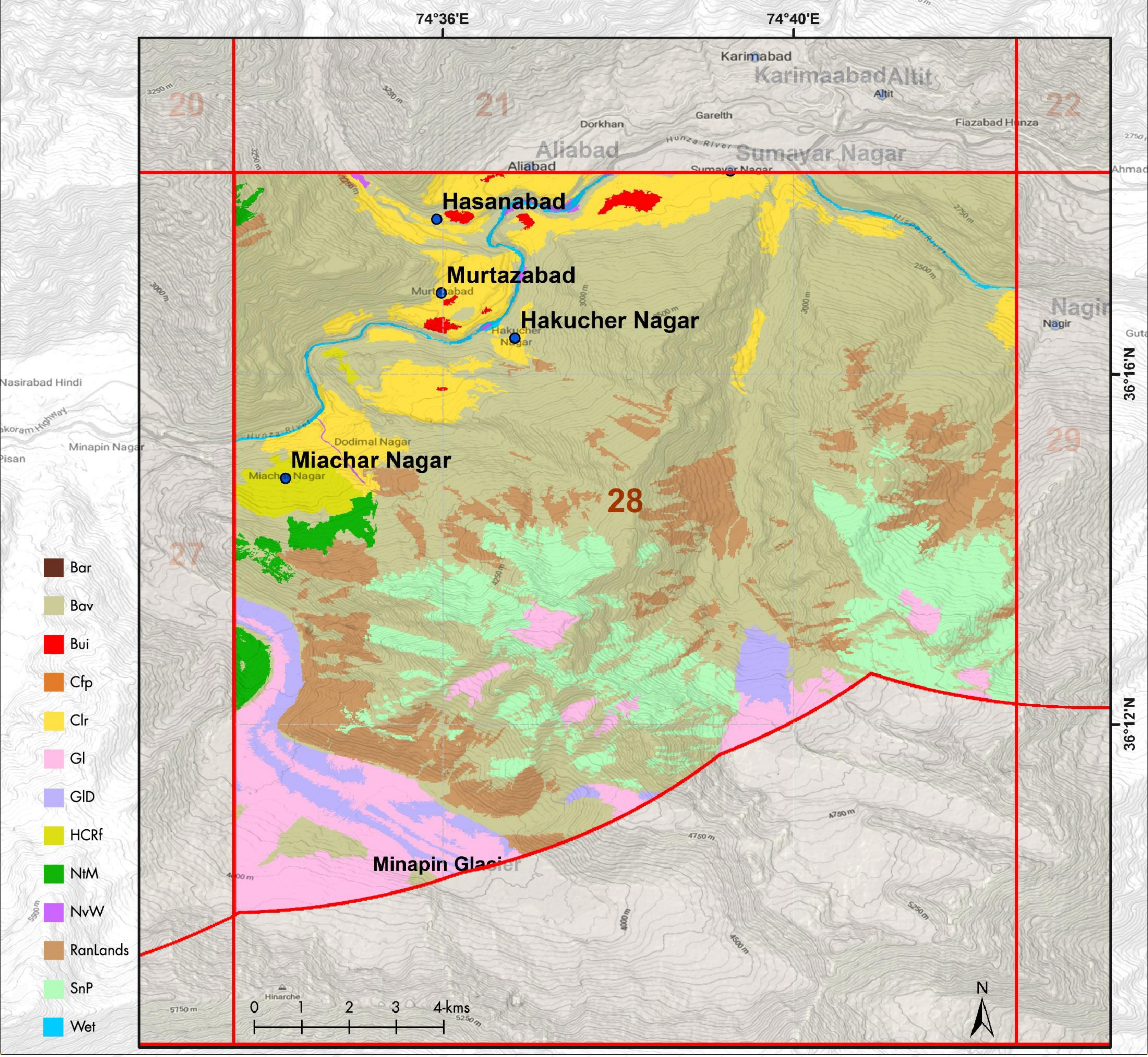


Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

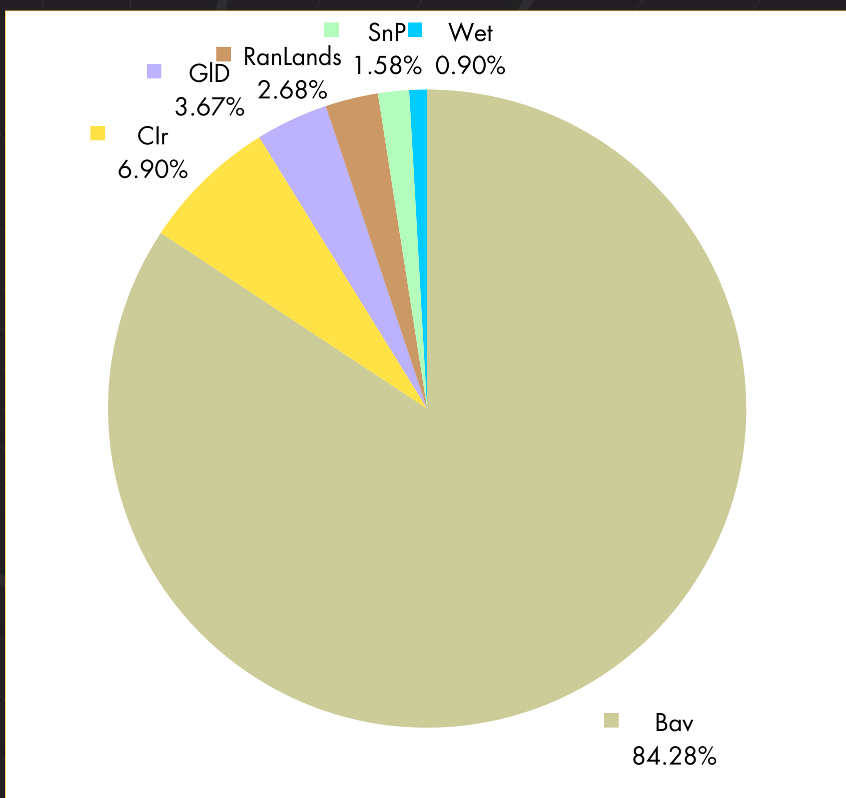
ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan



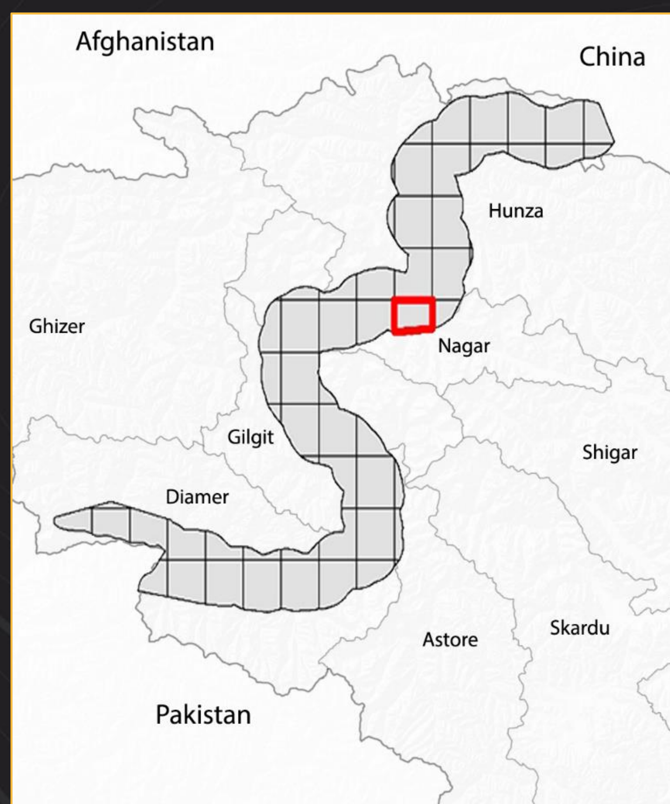
Land Use and Land Cover (LULC) Statistics Map of Zone 29

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	84.28	121.123
Bui		Built-up	0.07	0.098
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	6.90	9.918
Gl		Glacier	0.05	0.067
GlD		Glacier with Debris	3.67	5.276
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0	0
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	2.67	3.847
SnP		Snow Permanent	1.57	2.264
Wet		Wet Areas	0.89	1.286
Total Area (Sq km)				**143.879**

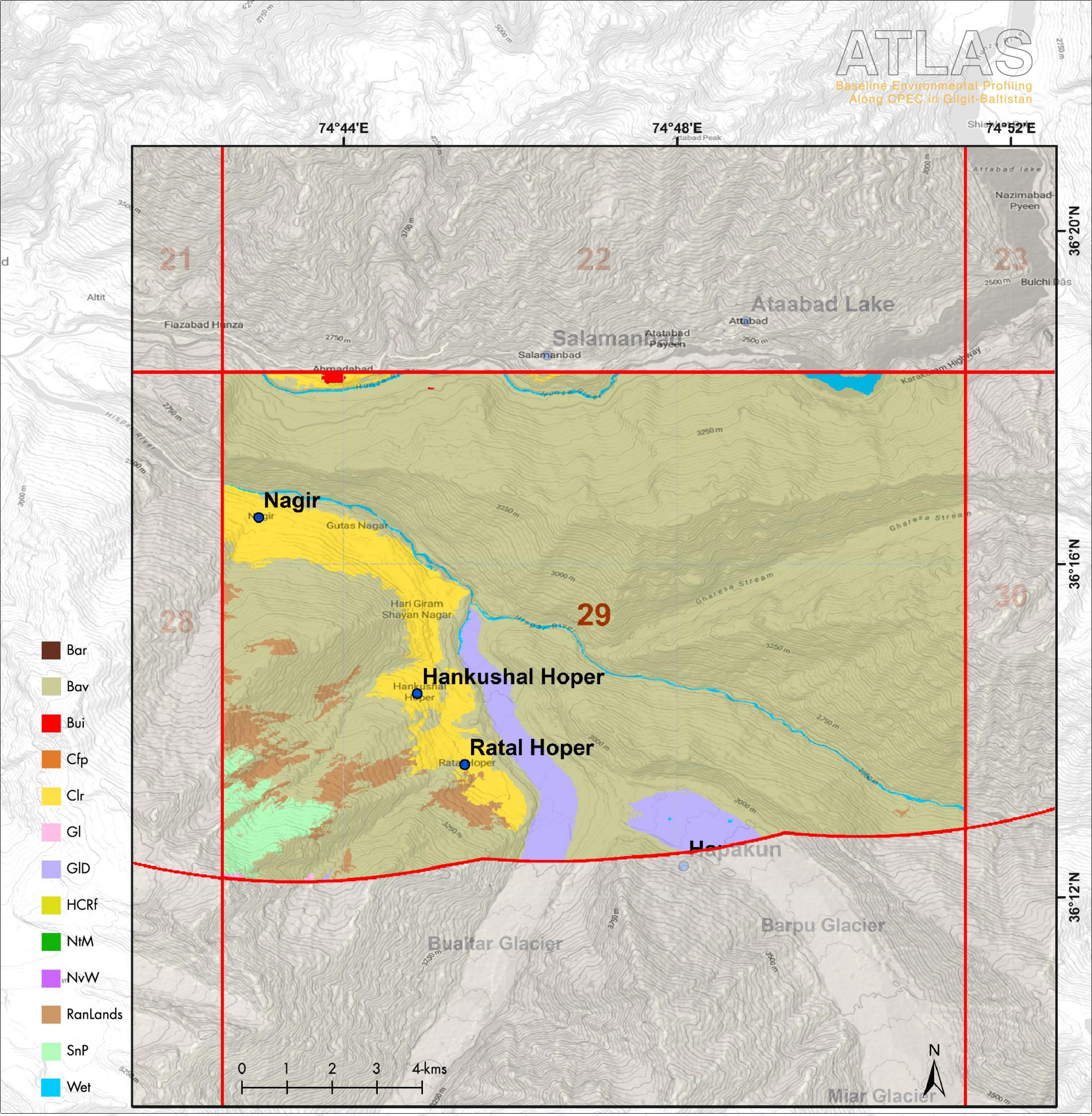
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



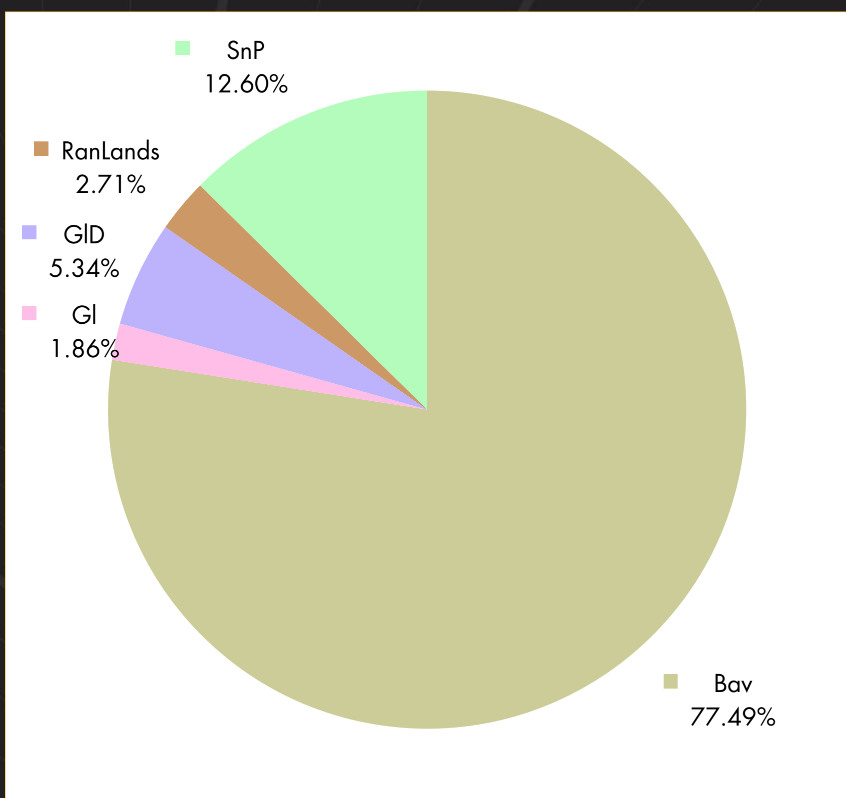
Map zone on the facing page.


74°44'E
74°48'E
74°52'E
36°20'N
36°16'N
36°12'N
21
22
23
28
29
30
Ataabad Lake
Salamanbad
Attabad
Nazimabad-Pyeen
Bulchi Dās
Fiazabad Hunza
Altit
Ahmadabad
Hunza River
Hispar River
Karakoram Highway
Nagir
Gutas Nagar
Hari Giram Shayan Nagar
Hankushal Hoper
Ratal Hoper
Gharesa Stream
Hapakun
Barpu Glacier
Bualtar Glacier
Miar Glacier
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4 kms
N

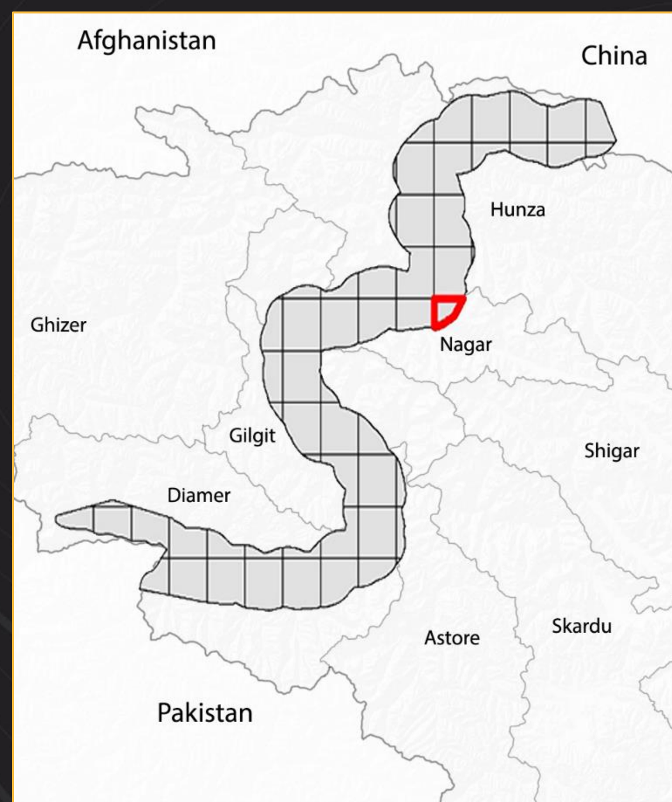
Land Use and Land Cover (LULC) Statistics Map of Zone 30

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	77.49	54.351
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	1.86	1.305
GlD		Glacier with Debris	5.34	3.746
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0	0
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	2.71	1.901
SnP		Snow Permanent	12.60	8.836
Wet		Wet Areas	0.03	0.021
Total Area (Sq km)				**70.160**

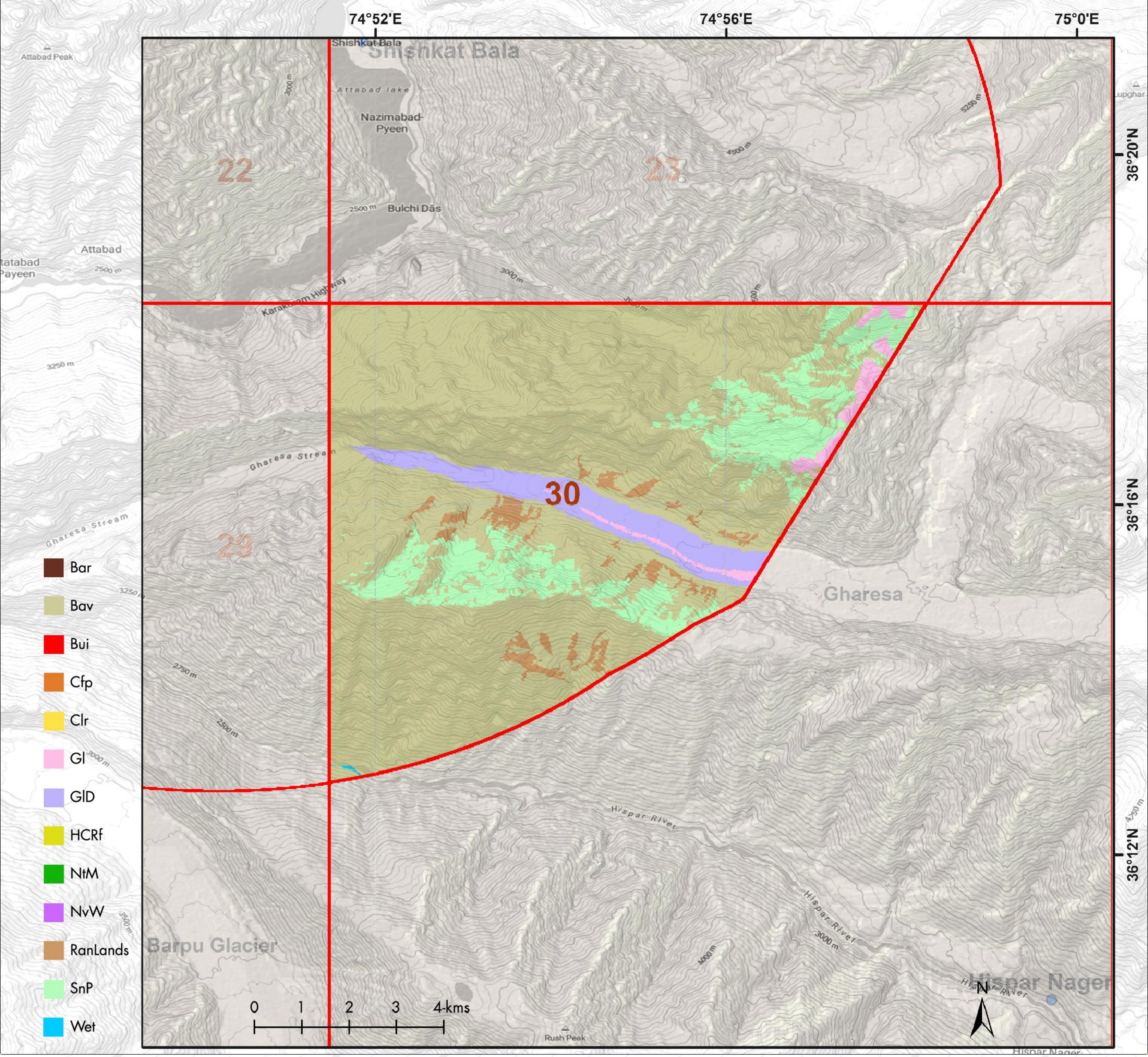
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



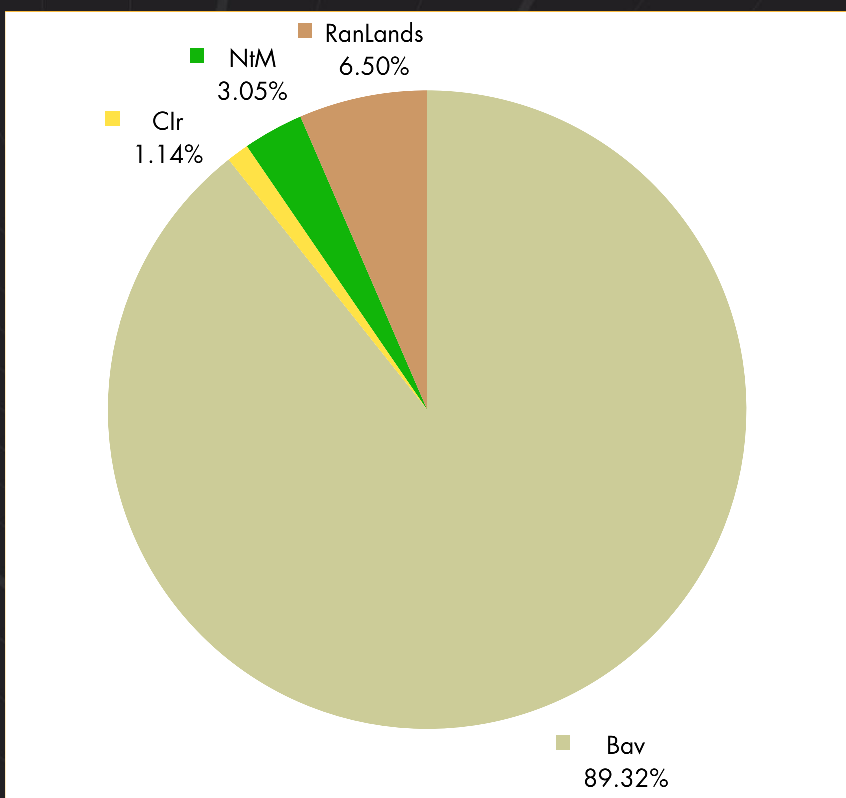
Map zone on the facing page.


74°52'E
74°56'E
75°0'E
36°20'N
36°16'N
36°12'N
22
23
29
30
Shishkat Bala
Attabad lake
Nazimabad-Pyeen
Bulchi Dās
Attabad
Attabad Peak
Karakoram Highway
Gharesa Stream
Gharesa
Hispar River
Barpu Glacier
Hispar Nager
Rush Peak
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

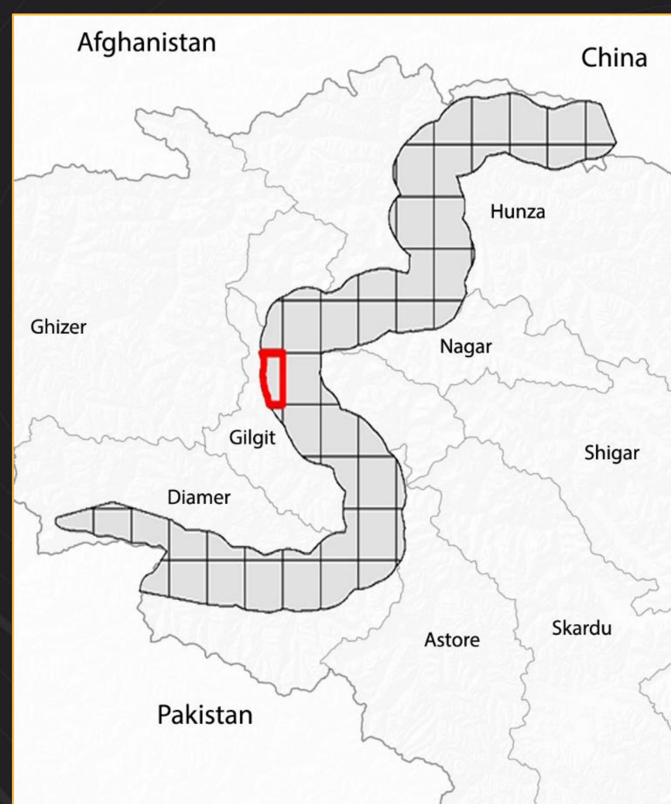
Land Use and Land Cover (LULC) Statistics Map of Zone 31

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	89.32	106.560
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	1.13	1.355
Gl		Glacier	0.19	0.233
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	3.05	3.636
NvW		Natural Vegetation in Wet Area	0.30	0.365
RanLands		Range Land	6.50	7.755
SnP		Snow Permanent	0	0
Wet		Wet Areas	0.12	0.150
Total Area (Sq km)				**120.054**

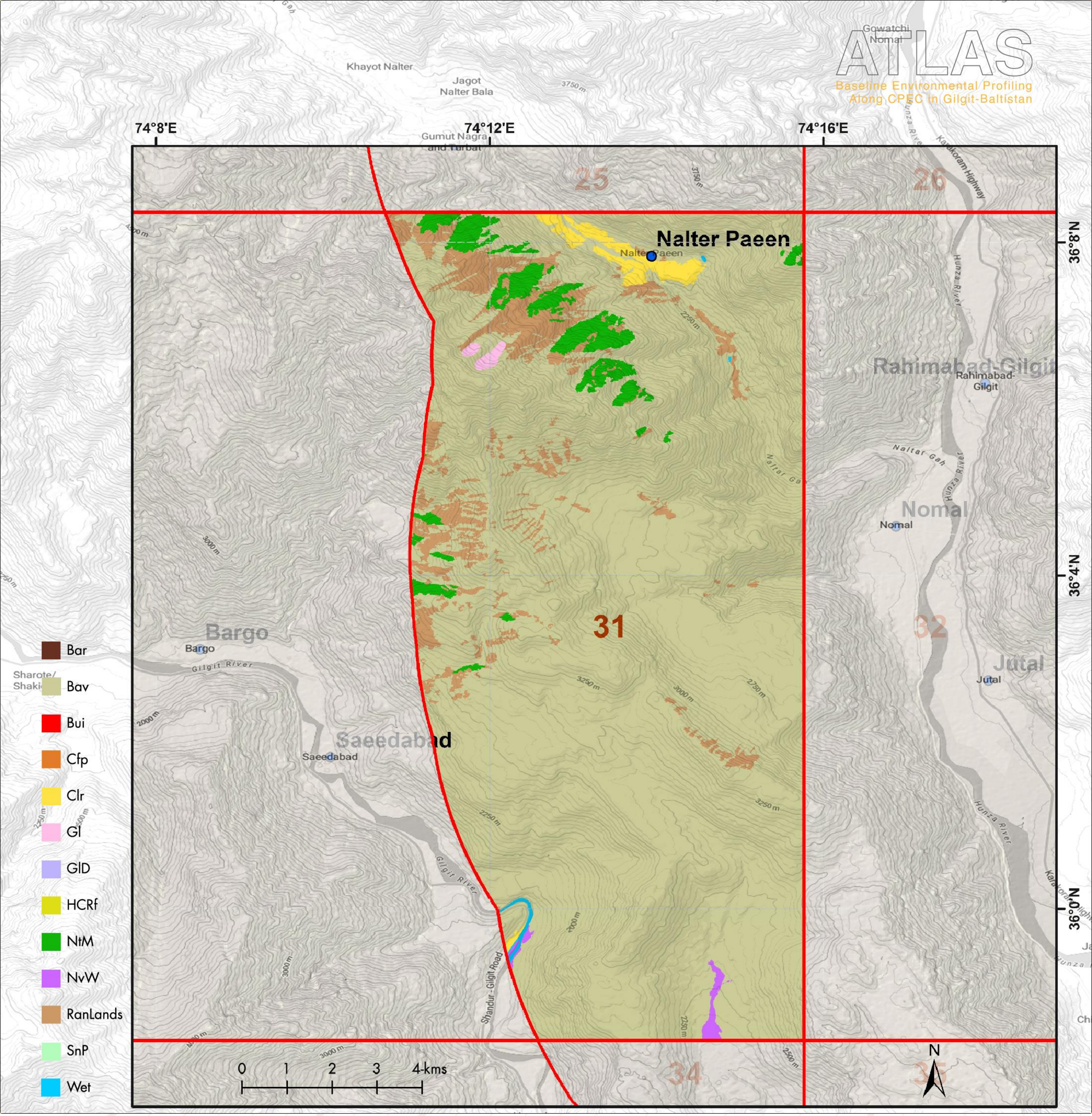
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



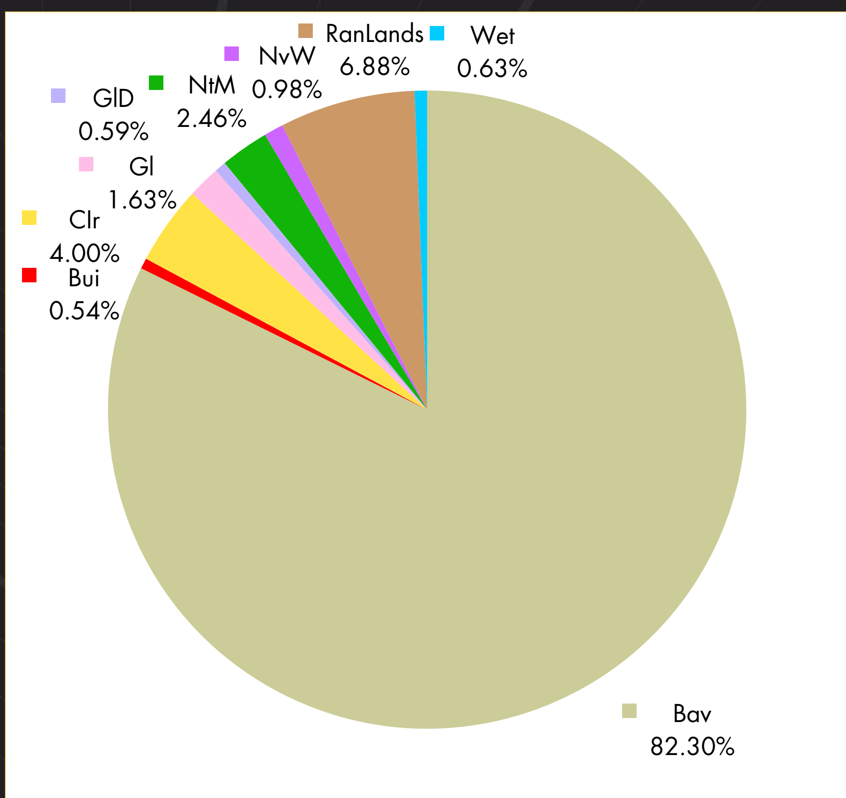
Map zone on the facing page.


ATLAS
Baseline Environmental Profiling Along CPEC in Gilgit-Baltistan
74°8'E
74°12'E
74°16'E
36°8'N
36°4'N
36°0'N
25
26
31
32
34
35
Nalter Paeen
Rahimabad-Gilgit
Nomal
Jutal
Bargo
Saeedabad
Khayot Nalter
Jagot Nalter Bala
Gumut Nagra and Turbat
Gowatchi Nomal
Gilgit River
Hunza River
Naltar Gah
Karakoram Highway
Shandur - Gilgit Road
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4-kms
N

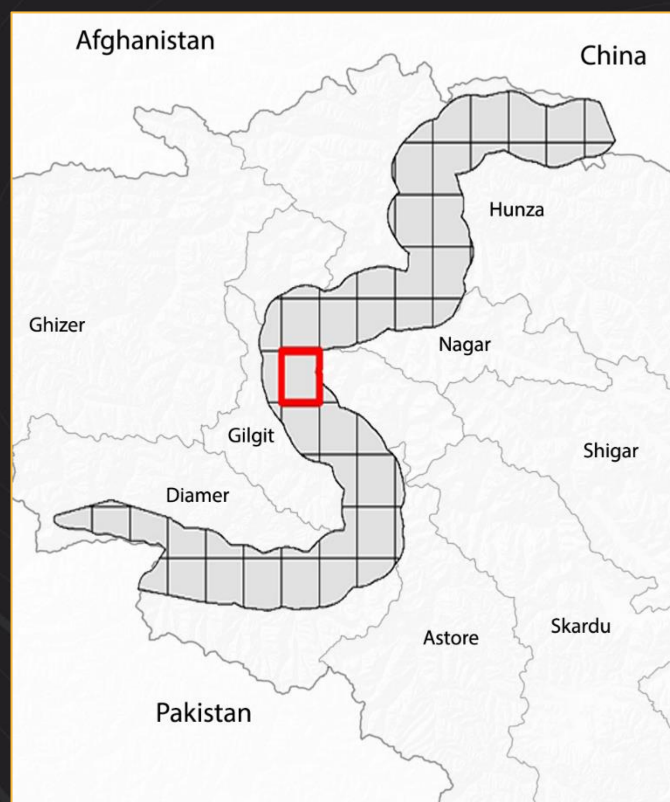
Land Use and Land Cover (LULC) Statistics Map of Zone 32

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0.02	0.057
Bav		Bare Area with Sparse Natural Vegetation	82.30	202.374
Bui		Built-up	0.54	1.316
Cfp		Crop in Flood Plain	0.00	0.000
Clr		Crop Irrigated	4.00	9.835
Gl		Glacier	1.63	4.019
GlD		Glacier with Debris	0.59	1.439
HCRf		Herbaceous Crop Rainfed	0.00	0.000
NtM		Forest – Natural Vegetation and Trees	2.46	6.048
NvW		Natural Vegetation in Wet Area	0.98	2.402
RanLands		Range Land	6.88	16.905
SnP		Snow Permanent	0.02	0.039
Wet		Wet Areas	0.63	1.547
Total Area (Sq km)				**245.981**

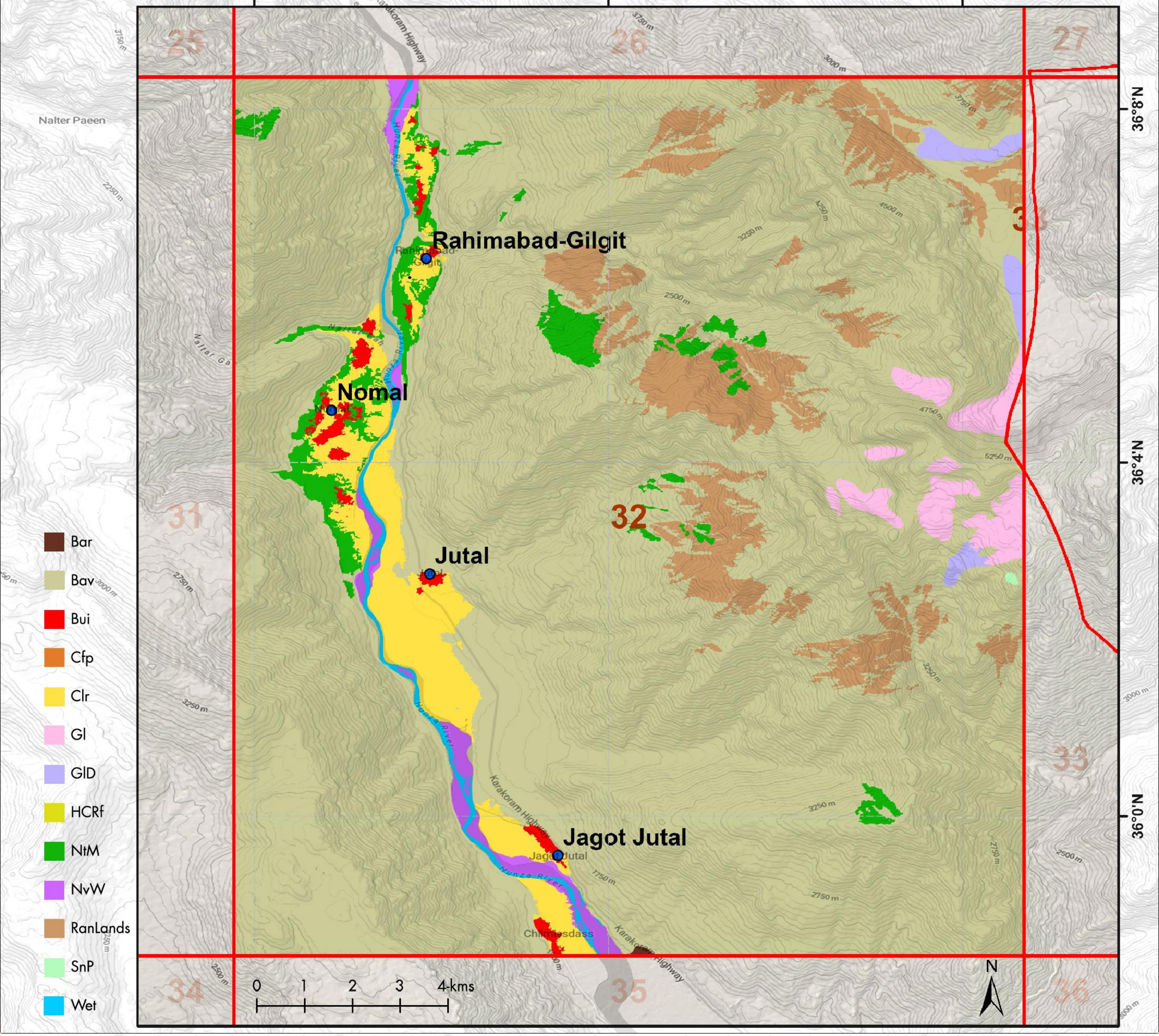
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



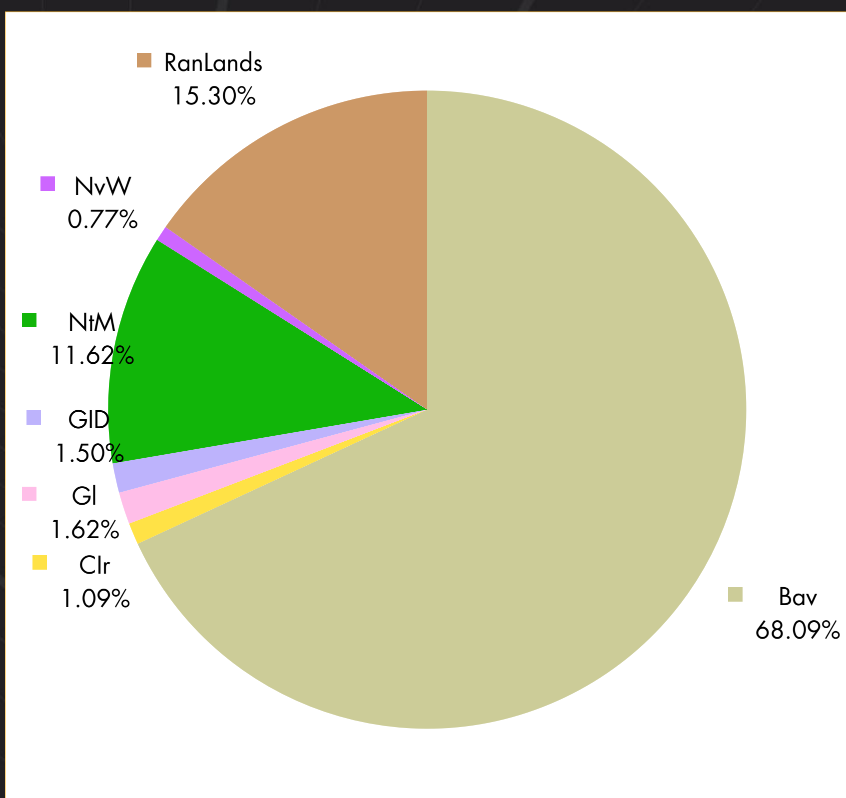
Map zone on the facing page.


74°16'E
74°20'E
74°24'E
36°8'N
36°4'N
36°0'N
25
26
27
31
32
33
34
35
36
Gowatchi Nomal
Nalter Paeen
Rahimabad-Gilgit
Nomal
Jutal
Jagot Jutal
Chalt
Hunza River
Karakoram Highway
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4 kms
N

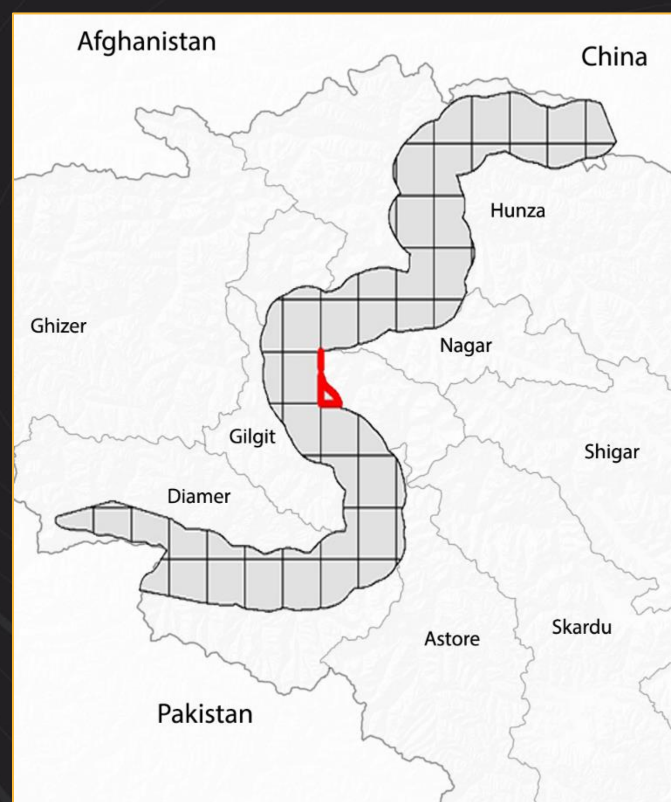
Land Use and Land Cover (LULC) Statistics Map of Zone 33

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	68.09	22.385
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	1.09	0.359
Gl		Glacier	1.62	0.533
GlD		Glacier with Debris	1.50	0.492
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	11.62	3.822
NvW		Natural Vegetation in Wet Area	0.77	0.252
RanLands		Range Land	15.30	5.031
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
Total Area (Sq km)				**32.874**

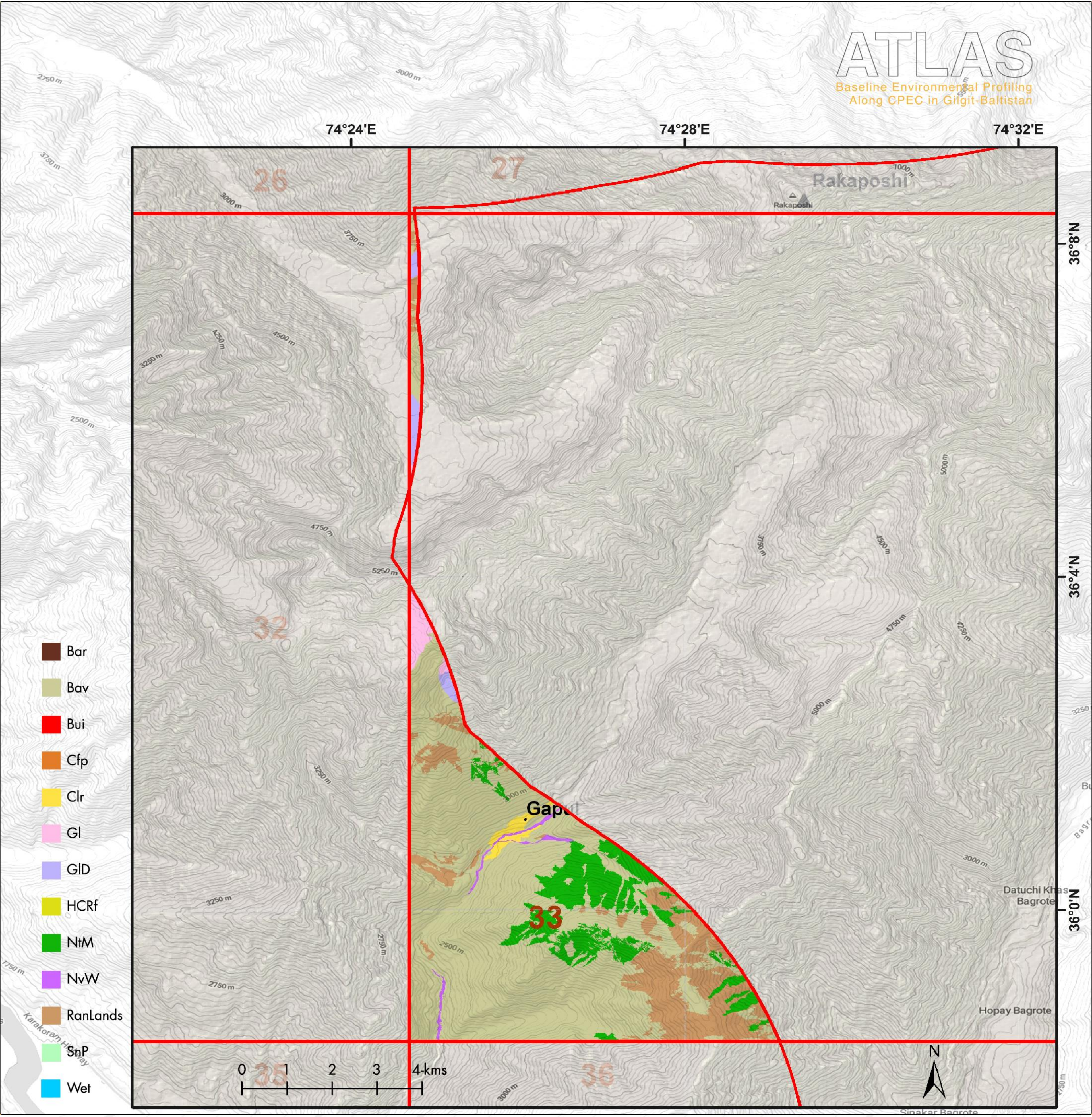
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

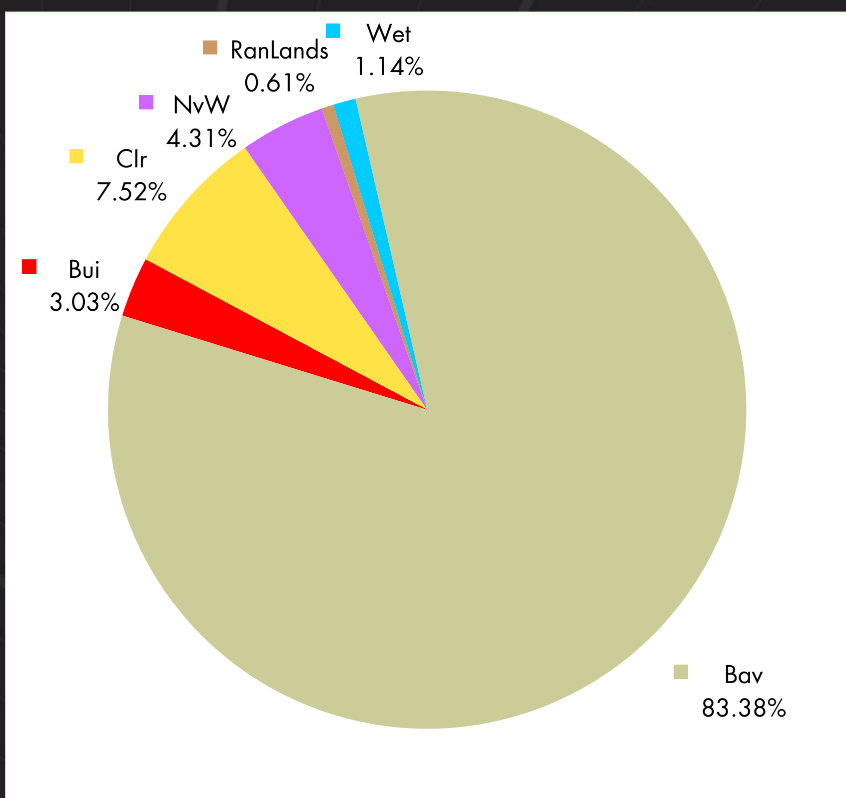


ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
74°24'E
74°28'E
74°32'E
36°8'N
36°4'N
36°0'N
26
27
32
33
35
36
Rakaposhi
Gapu
Datuchi Khas Bagrote
Hopay Bagrote
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4 kms
N

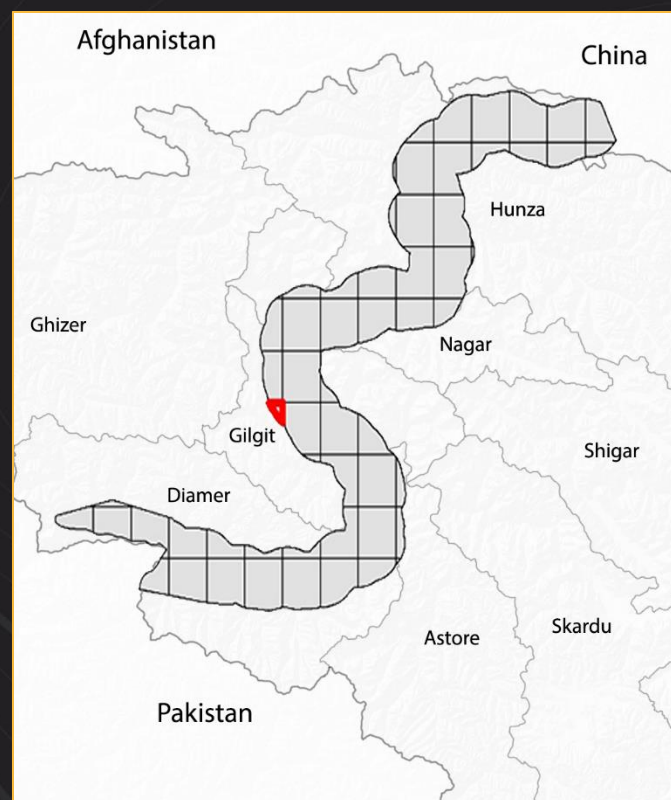
Land Use and Land Cover (LULC) Statistics Map of Zone 34

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0.19	0.036
Bav		Bare Area with Sparse Natural Vegetation	83.38	15.556
Bui		Built-up	3.02	0.566
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	7.52	1.403
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0.22	0.042
NvW		Natural Vegetation in Wet Area	4.31	0.805
RanLands		Range Land	0.61	0.114
SnP		Snow Permanent	0	0
Wet		Wet Areas	1.13	0.212
Total Area (Sq km)				**18.734**

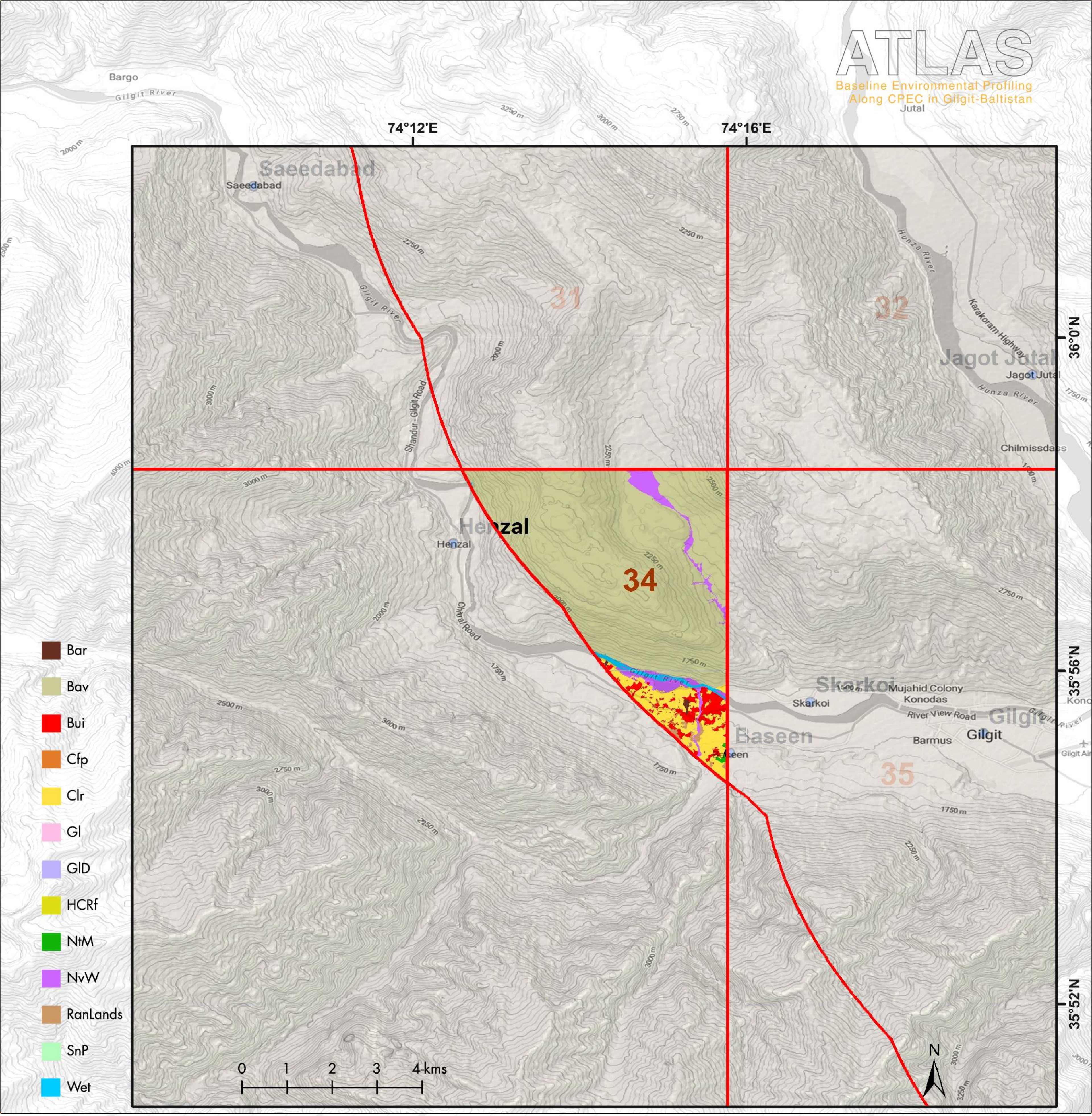
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

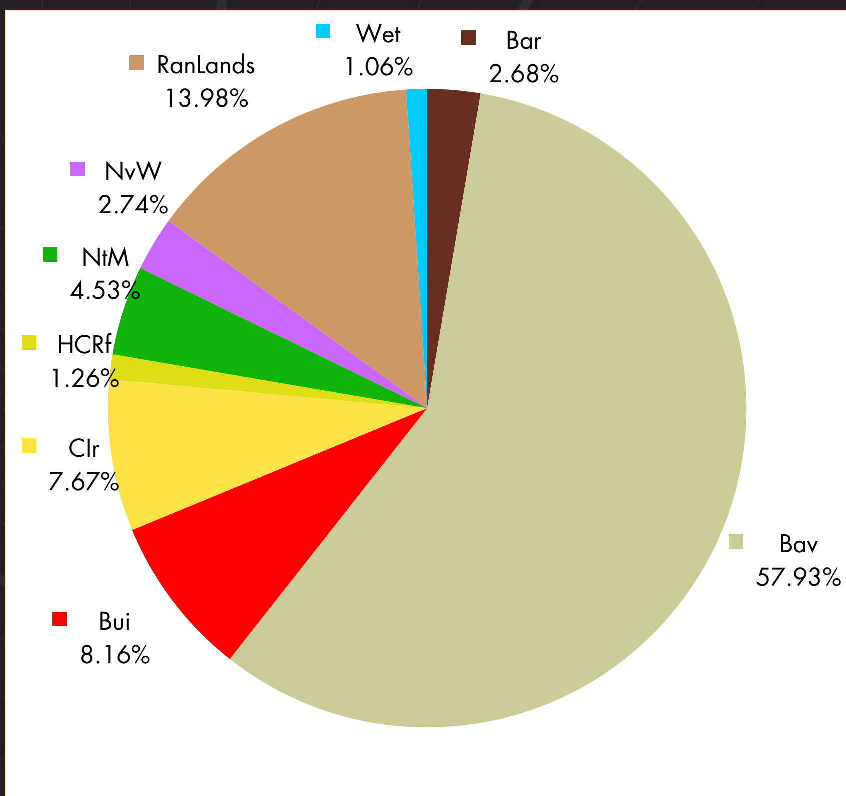


ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
74°12'E
74°16'E
36°0'N
35°56'N
35°52'N
Saeedabad
Henzal
Skarkoi
Baseen
Gilgit
Jagot Jutal
Mujahid Colony
Konodas
River View Road
Barmus
Chilmissdass
Gilgit River
Hunza River
Karakoram Highway
Shandur - Gilgit Road
Chitral Road
Bargo
Jutal
31
32
34
35
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4-kms
N

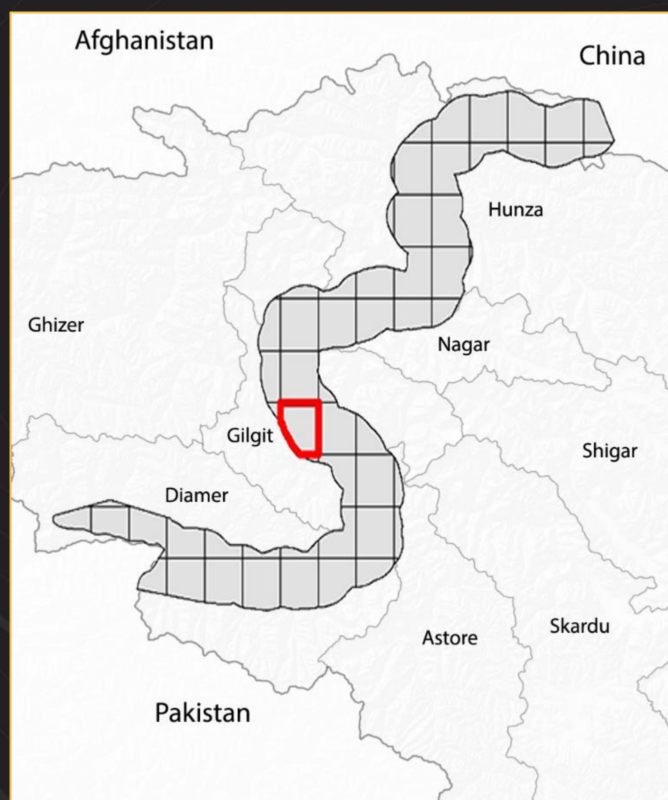
Land Use and Land Cover (LULC) Statistics Map of Zone 35

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	2.68	5.685
Bav		Bare Area with Sparse Natural Vegetation	57.93	122.864
Bui		Built-up	8.16	17.300
Cfp		Crop in Flood Plain	0.12	0.254
Clr		Crop Irrigated	7.67	16.276
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	1.26	2.679
NtM		Forest – Natural Vegetation and Trees	4.52	9.602
NvW		Natural Vegetation in Wet Area	2.74	5.809
RanLands		Range Land	13.98	29.646
SnP		Snow Permanent	0	0
Wet		Wet Areas	1.05	2.238
Total Area (Sq km)				**212.353**

LULC Statistic of Zone on the facing page.

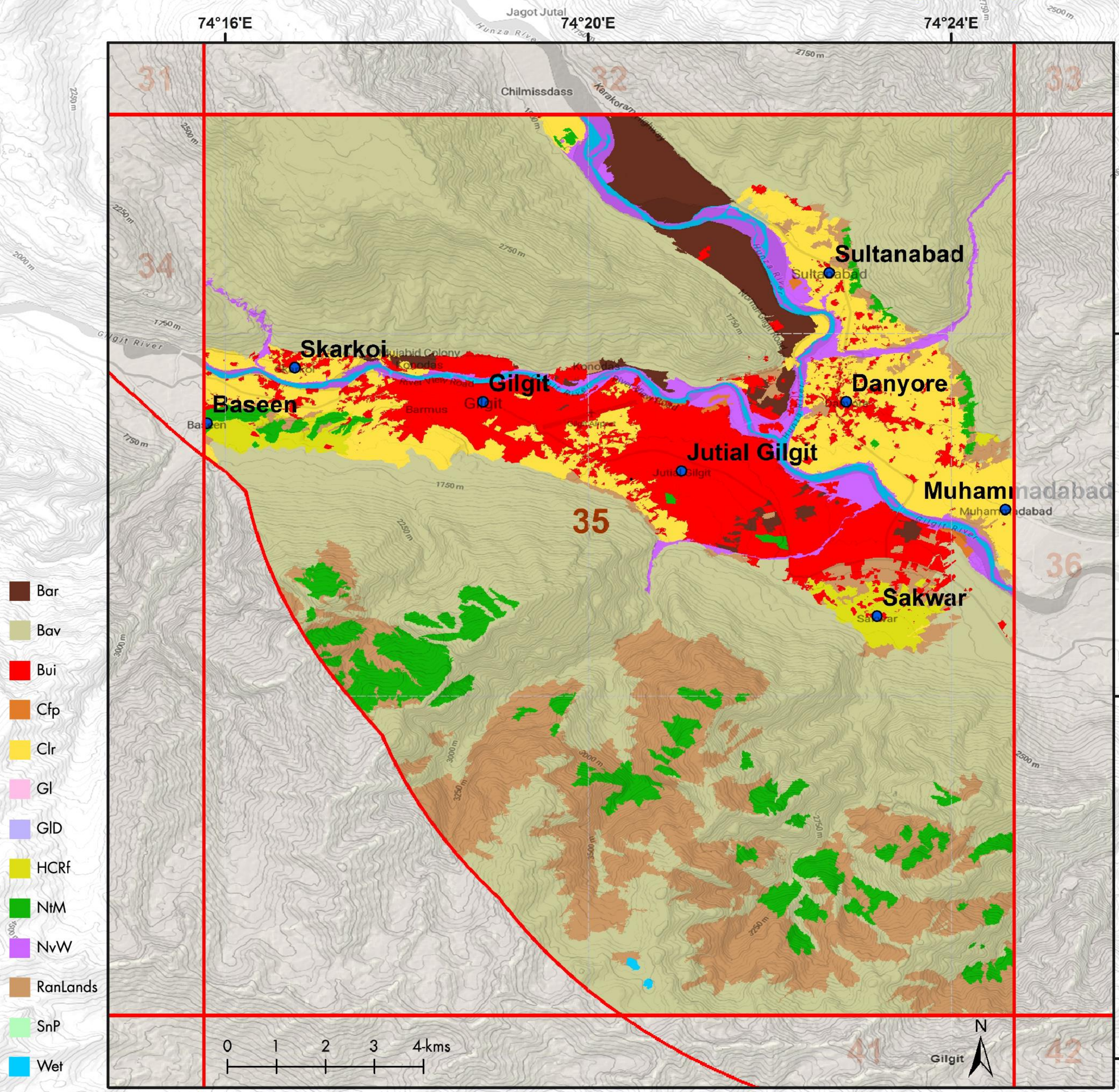


Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

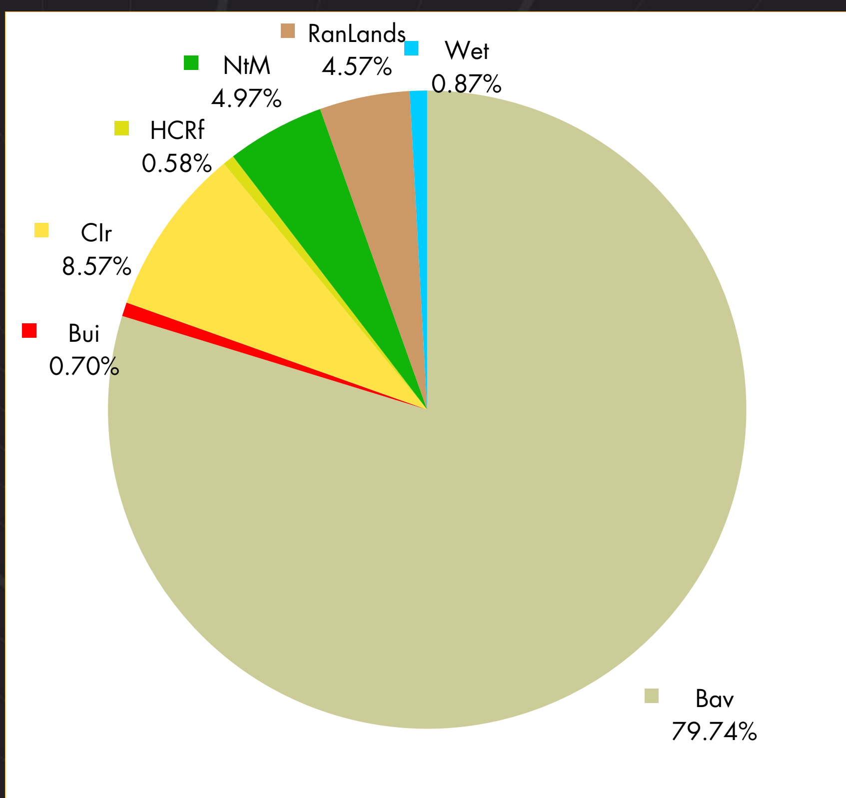
ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan



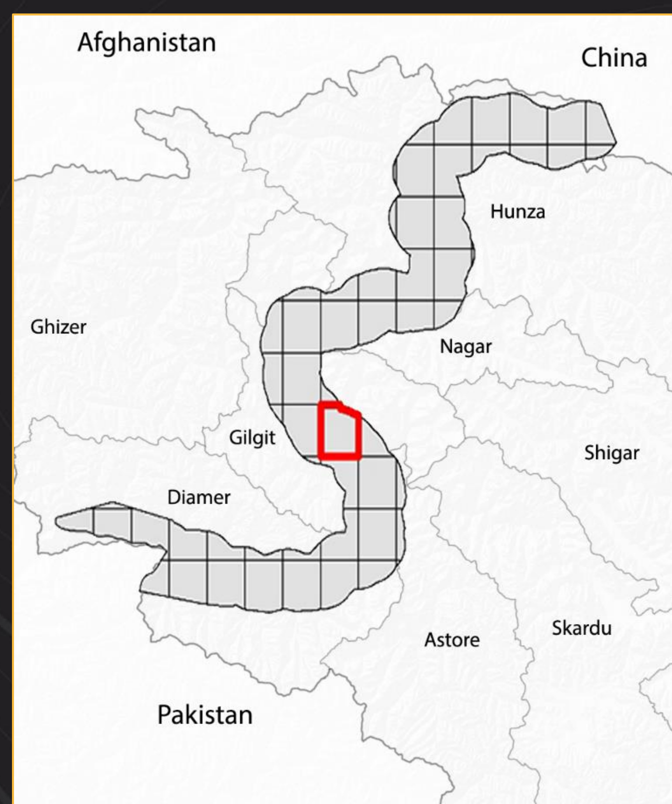
Land Use and Land Cover (LULC) Statistics Map of Zone 36

Legend	*Class Code*	*Abbreviation*	*Percentage (%)*	*Area (Sq Km)*
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	79.74	183.224
Bui		Built-up	0.70	1.611
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	8.57	19.680
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0.58	1.334
NtM		Forest – Natural Vegetation and Trees	4.97	11.413
NvW		Natural Vegetation in Wet Area	0.29	0.666
RanLands		Range Land	4.56	10.500
SnP		Snow Permanent	0	0
Wet		Wet Areas	0.87	2.004
Total Area (Sq km)				**230.432**

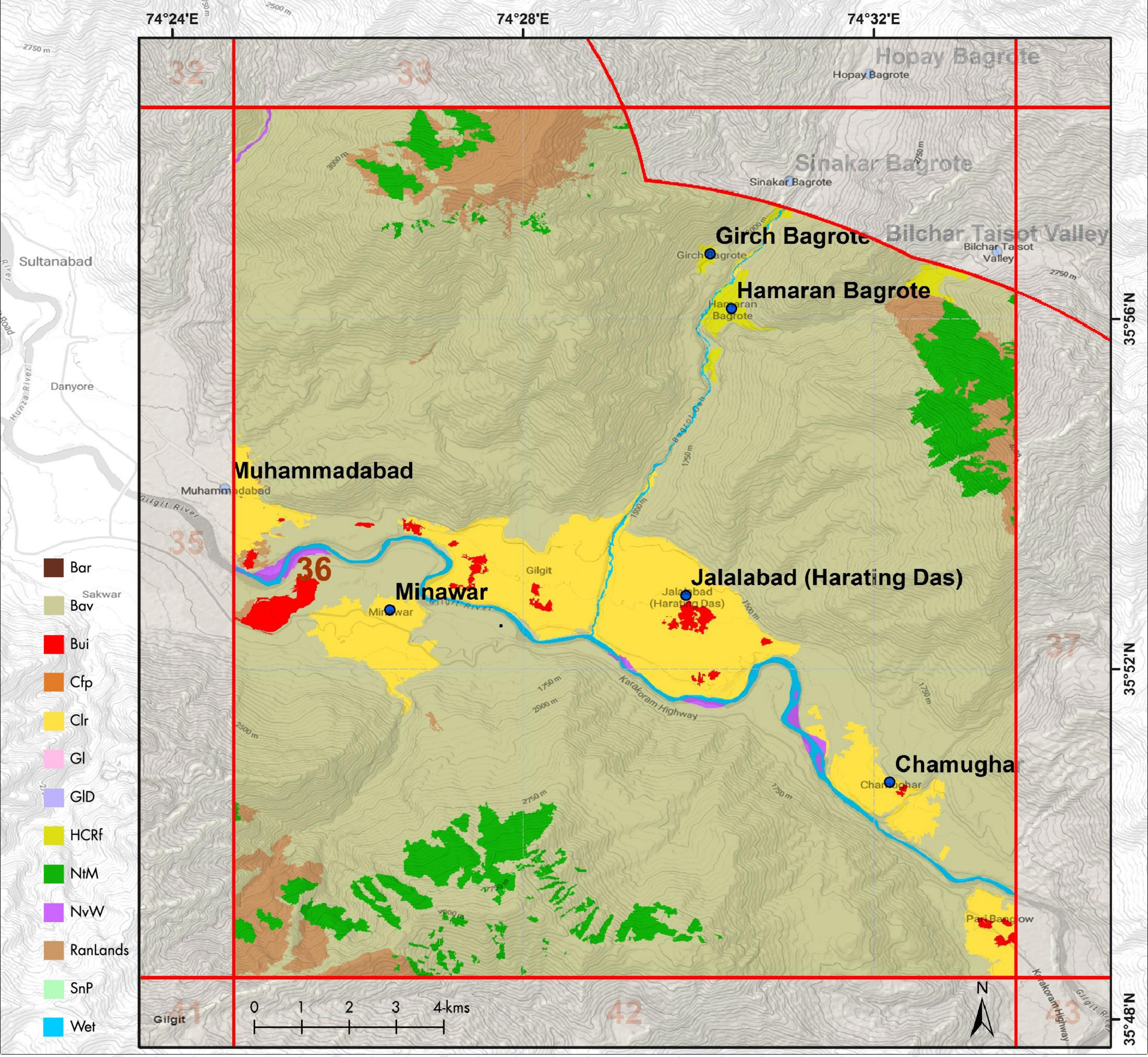
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



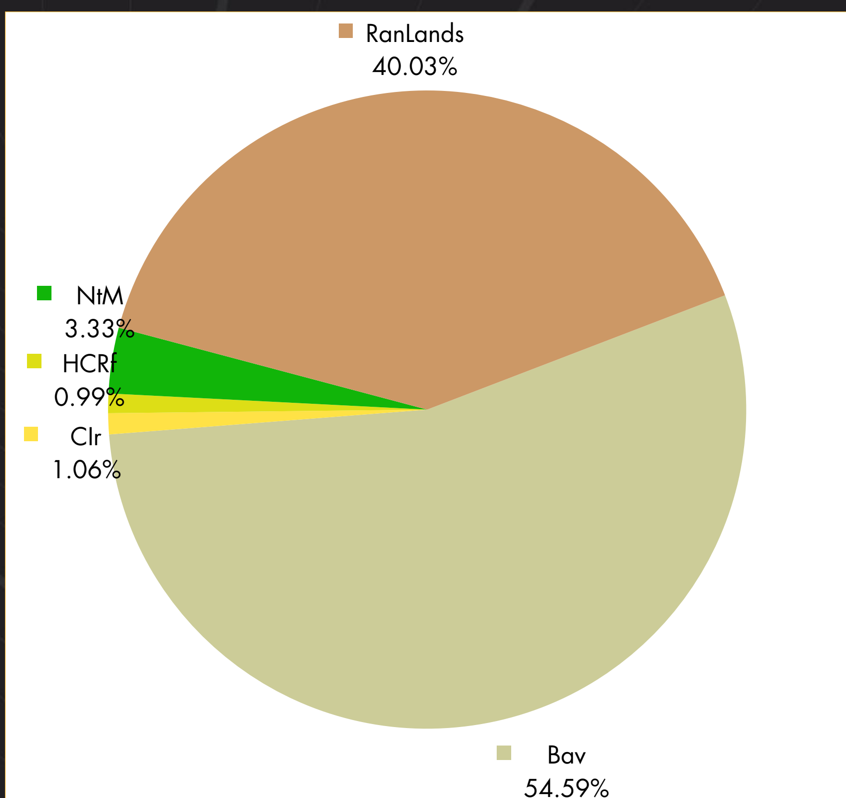
Map zone on the facing page.


74°24'E
74°28'E
74°32'E
35°56'N
35°52'N
35°48'N
Hopay Bagrote
Sinakar Bagrote
Girch Bagrote
Bilchar Taisot Valley
Hamaran Bagrote
Muhammadabad
Minawar
Jalalabad (Harating Das)
Chamugha
Sultanabad
Danyore
Gilgit
Karakoram Highway
32
33
35
36
37
41
42
43
0 1 2 3 4-kms
N
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet

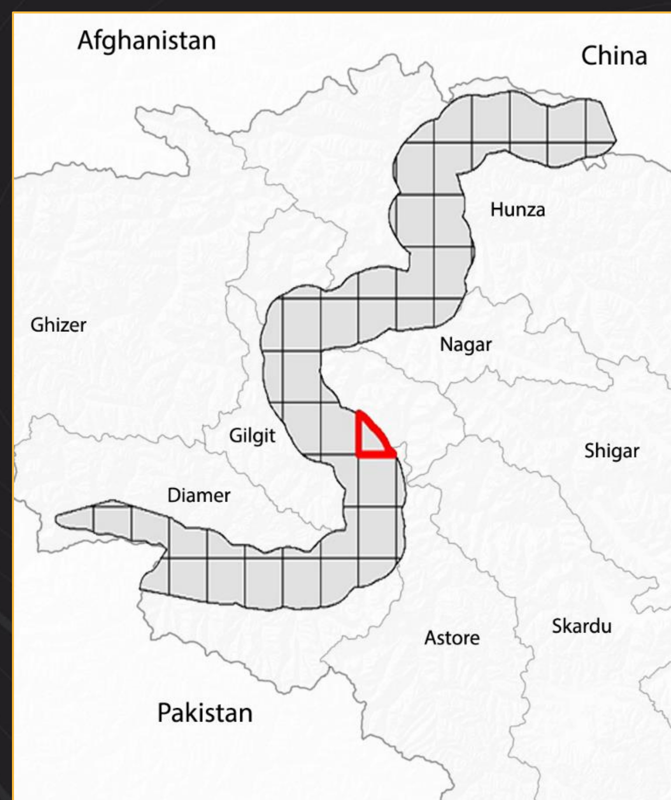
Land Use and Land Cover (LULC) Statistics Map of Zone 37

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	54.59	55.384
Bui		Built-up	0.03	0.026
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	1.06	1.078
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0.98	1.001
NtM		Forest – Natural Vegetation and Trees	3.33	3.374
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	40.03	40.614
SnP		Snow Permanent	0	0
Wet		Wet Areas	0.49	0.496
Total Area (Sq km)				**101.973**

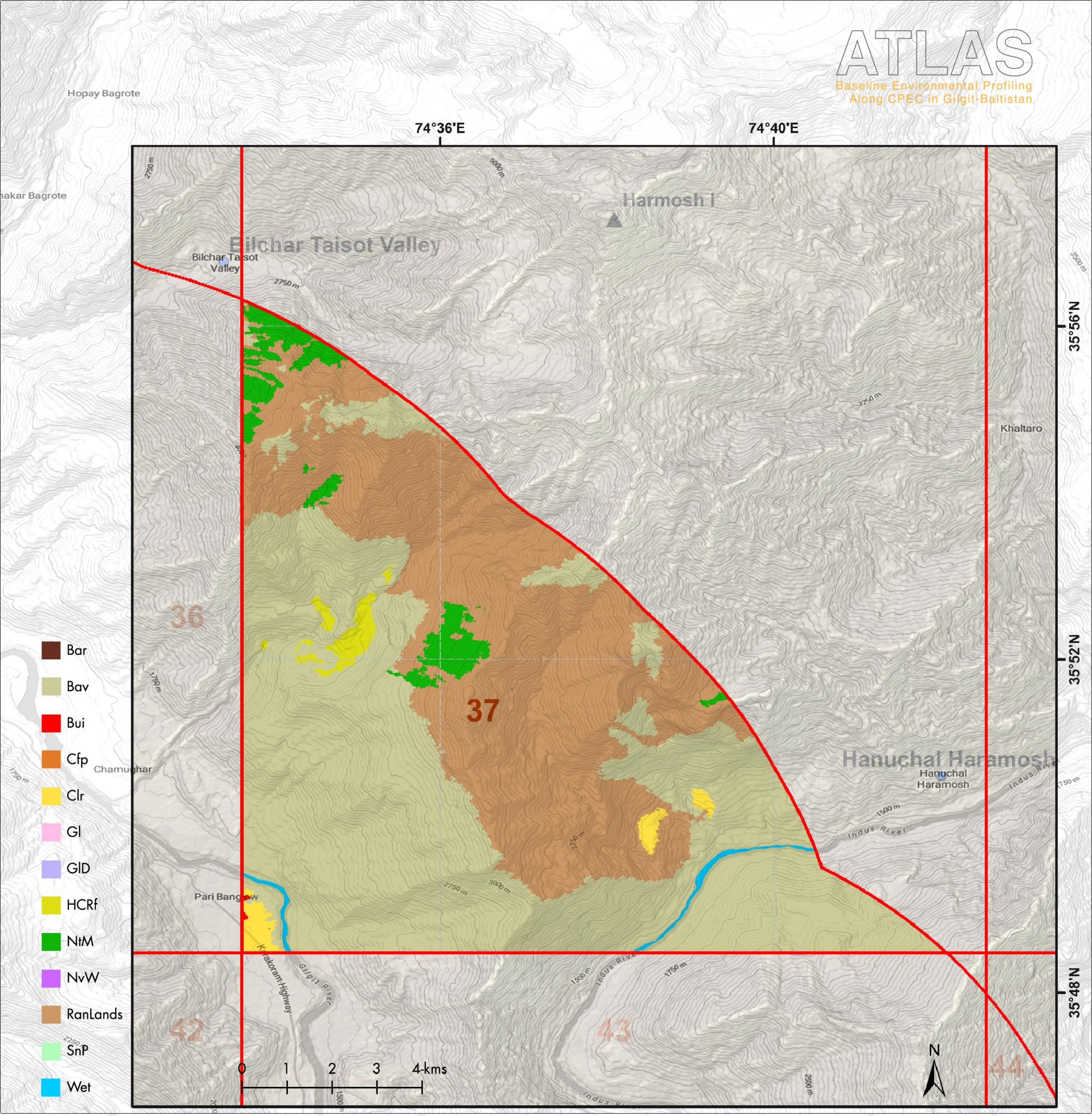
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



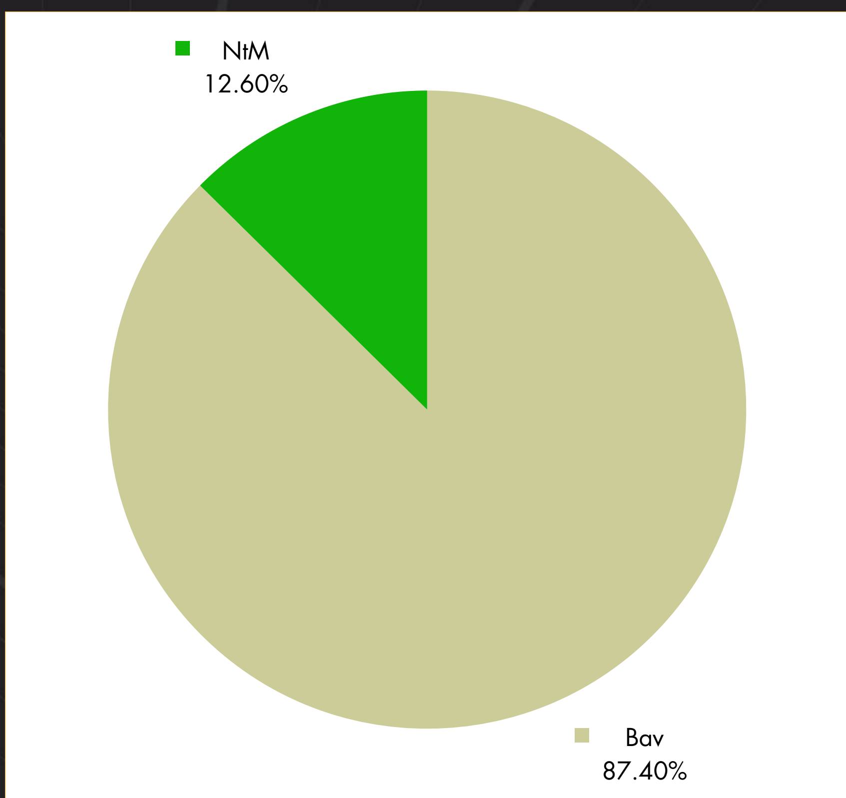
Map zone on the facing page.


Hopay Bagrote
74°36'E
74°40'E
Harmosh I
Bilchar Taisot Valley
Khaltaro
35°56'N
35°52'N
35°48'N
Hanuchal Haramosh
Chamughar
Pari Bangaw
Karakoram Highway
Gilgit River
Indus River
36
37
42
43
44
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4-kms
N

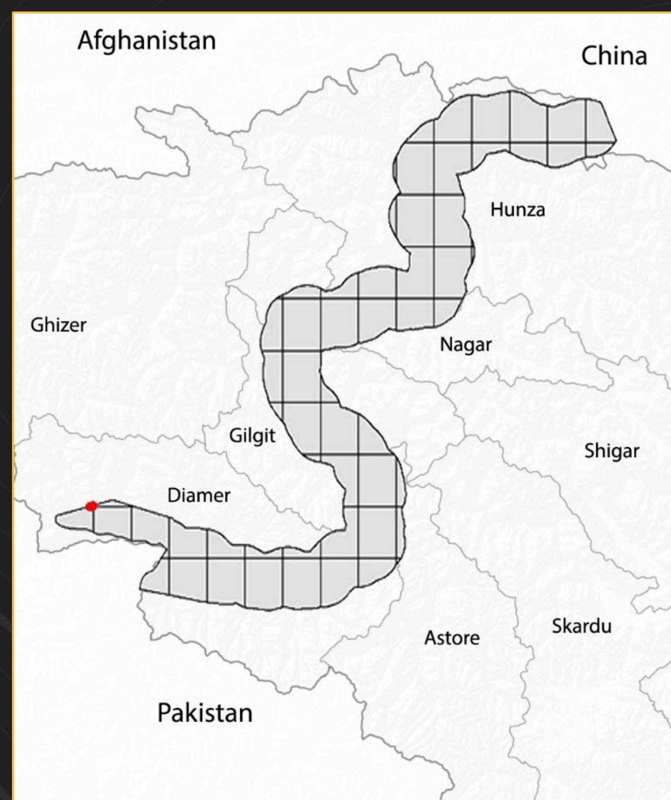
Land Use and Land Cover (LULC) Statistics Map of Zone 38

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	87.40	0.398
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	12.60	0.057
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	0	0
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
Total Area (Sq km)				**0.455**

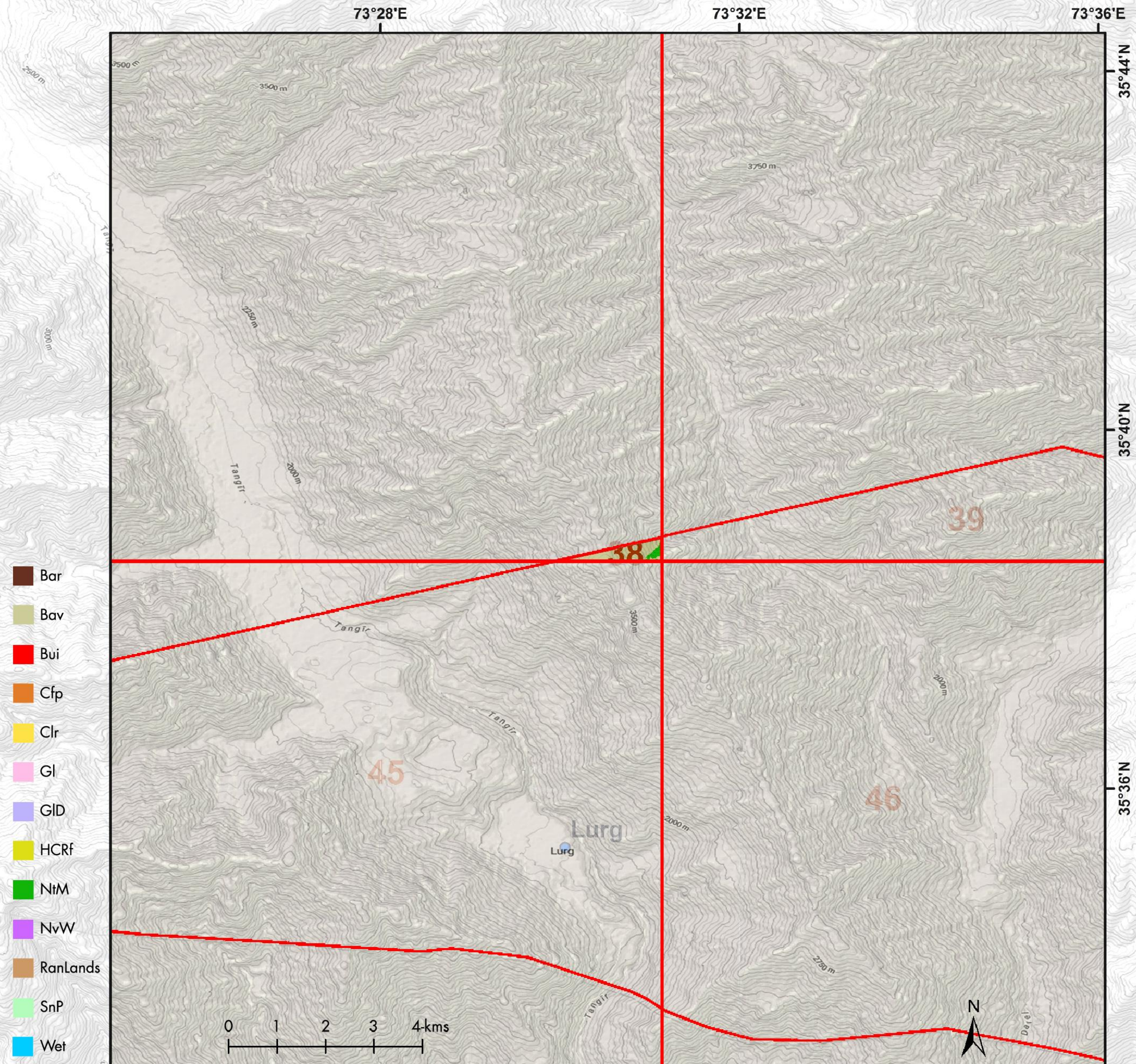
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



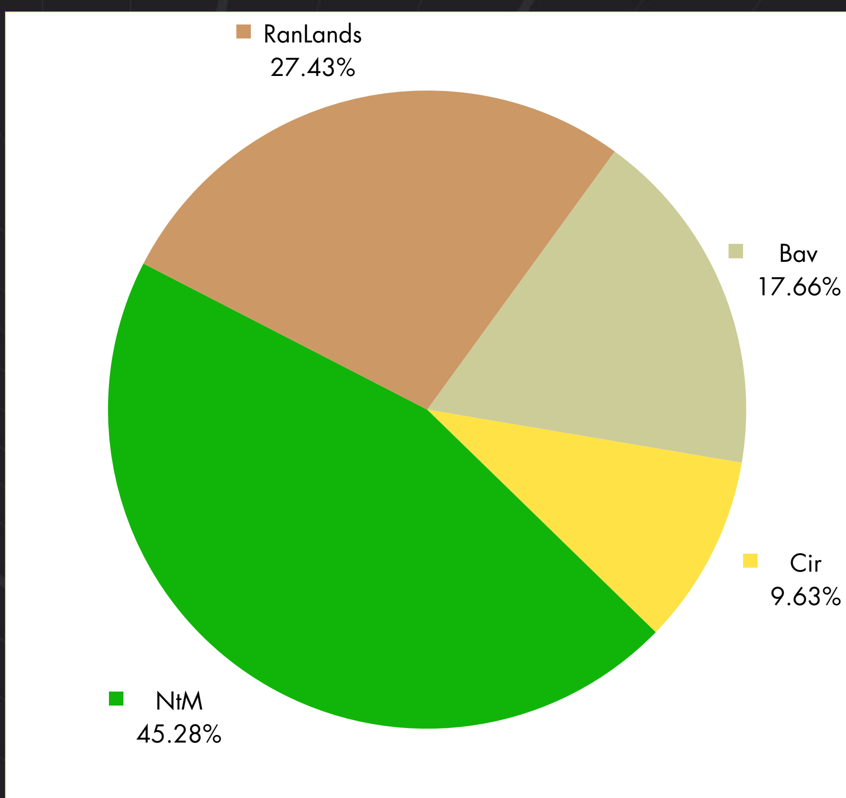
Map zone on the facing page.


73°28'E
73°32'E
73°36'E
35°44'N
35°40'N
35°36'N
38
39
45
46
Lurg
Lurg
Tangir
3500 m
3750 m
2250 m
2000 m
2750 m
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

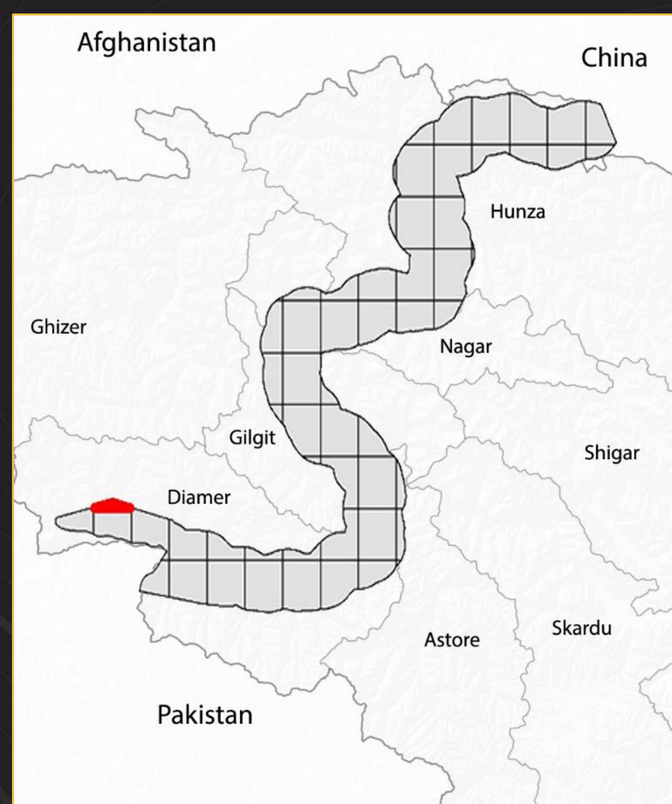
Land Use and Land Cover (LULC) Statistics Map of Zone 39

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	17.66	3.277
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	9.63	1.786
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	45.28	8.399
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	27.43	5.089
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
Total Area (Sq km)				**18.551**

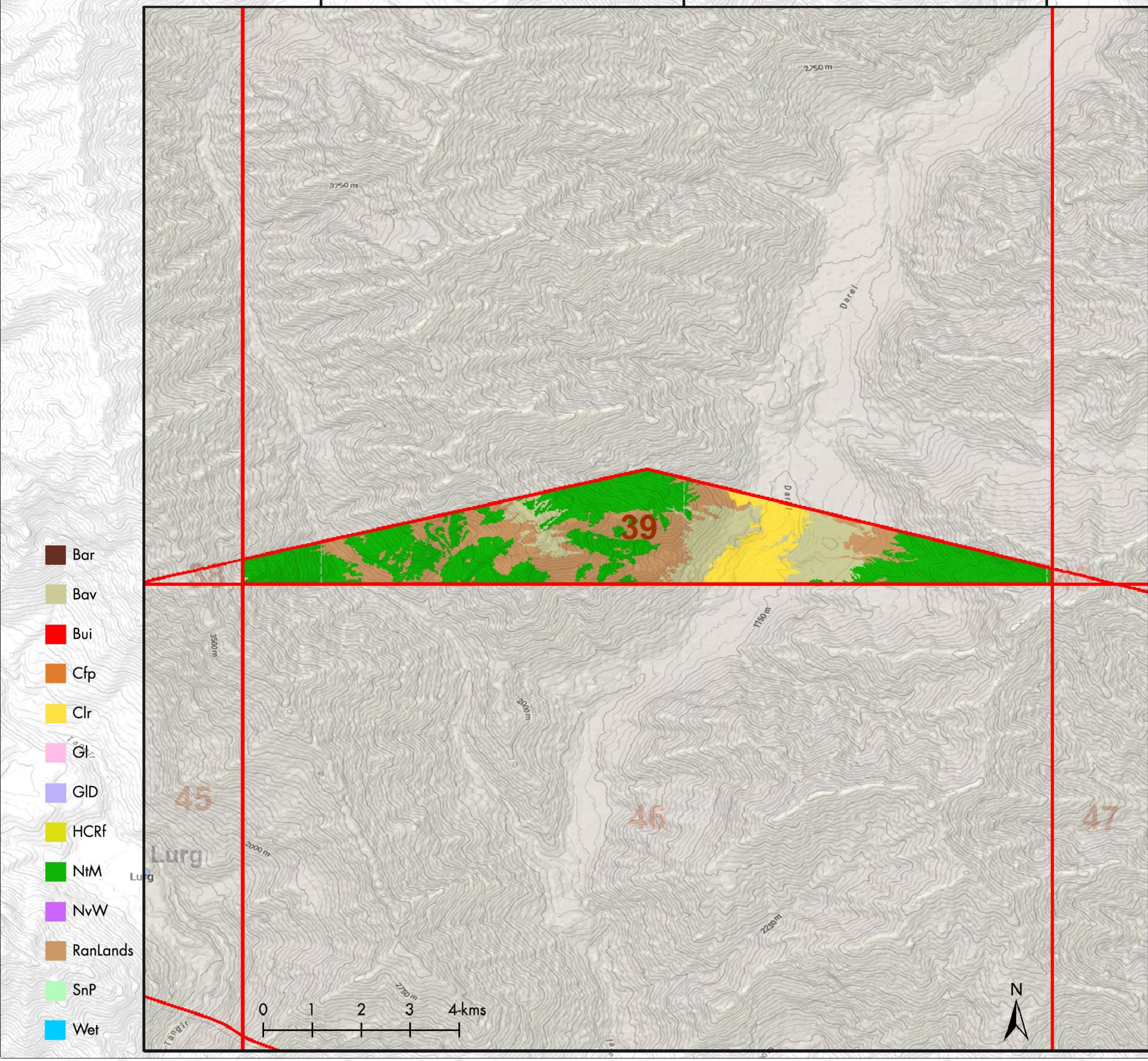
LULC Statistic of Zone on the facing page.



***Note:** Area less than 0.5% is not shown in graph.*



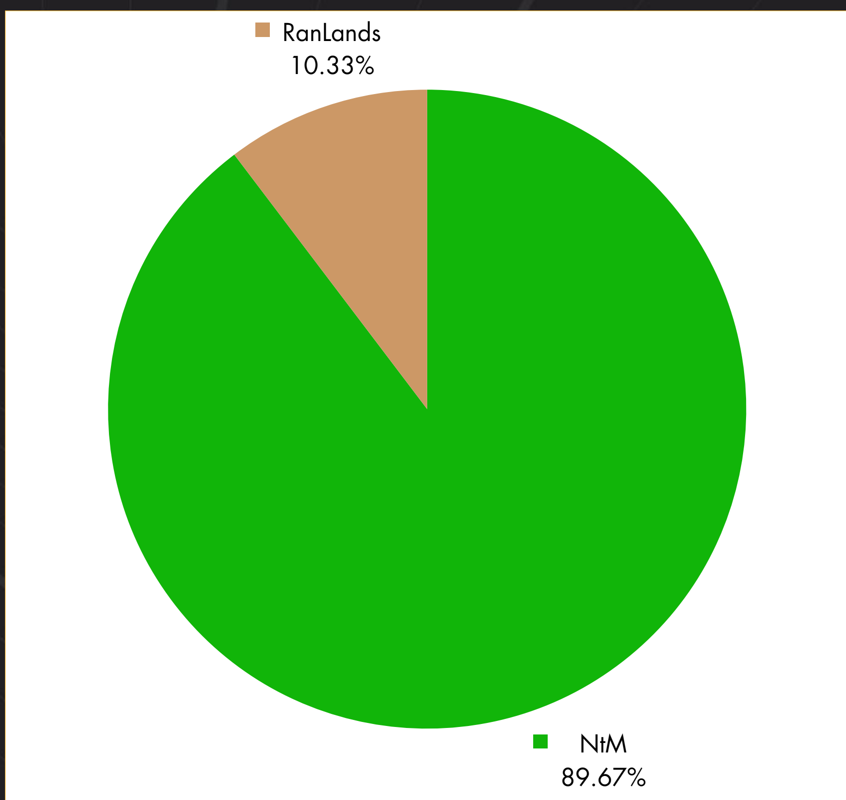
Map zone on the facing page.


73°32'E
73°36'E
73°40'E
35°44'N
35°40'N
35°36'N
2750 m
3750 m
Darel
39
1750 m
3500 m
2000 m
45
46
47
Lurg
2250 m
2750 m
Tangir
0 1 2 3 4-kms
N
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet

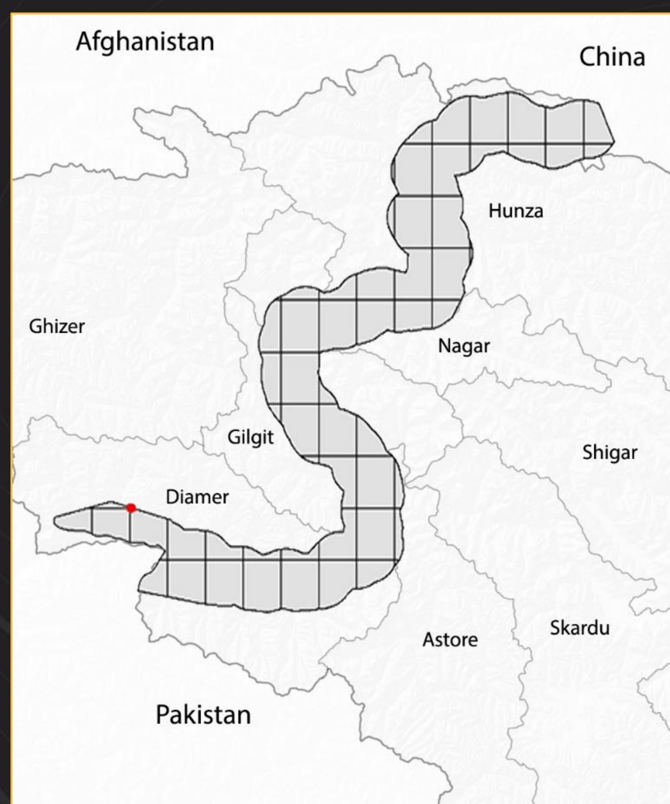
Land Use and Land Cover (LULC) Statistics Map of Zone 40

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	0	0
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	89.67	0.147
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	10.33	0.017
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
Total Area (Sq km)				**0.164**

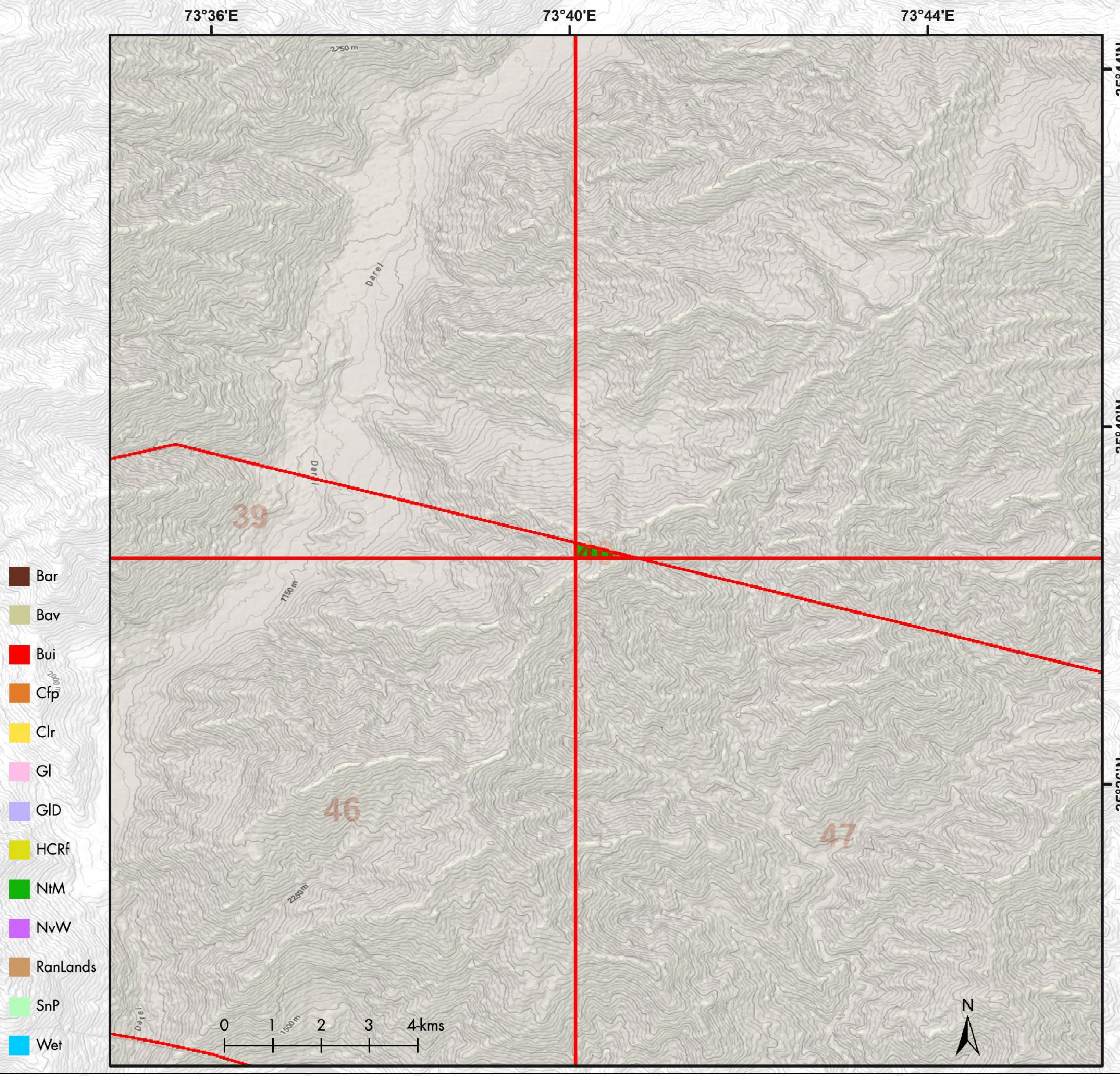
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



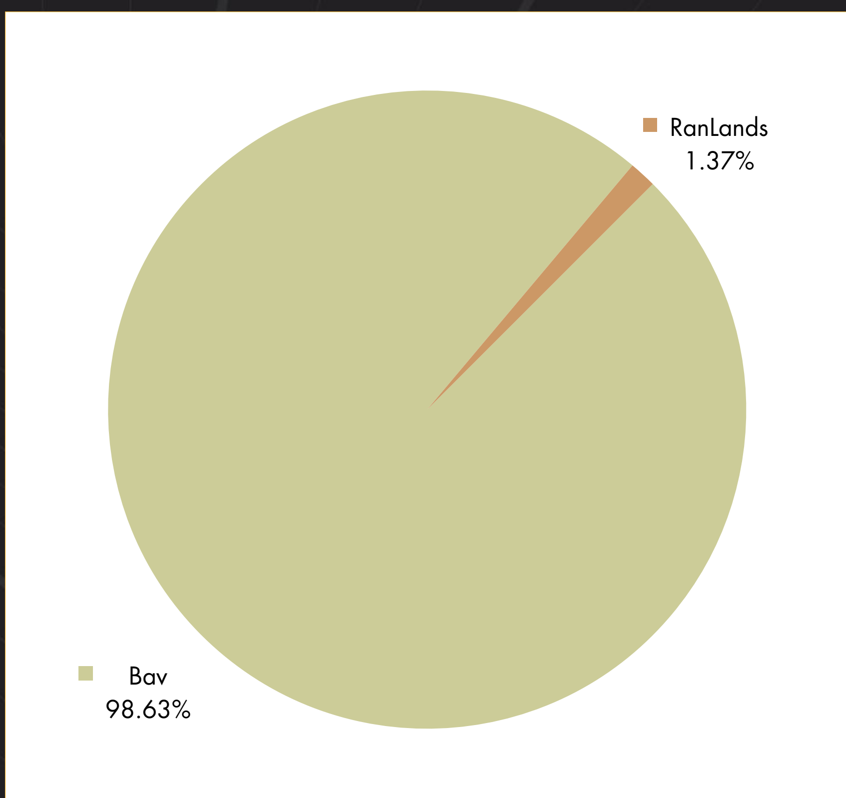
Map zone on the facing page.


73°36'E
73°40'E
73°44'E
35°44'N
35°40'N
35°36'N
2750 m
Darel
Darel
1750 m
2250 m
1500 m
39
46
47
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

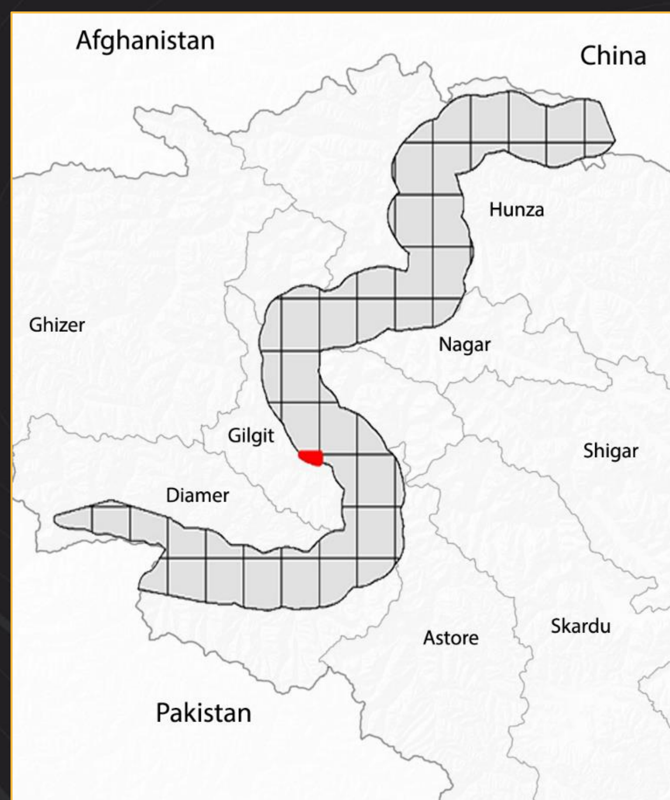
Land Use and Land Cover (LULC) Statistics Map of Zone 41

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	98.63	11.148
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	0	0
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	0	0
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	1.37	0.155
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
Total Area (Sq km)				**11.303**

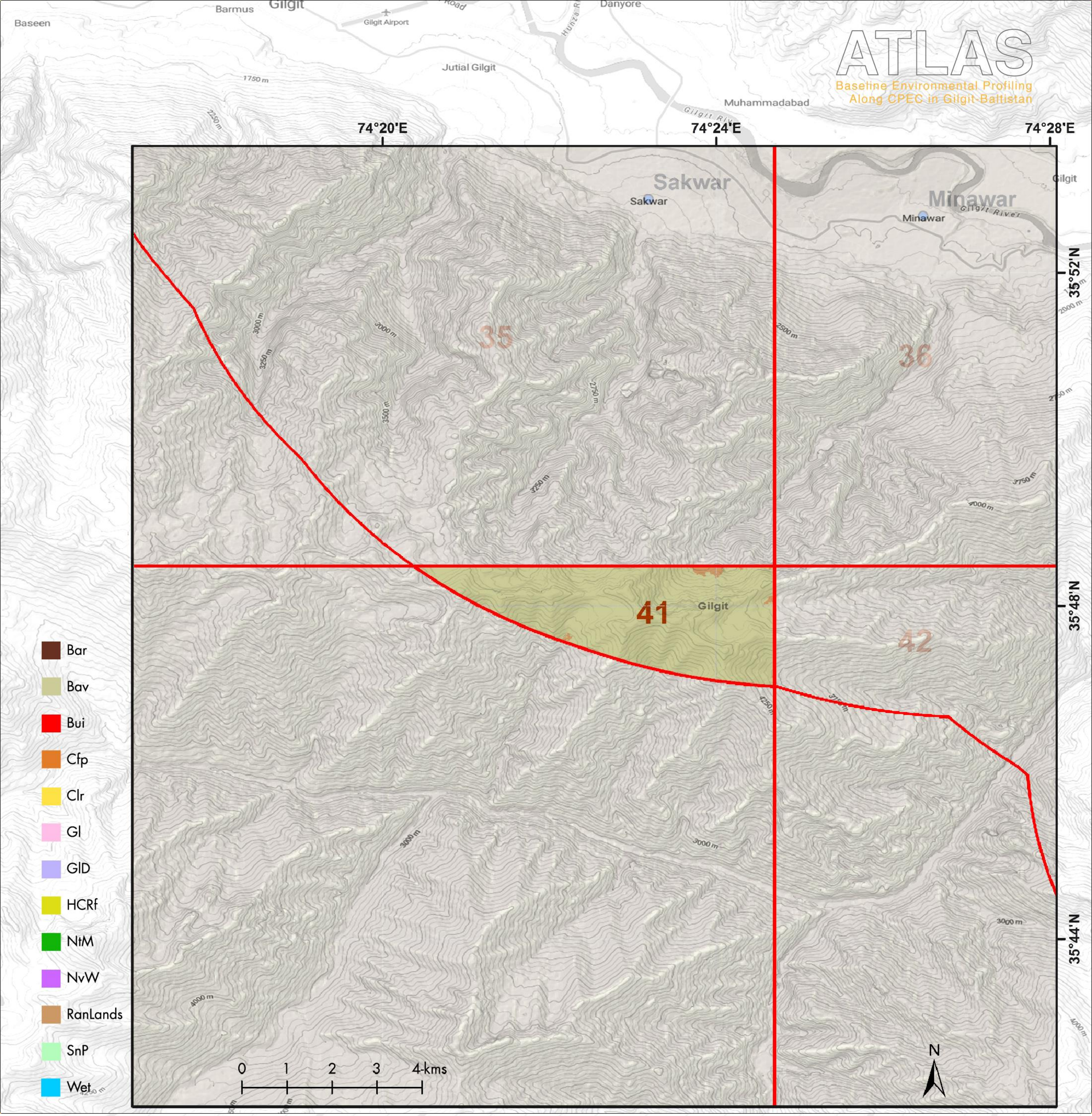
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



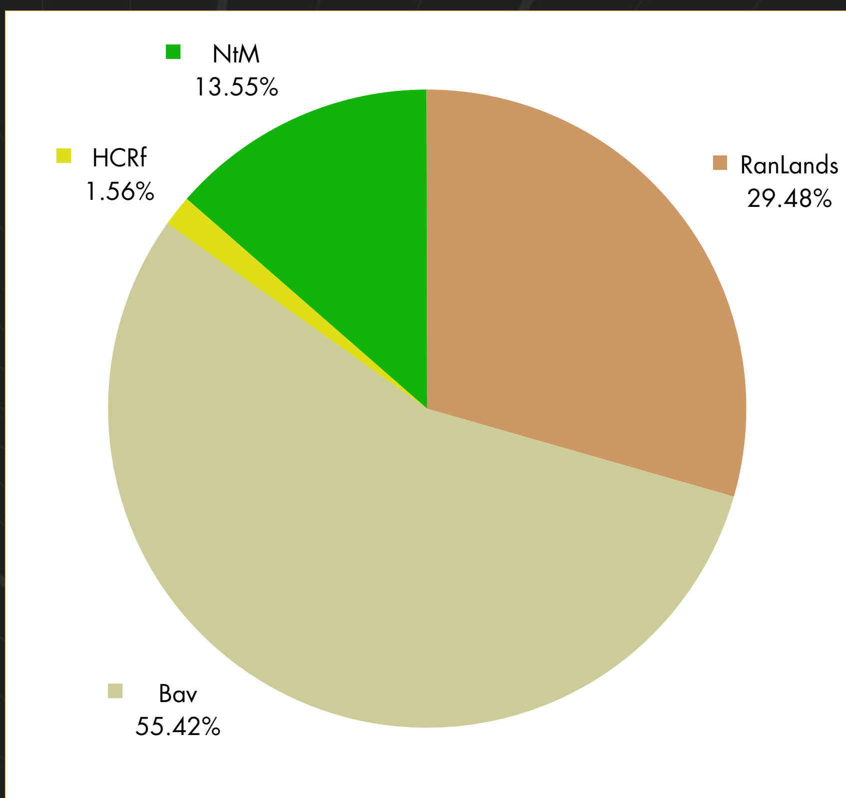
Map zone on the facing page.


ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
Gilgit
Barmus
Baseen
Gilgit Airport
Danyore
Jutial Gilgit
Muhammadabad
Gilgit River
74°20'E
74°24'E
74°28'E
35°52'N
35°48'N
35°44'N
Sakwar
Minawar
35
36
41
42
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

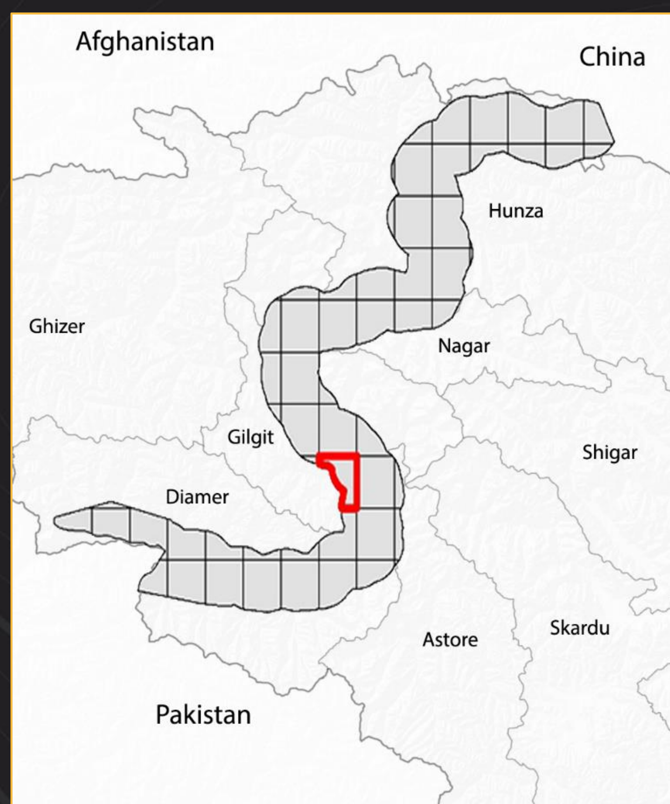
Land Use and Land Cover (LULC) Statistics Map of Zone 42

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	55.42	80.228
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0.33	0.481
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	1.56	2.262
NtM		Forest – Natural Vegetation and Trees	13.55	19.613
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	29.48	42.673
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
Total Area (Sq km)				**145.257**

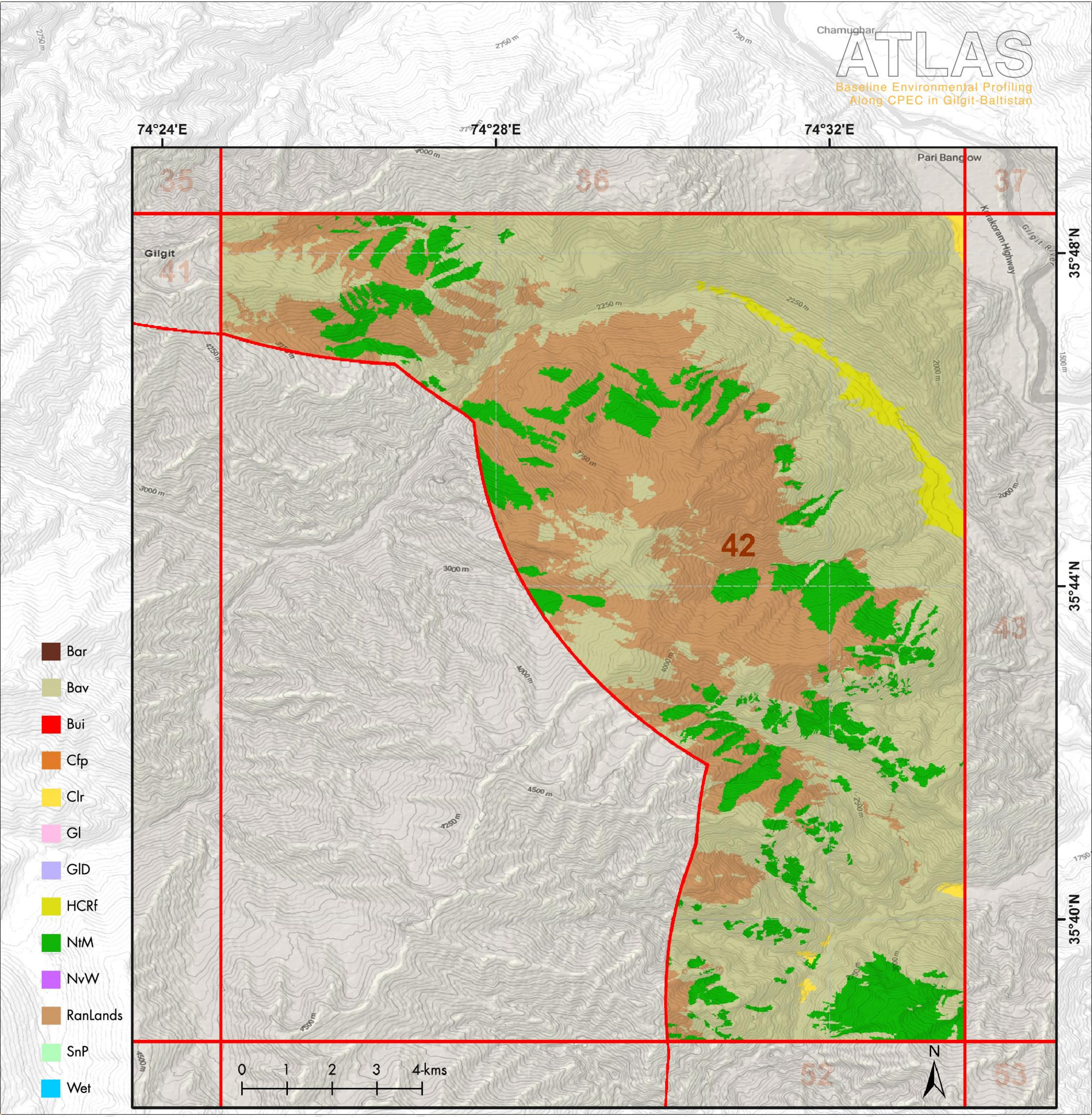
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

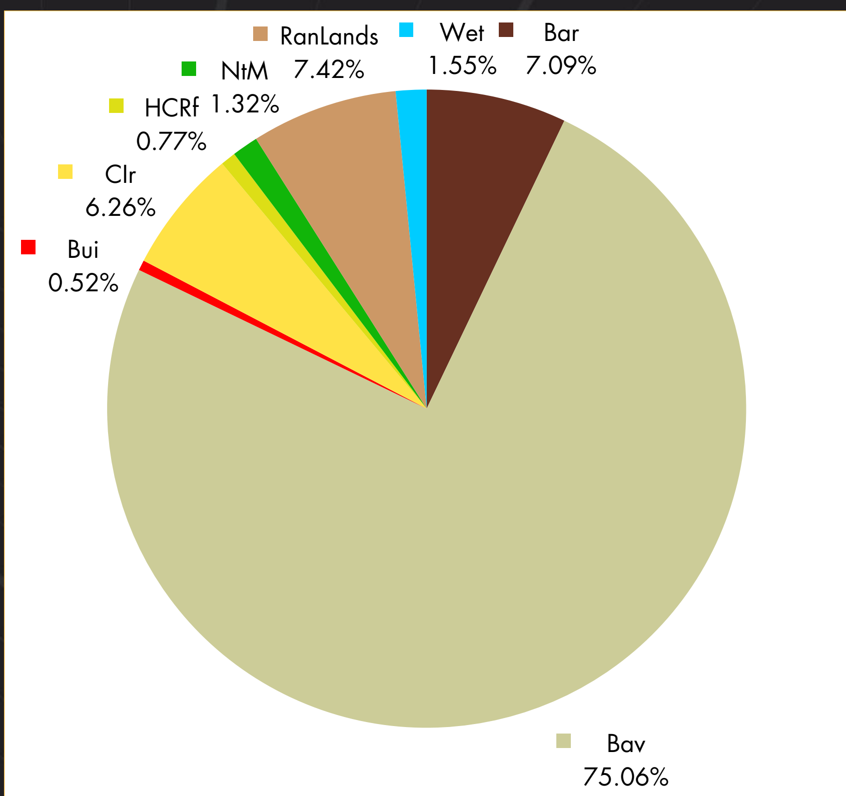


ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
Chamughar
Pari Bangow
Gilgit
Karakoram Highway
74°24'E
74°28'E
74°32'E
35°48'N
35°44'N
35°40'N
35
36
37
41
42
43
52
53
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

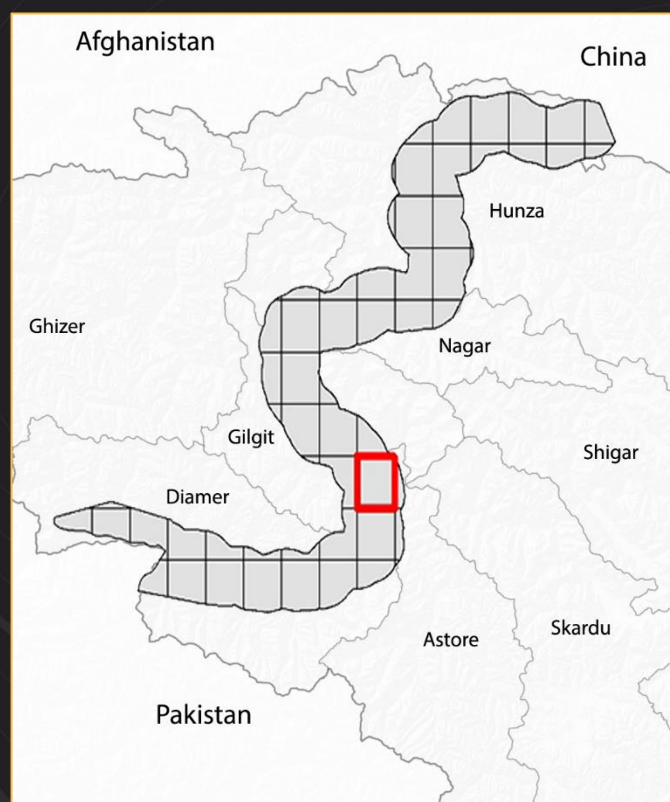
Land Use and Land Cover (LULC) Statistics Map of Zone 43

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	7.09	17.487
Bav		Bare Area with Sparse Natural Vegetation	75.06	185.057
Bui		Built-up	0.52	1.279
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	6.26	15.443
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0.77	1.893
NtM		Forest – Natural Vegetation and Trees	1.32	3.265
NvW		Natural Vegetation in Wet Area	0.20	0.486
RanLands		Range Land	7.42	18.283
SnP		Snow Permanent	0	0
Wet		Wet Areas	1.55	3.826
Total Area (Sq km)				**247.019**

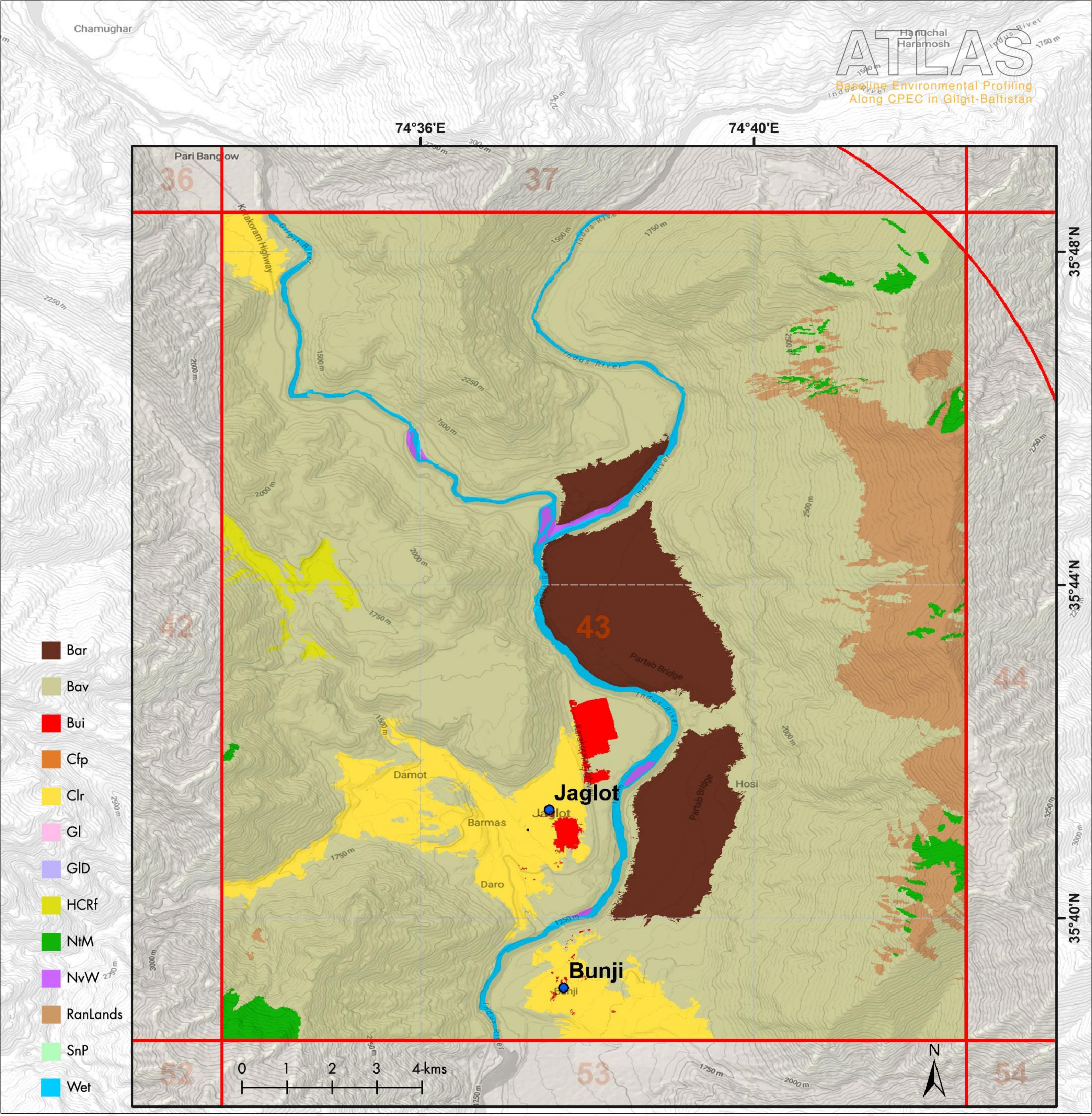
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



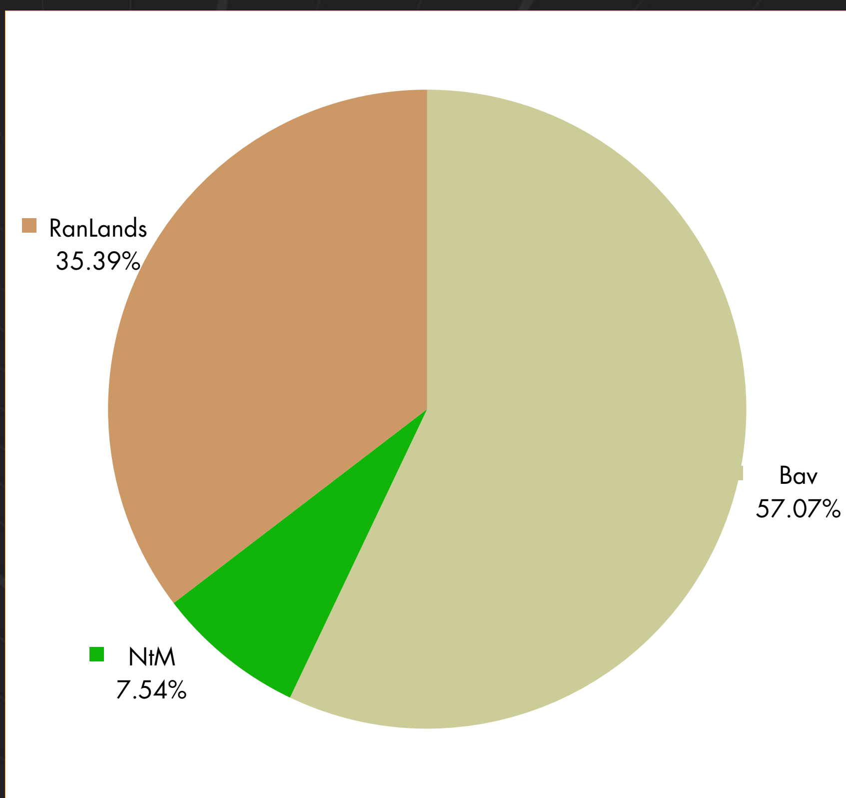
Map zone on the facing page.


74°36'E
74°40'E
35°48'N
35°44'N
35°40'N
36
37
42
43
44
52
53
54
Jaglot
Bunji
Damot
Barmas
Daro
Hosi
Partab Bridge
Indus River
Gilgit River
Karakoram Highway
Pari Bangow
Chamughar
Haramosh
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

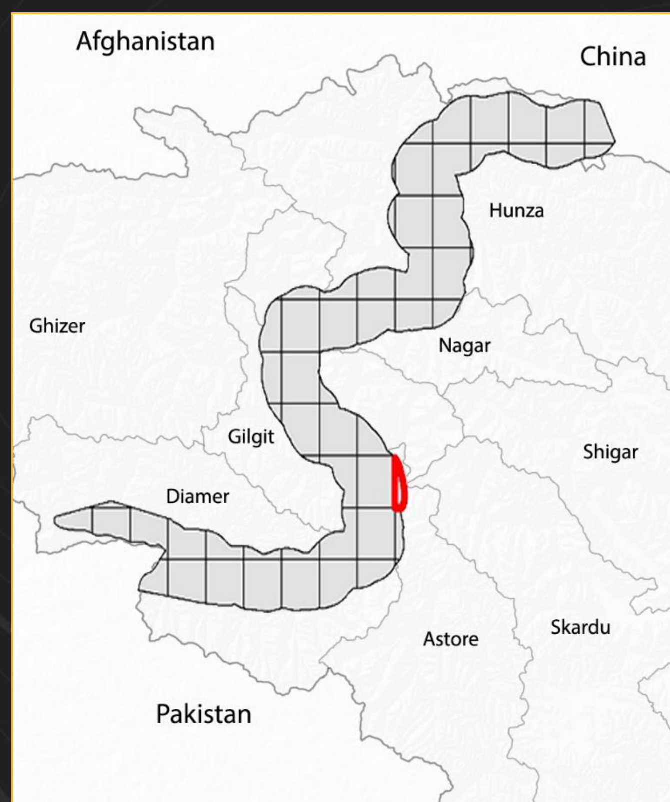
Land Use and Land Cover (LULC) Statistics Map of Zone 44

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	57.07	24.453
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	7.54	3.232
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	35.39	15.162
SnP		Snow Permanent	0	0
Wet		Wet Areas	0.14	0.059
Total Area (Sq km)				**42.906**

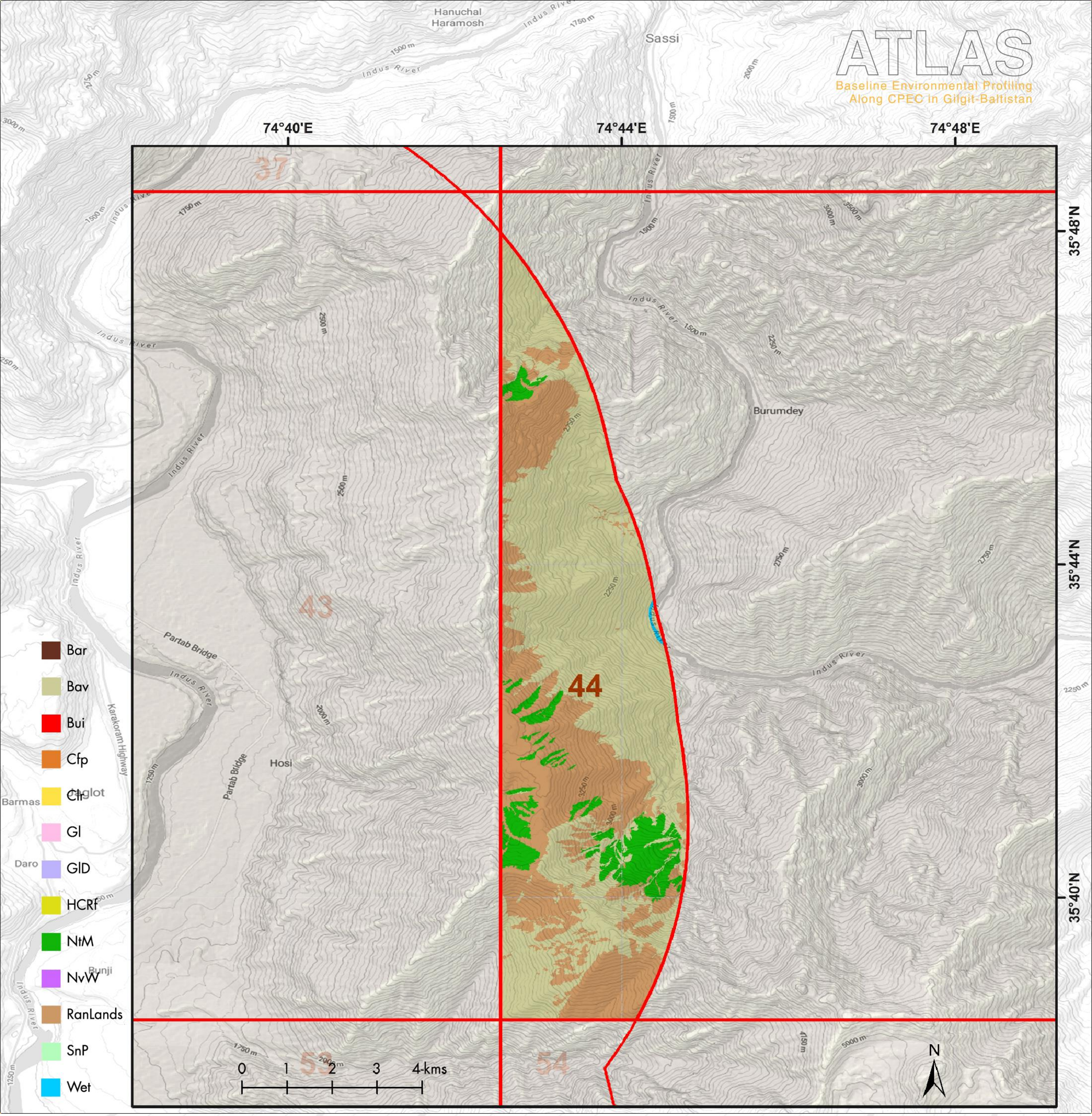
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

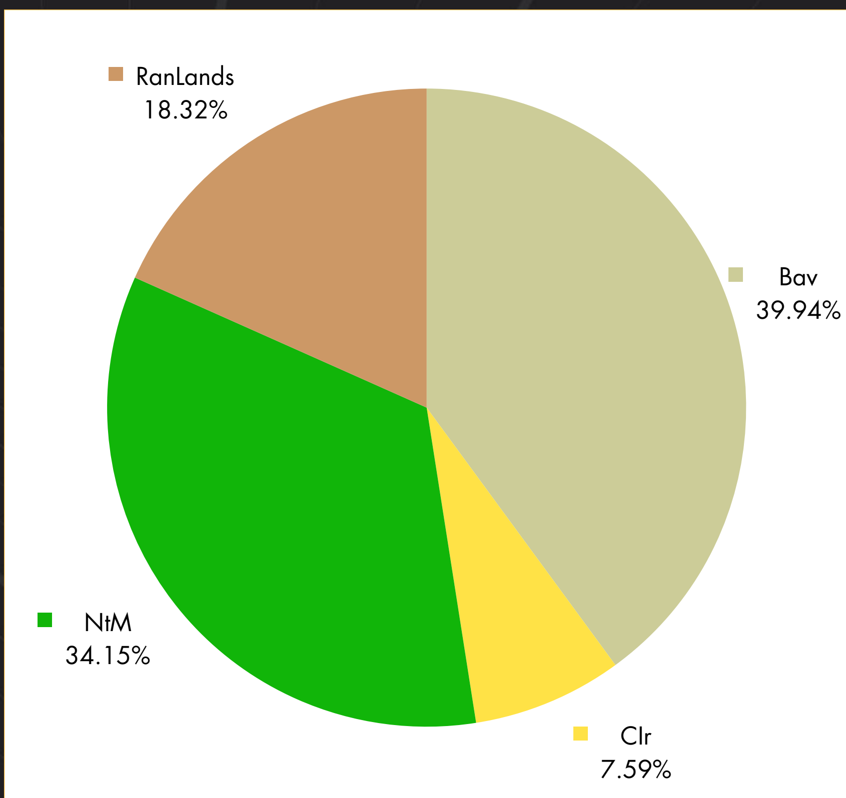


ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
74°40'E
74°44'E
74°48'E
35°48'N
35°44'N
35°40'N
Hanuchal
Haramosh
Sassi
Burumdey
Hosi
Partab Bridge
Indus River
Karakoram Highway
Barmas
Daro
Bunji
37
43
44
53
54
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

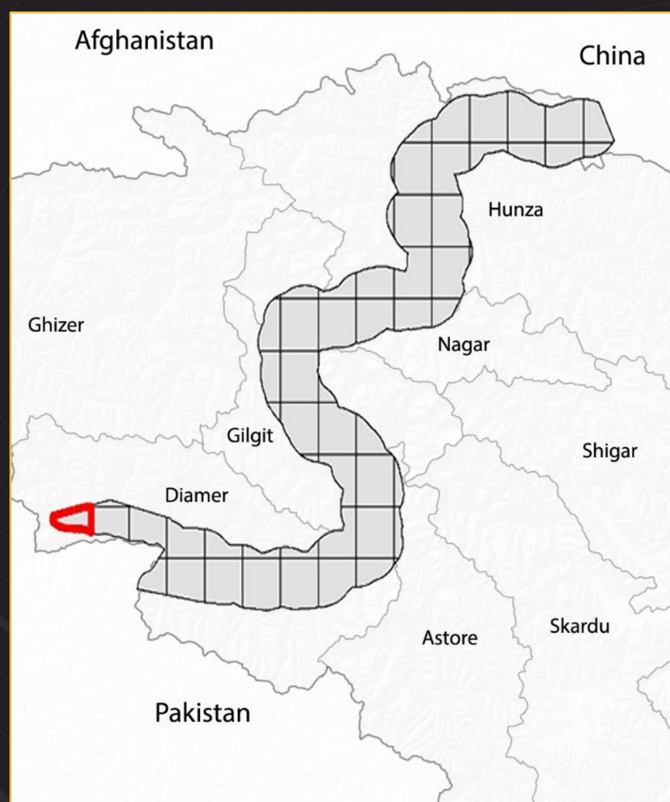
Land Use and Land Cover (LULC) Statistics Map of Zone 45

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	39.94	33.991
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	7.59	6.457
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	34.15	29.067
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	18.32	15.593
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
Total Area (Sq km)				**85.108**

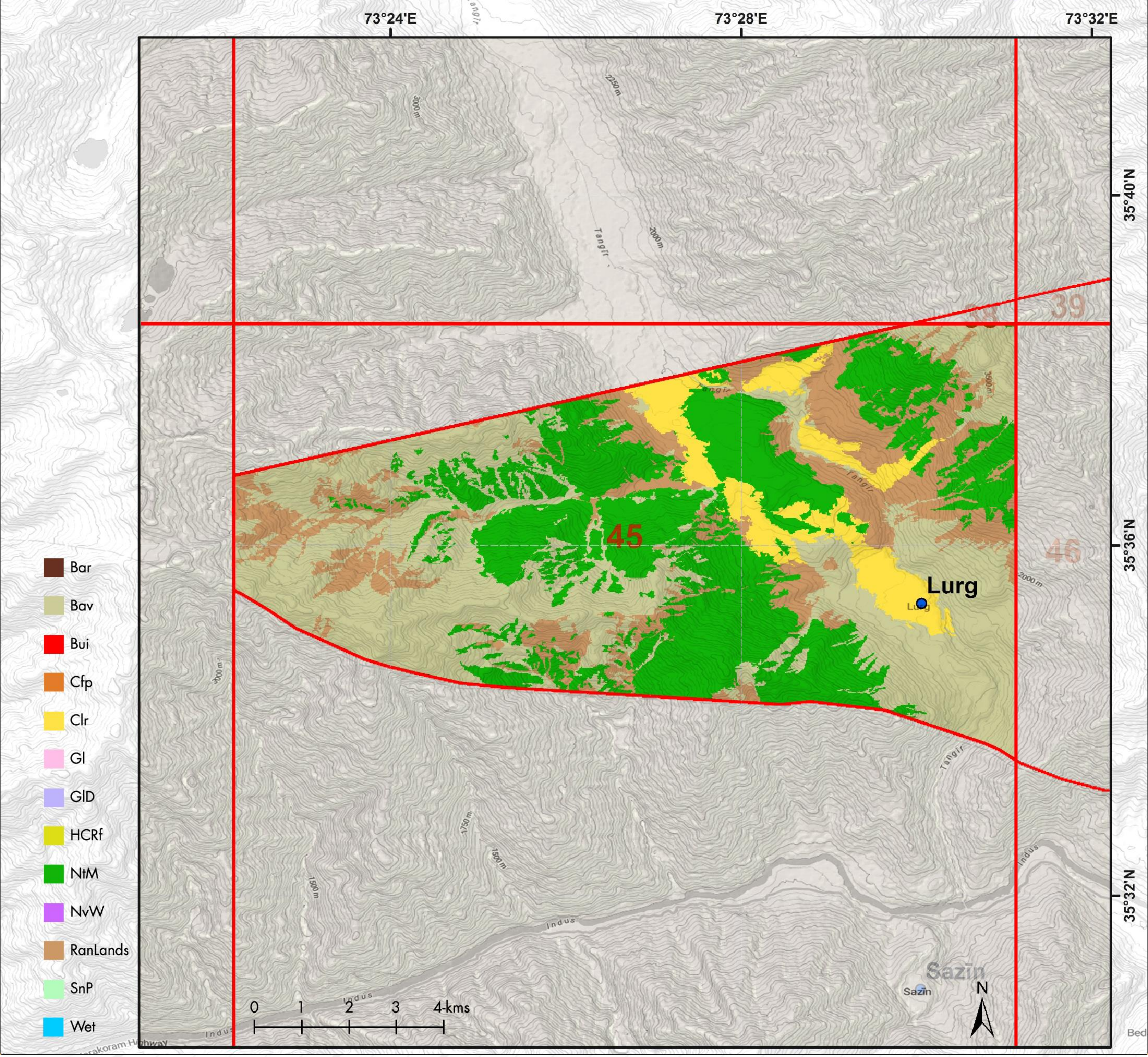
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



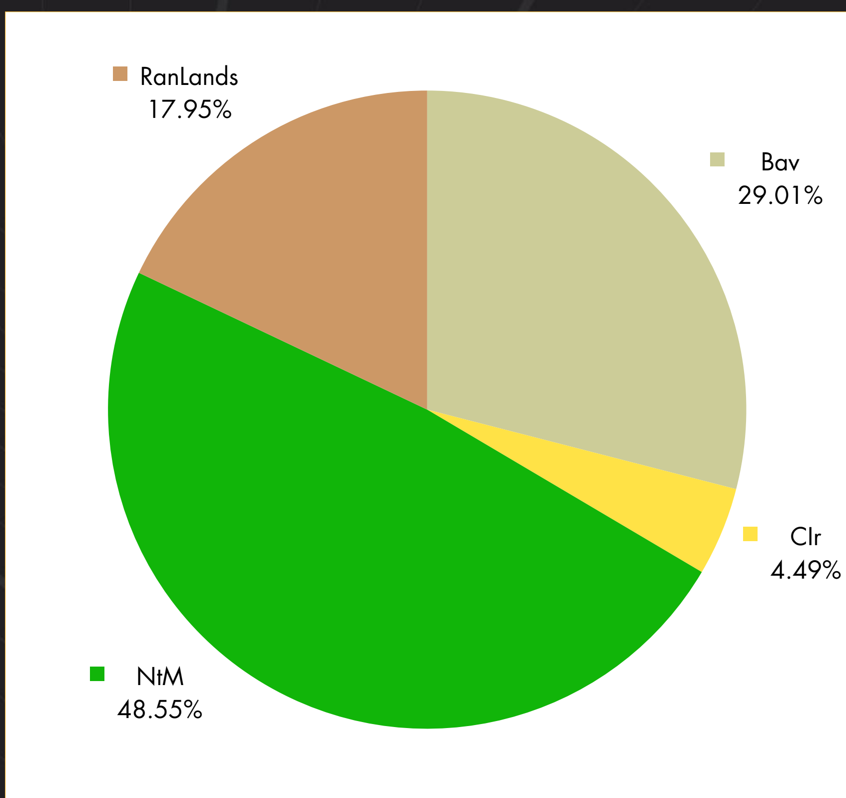
Map zone on the facing page.


73°24'E
73°28'E
73°32'E
35°40'N
35°36'N
35°32'N
39
45
46
Lurg
Sazin
Tangir
Indus
N
0
1
2
3
4-kms
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet

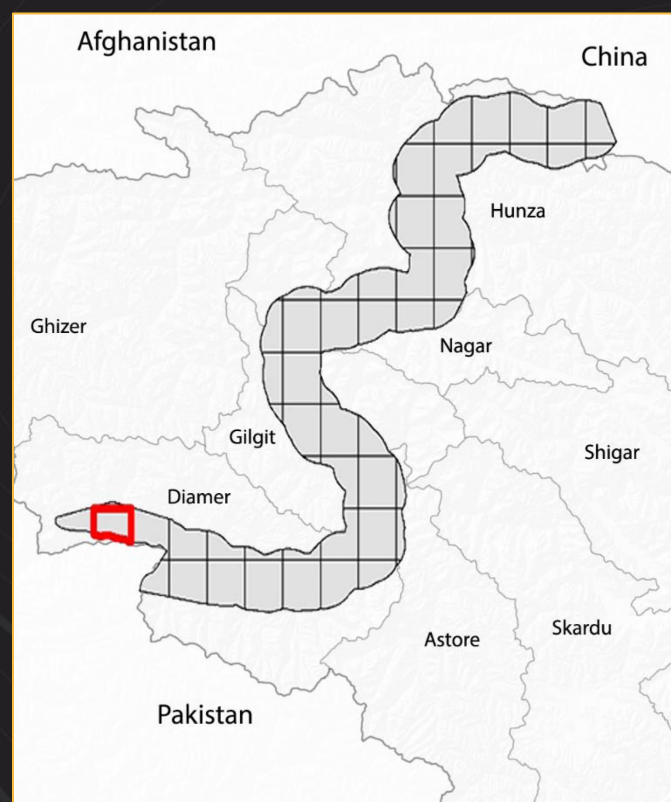
Land Use and Land Cover (LULC) Statistics Map of Zone 46

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	29.01	40.565
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	4.49	6.282
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	48.55	67.896
NvW		Natural Vegetation in Wet Area	0.01	0.014
RanLands		Range Land	17.95	25.097
SnP		Snow Permanent	0	0
Wet		Wet Areas	0.10	0.140
Total Area (Sq km)				**139.994**

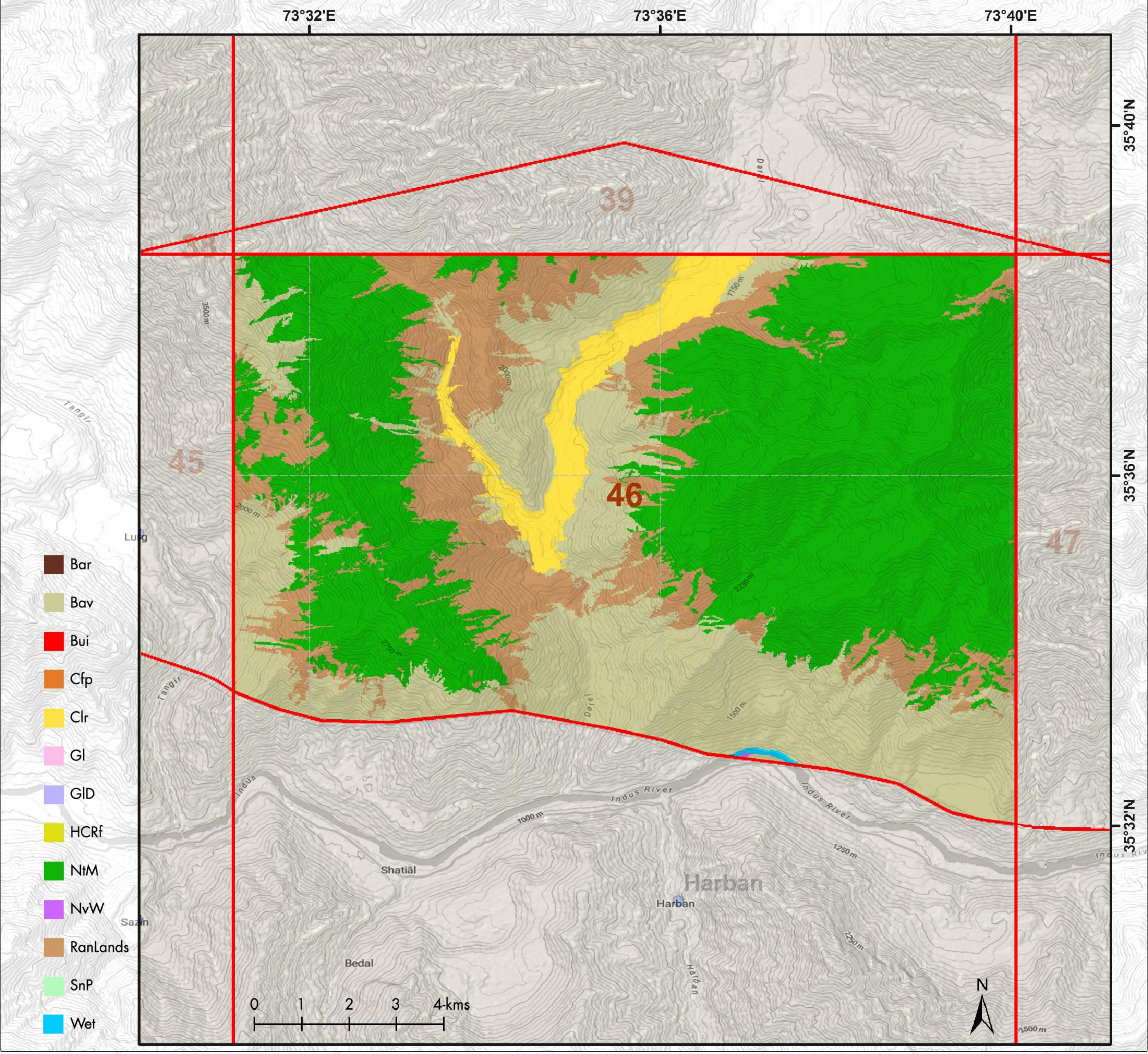
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



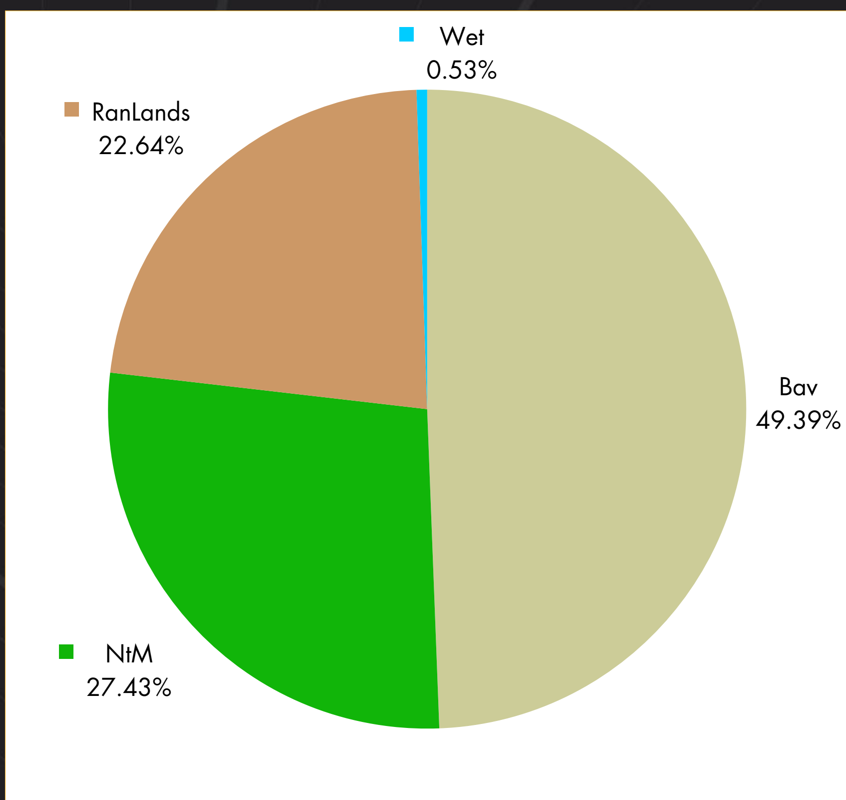
Map zone on the facing page.


73°32'E
73°36'E
73°40'E
35°40'N
35°36'N
35°32'N
39
45
46
47
Darel
Tangir
Lurg
Indus River
Shatiāl
Harban
Sazin
Bedal
1000 m
1250 m
1500 m
2000 m
2250 m
2750 m
3500 m
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4 kms
N

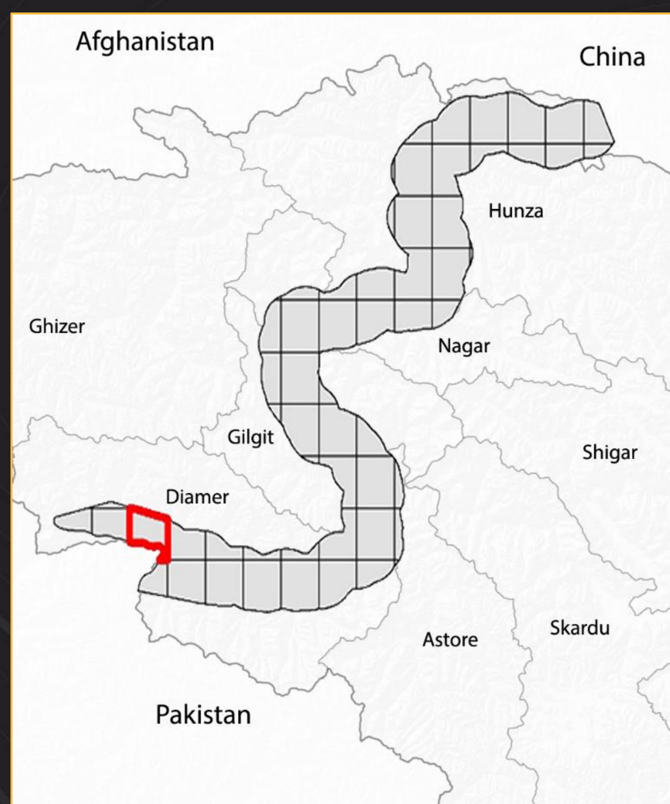
Land Use and Land Cover (LULC) Statistics Map of Zone 47

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	49.39	78.737
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0.22	0.351
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	27.43	43.731
NvW		Natural Vegetation in Wet Area	0.29	0.462
RanLands		Range Land	22.64	36.091
SnP		Snow Permanent	0	0
Wet		Wet Areas	0.53	0.848
Total Area (Sq km)				**160.220**

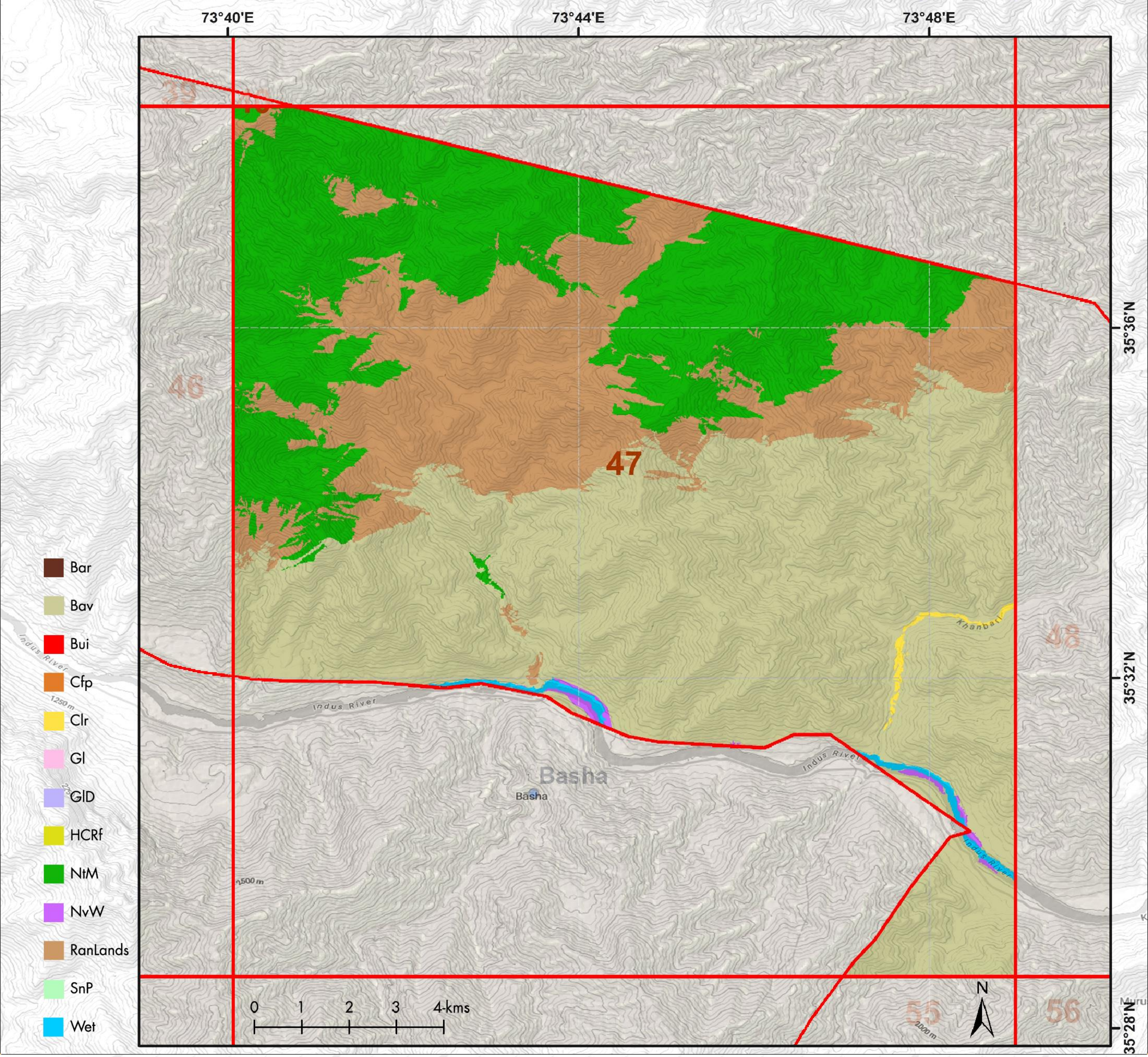
LULC Statistic of Zone on the facing page.



***Note:** Area less than 0.5% is not shown in graph.*



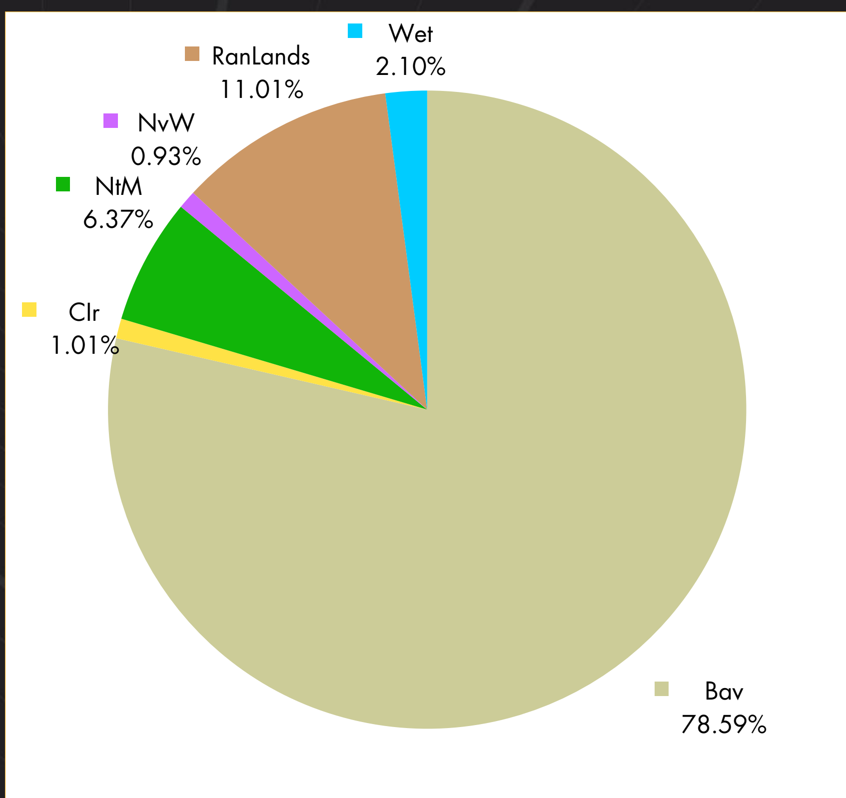
Map zone on the facing page.


73°40'E
73°44'E
73°48'E
35°36'N
35°32'N
35°28'N
47
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
Basha
Indus River
Khanbari
0 1 2 3 4 kms
N

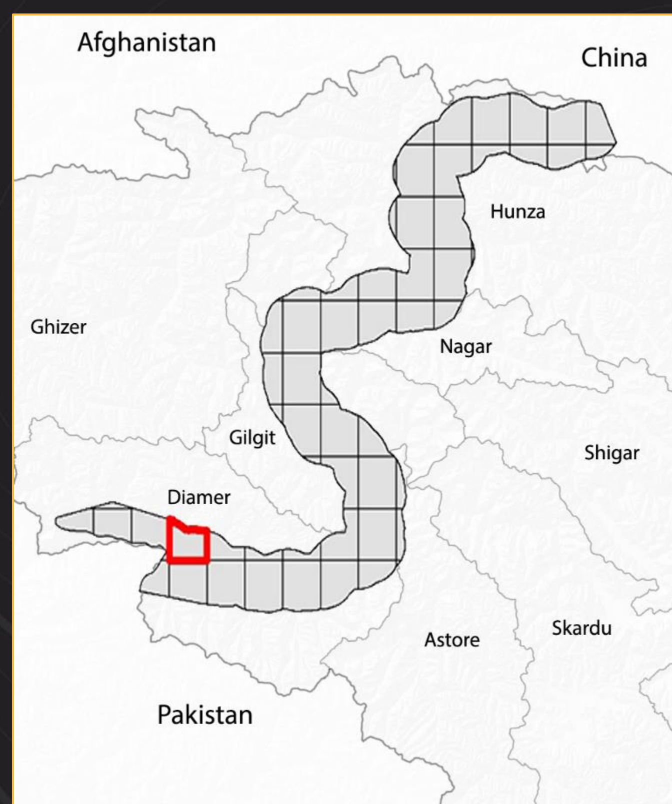
Land Use and Land Cover (LULC) Statistics Map of Zone 48

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	78.59	124.434
Bui		Built-up	0.05	0.084
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	1.01	1.593
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0.03	0.052
NtM		Forest – Natural Vegetation and Trees	6.37	10.083
NvW		Natural Vegetation in Wet Area	0.92	1.466
RanLands		Range Land	11.01	17.431
SnP		Snow Permanent	0	0
Wet		Wet Areas	2.10	3.323
Total Area (Sq km)				**158.466**

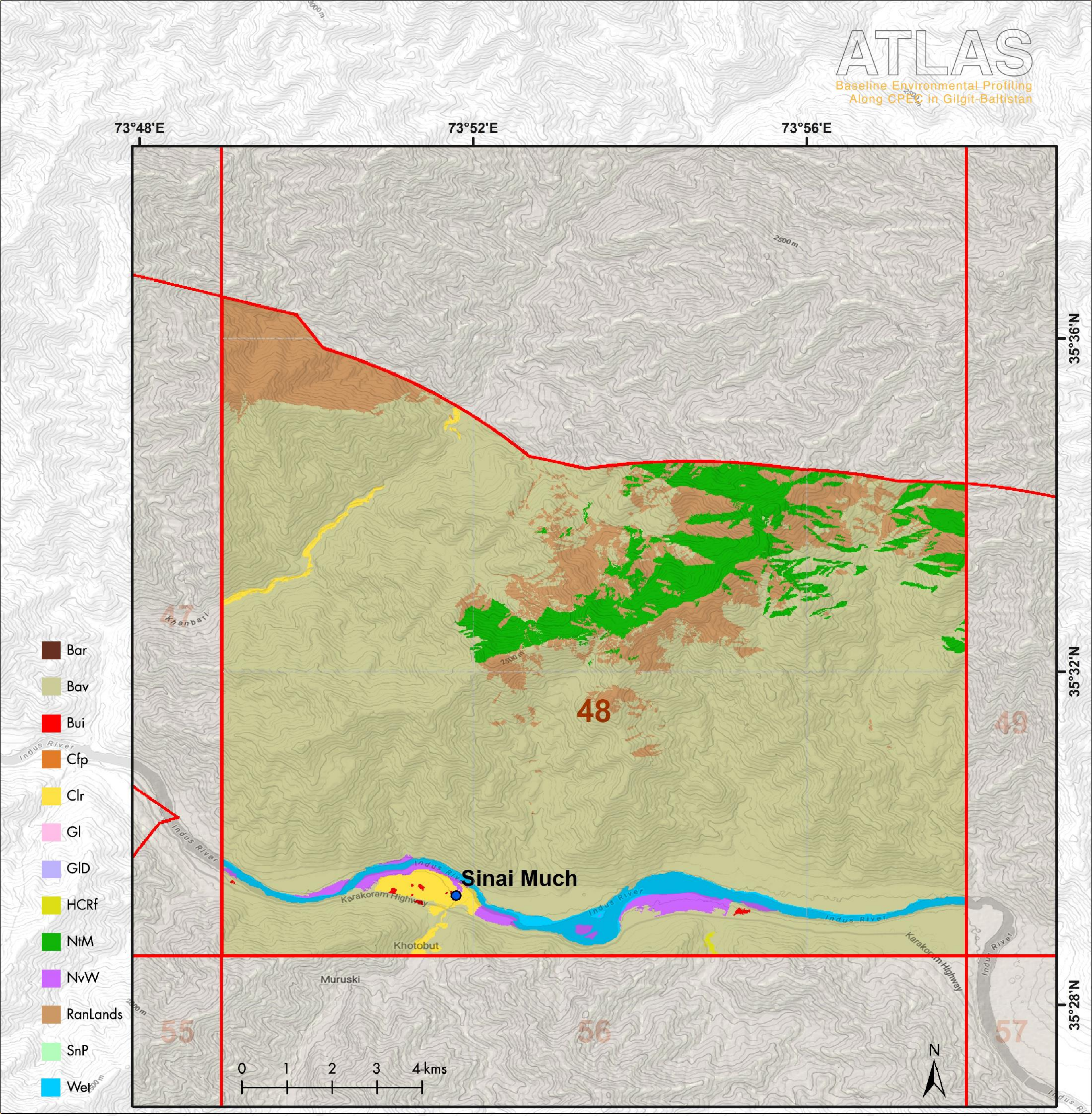
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

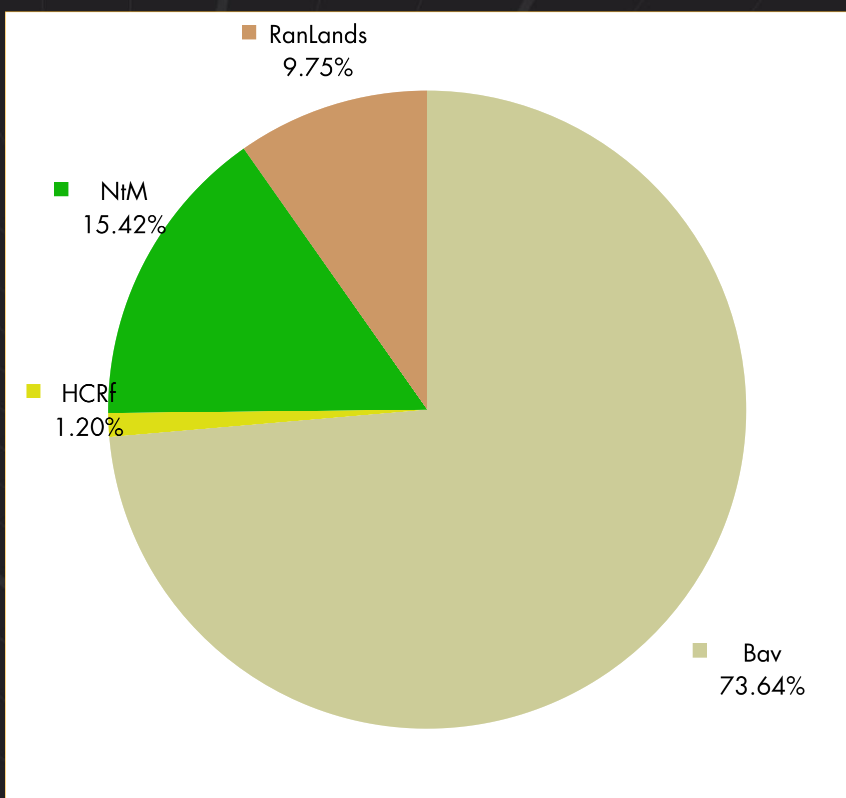


ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
73°48'E
73°52'E
73°56'E
35°36'N
35°32'N
35°28'N
2500 m
47
Khanbari
48
49
55
56
57
Sinai Much
Indus River
Karakoram Highway
Khotobut
Muruski
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4 kms
N

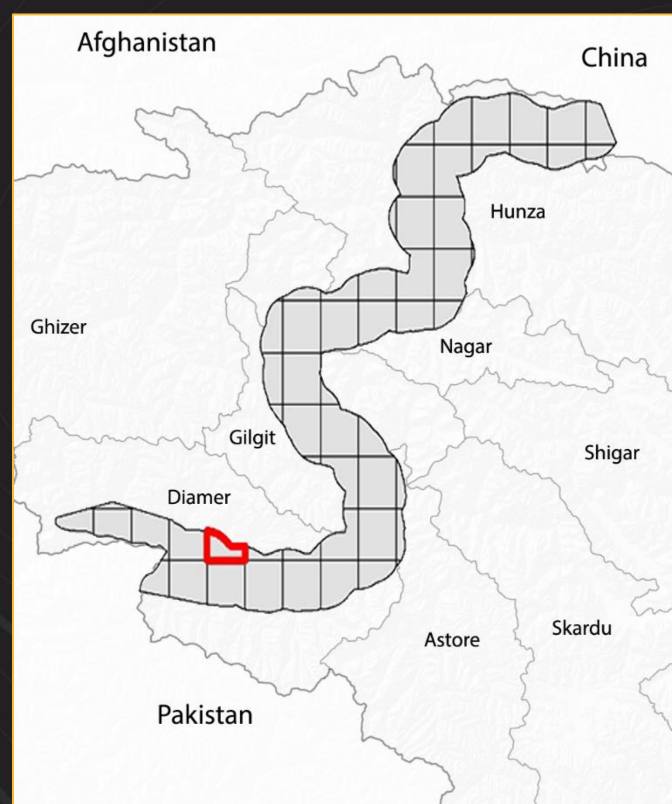
Land Use and Land Cover (LULC) Statistics Map of Zone 49

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0.30	0.297
Bav		Bare Area with Sparse Natural Vegetation	73.64	71.786
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0.01	0.014
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	1.19	1.170
NtM		Forest – Natural Vegetation and Trees	15.42	15.028
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	9.75	9.504
SnP		Snow Permanent	0	0
Wet		Wet Areas	0.36	0.350
Total Area (Sq km)				**98.149**

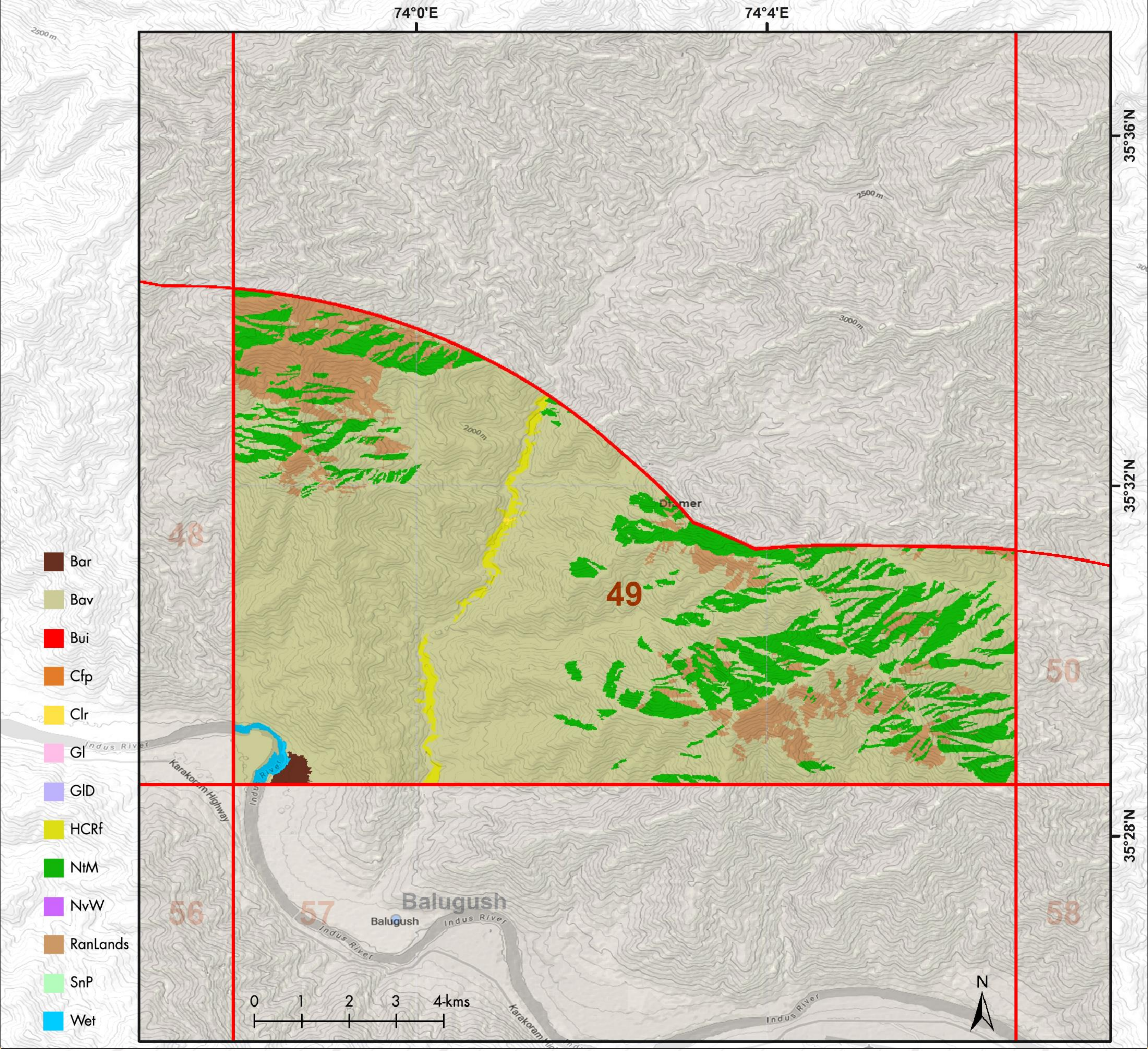
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



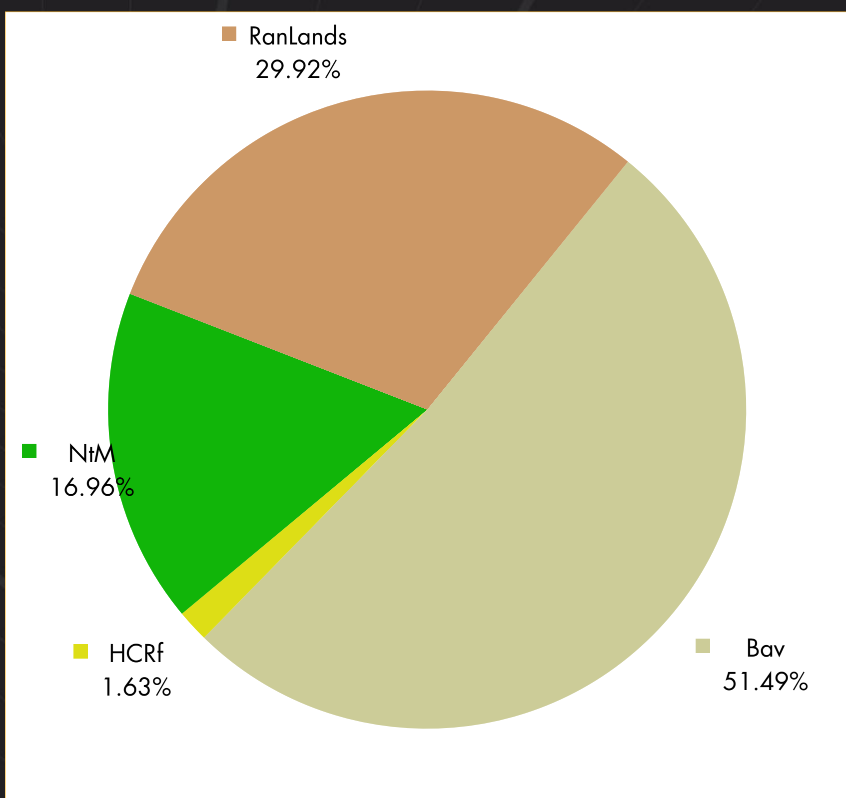
Map zone on the facing page.


74°0'E
74°4'E
35°36'N
35°32'N
35°28'N
2500 m
3000 m
2000 m
Damer
48
49
50
56
57
58
Balugush
Indus River
Karakoram Highway
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4 kms
N

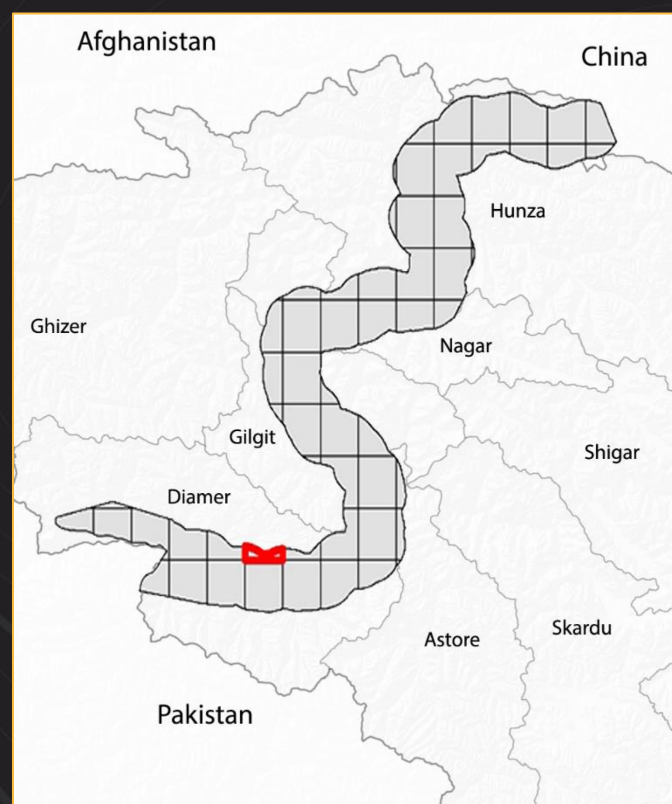
Land Use and Land Cover (LULC) Statistics Map of Zone 50

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	51.49	23.540
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	1.63	0.743
NtM		Forest – Natural Vegetation and Trees	16.96	7.753
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	29.92	13.680
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
Total Area (Sq km)				**45.716**

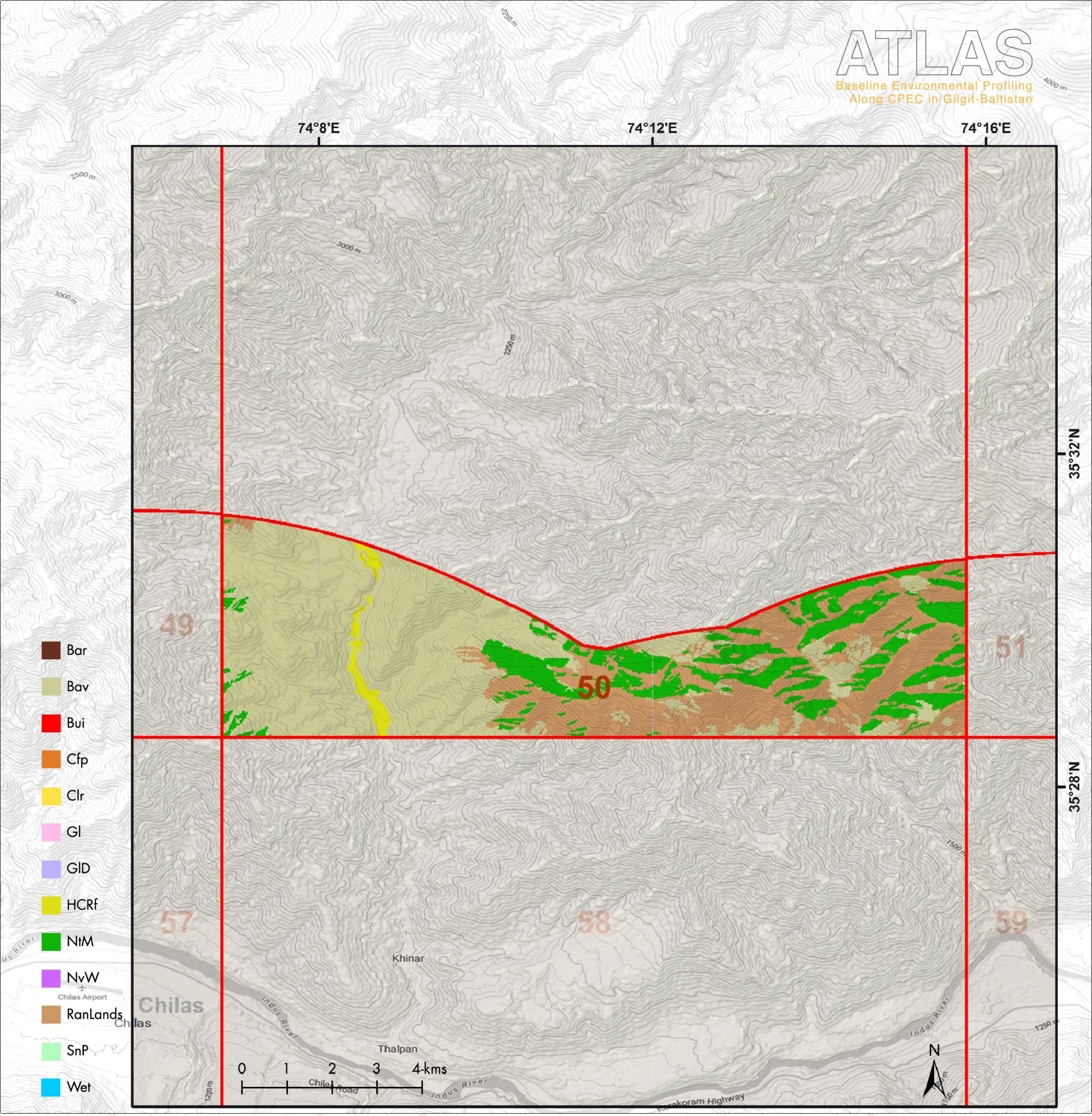
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

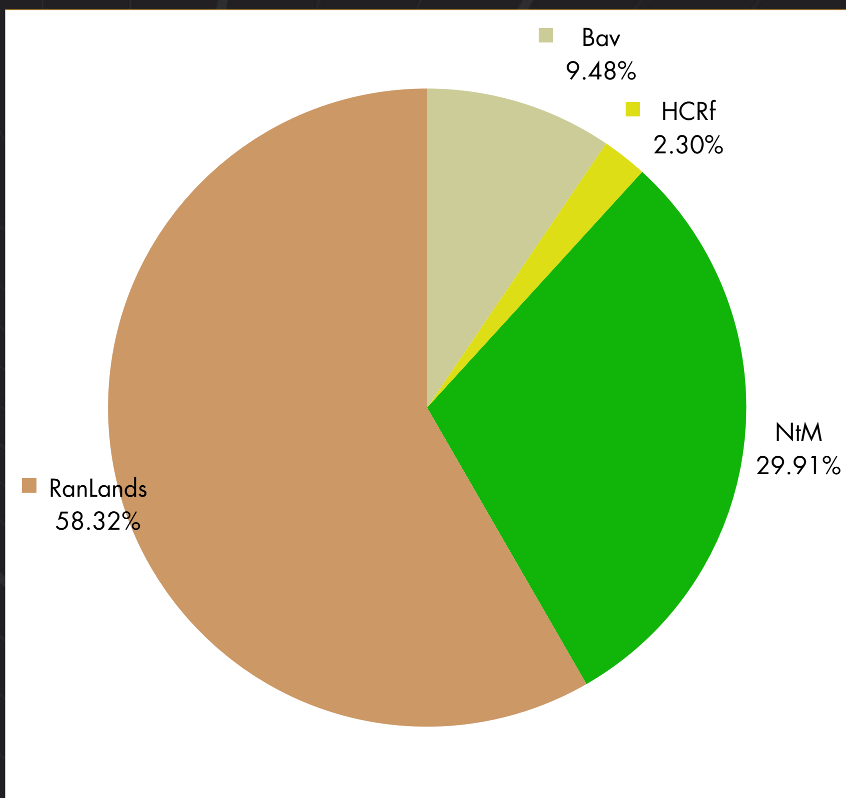


ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
74°8'E
74°12'E
74°16'E
35°32'N
35°28'N
49
50
51
57
58
59
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
Chilas
Chilas Airport
Khinar
Thalpan
Indus River
Karakoram Highway
0 1 2 3 4-kms
N

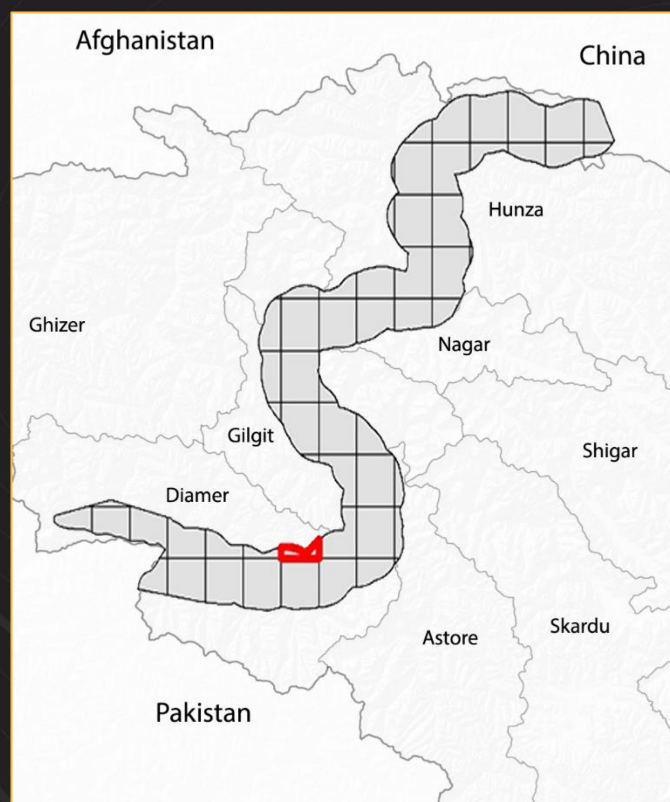
Land Use and Land Cover (LULC) Statistics Map of Zone 51

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	9.48	4.828
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	2.30	1.170
NtM		Forest – Natural Vegetation and Trees	29.91	15.238
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	58.32	29.714
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
		Total Area (Sq km)		**50.950**

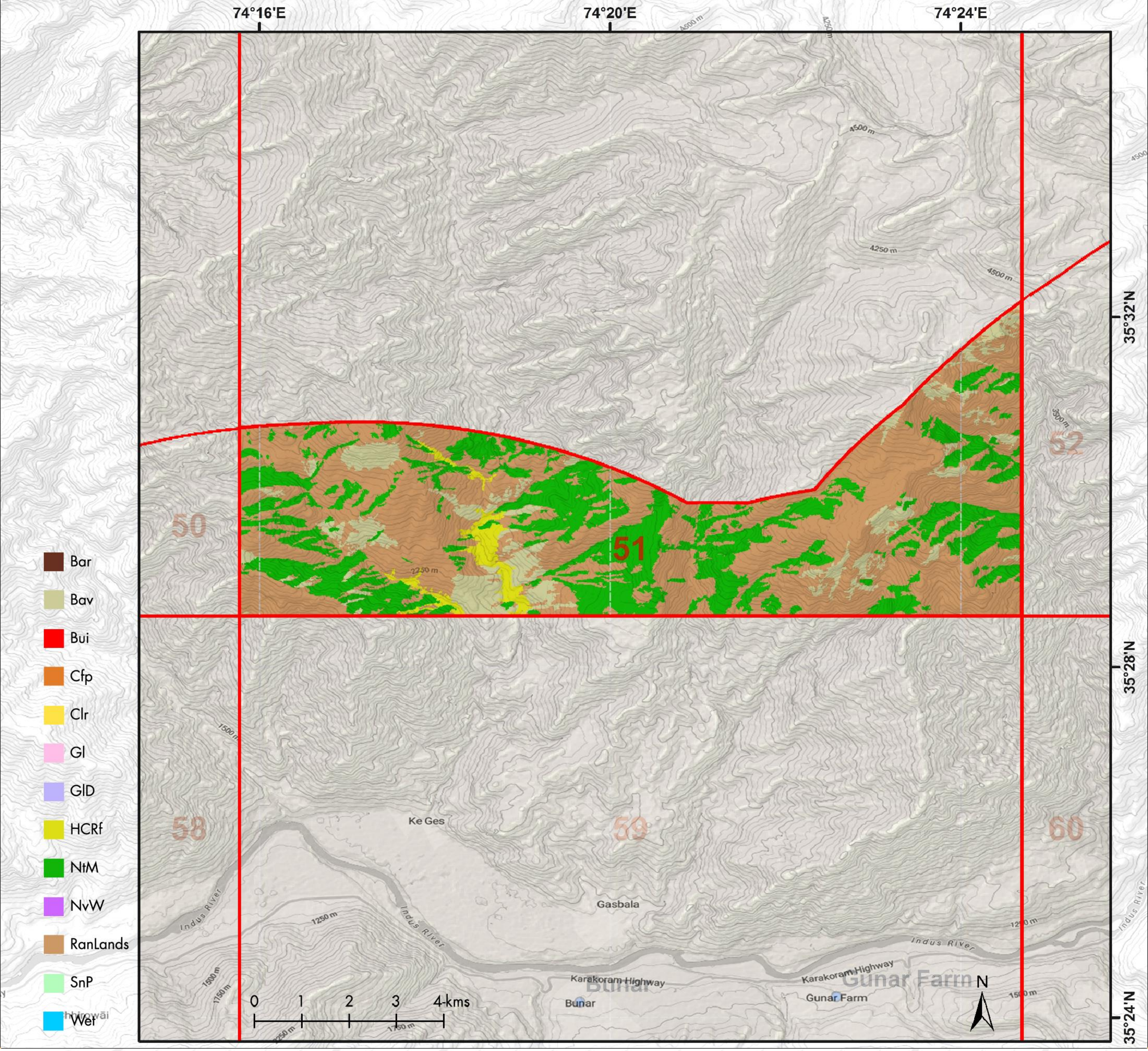
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



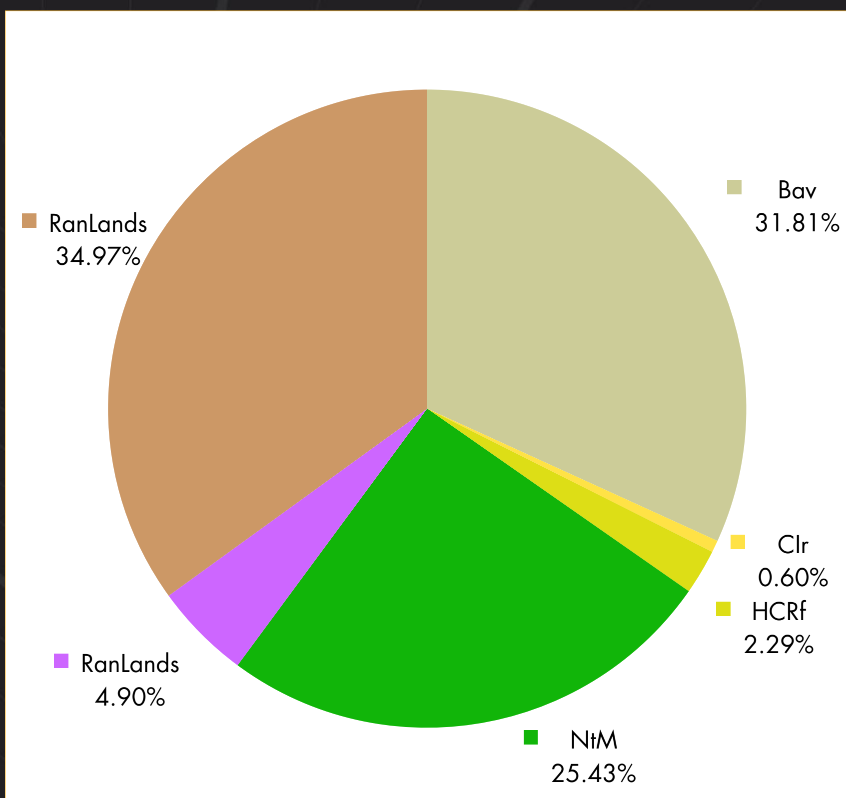
Map zone on the facing page.


74°16'E
74°20'E
74°24'E
35°32'N
35°28'N
35°24'N
50
51
52
58
59
60
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
Ke Ges
Gasbala
Indus River
Karakoram Highway
Bunar
Gunar Farm
0 1 2 3 4 kms
N

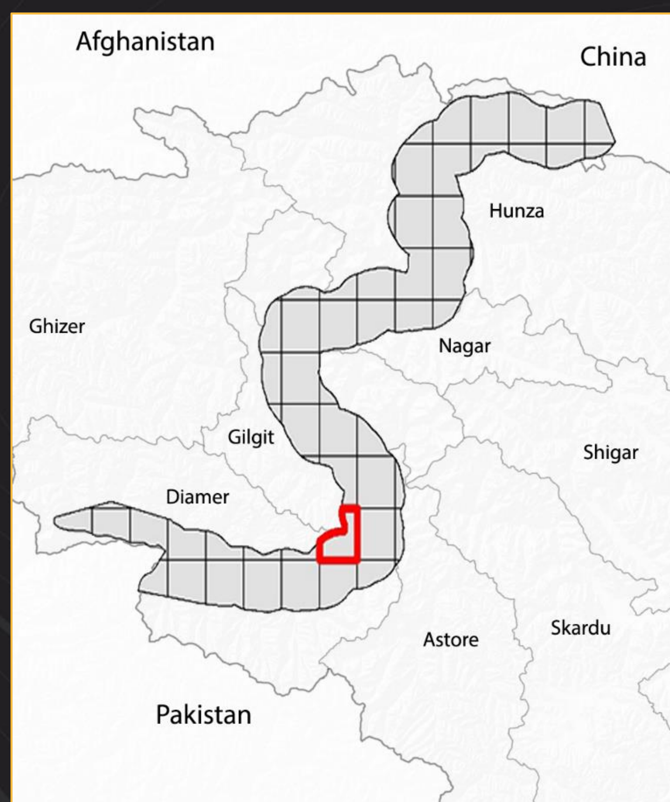
Land Use and Land Cover (LULC) Statistics Map of Zone 52

Legend	*Class Code*	*Abbreviation*	*Percentage (%)*	*Area (Sq Km)*
Bar		Bare Land	0.41	0.703
Bav		Bare Area with Sparse Natural Vegetation	31.81	53.576
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0.60	1.018
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	2.29	3.850
NtM		Forest – Natural Vegetation and Trees	25.43	42.830
NvW		Natural Vegetation in Wet Area	4.90	8.259
RanLands		Range Land	34.97	58.908
SnP		Snow Permanent	0	0
Wet		Wet Areas	0.17	0.287
Total Area (Sq km)				**169.431**

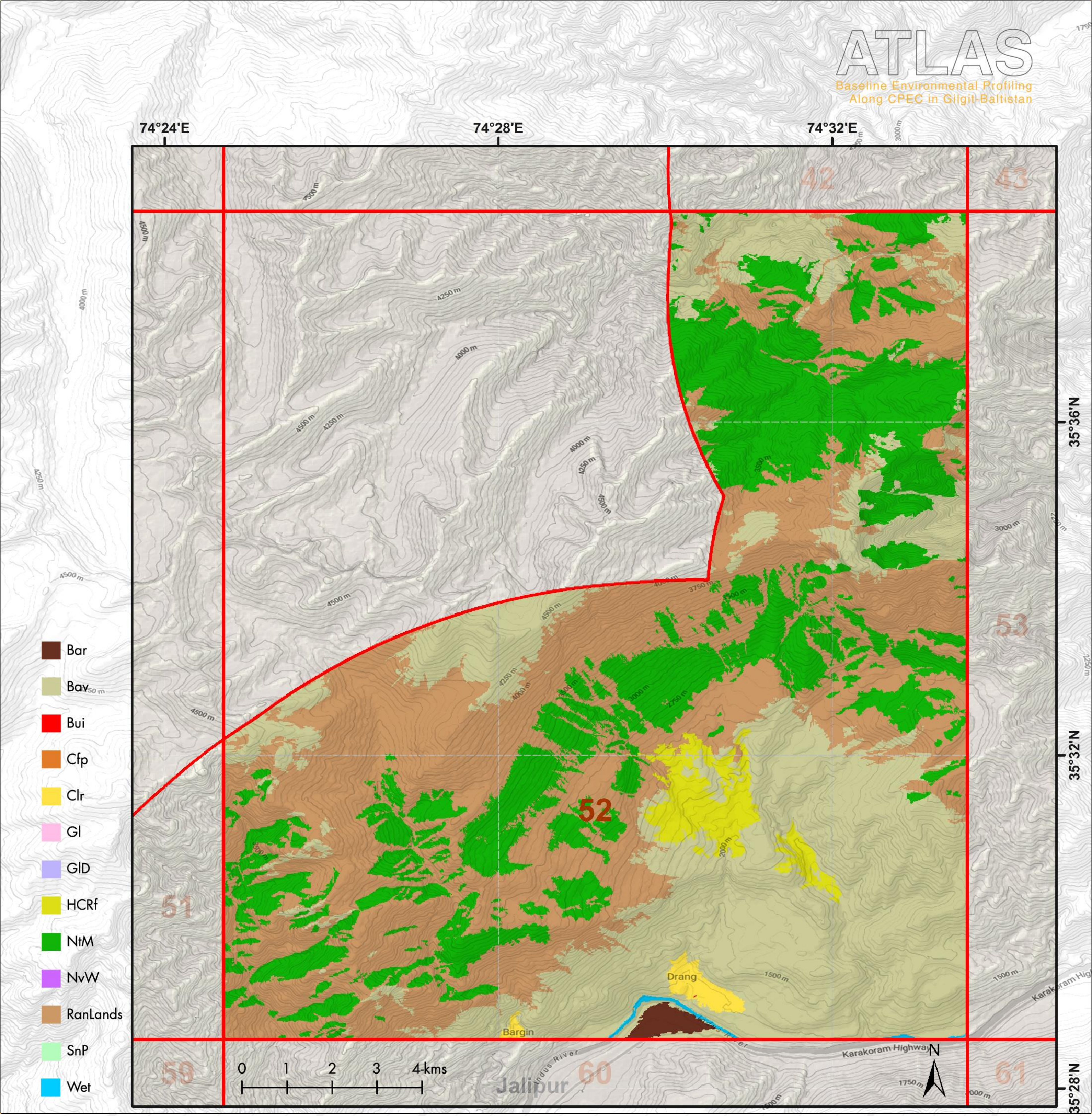
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

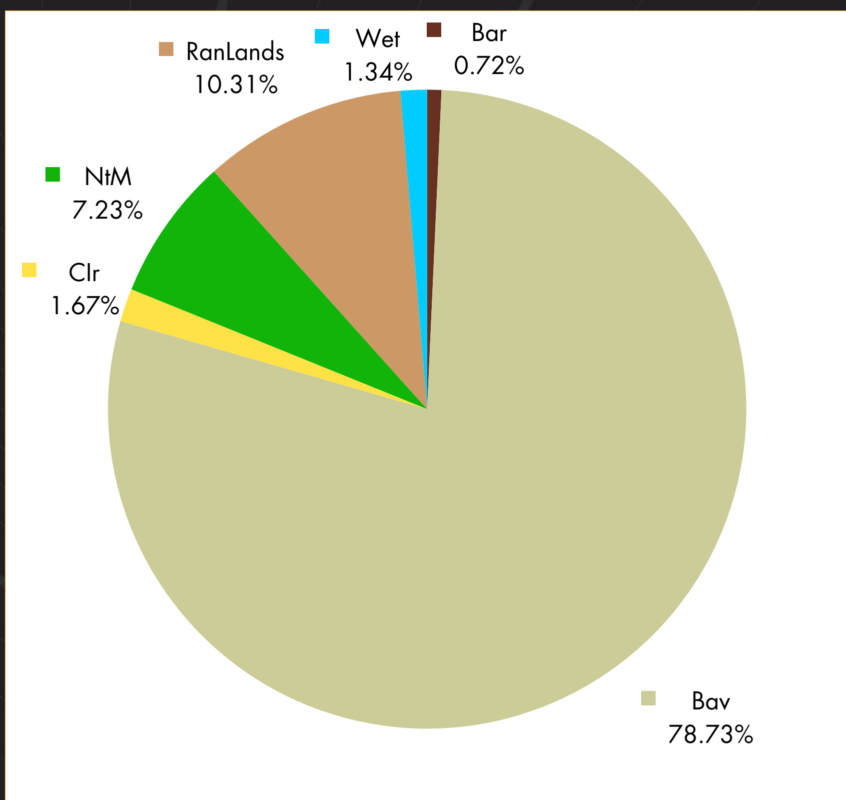


ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
74°24'E
74°28'E
74°32'E
35°36'N
35°32'N
35°28'N
42
43
51
52
53
59
60
61
Drang
Bargin
Jalipur
Karakoram Highway
Indus River
0 1 2 3 4 kms
N
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet

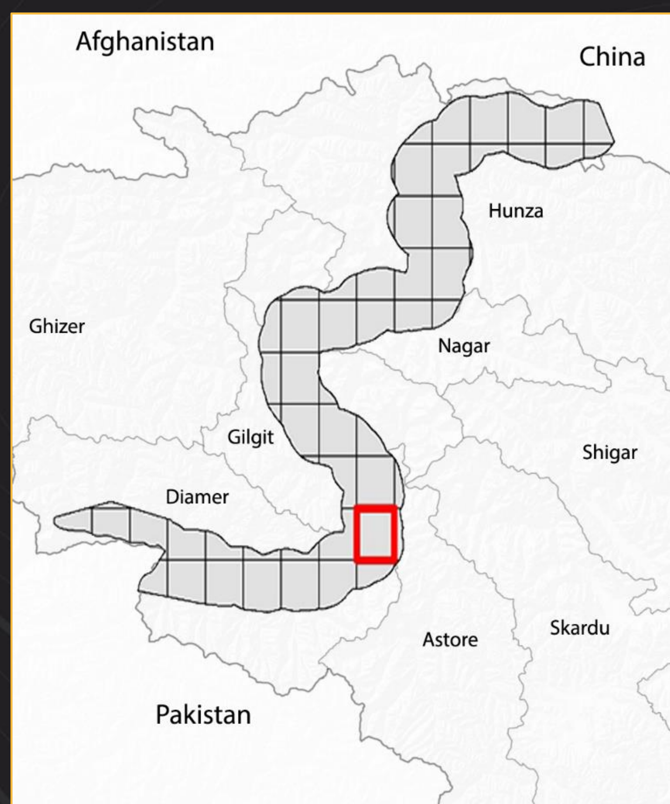
Land Use and Land Cover (LULC) Statistics Map of Zone 53

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0.72	1.780
Bav		Bare Area with Sparse Natural Vegetation	78.73	195.037
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	1.67	4.141
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	7.23	17.915
NvW		Natural Vegetation in Wet Area	0.04	0.102
RanLands		Range Land	10.31	25.541
SnP		Snow Permanent	0	0
Wet		Wet Areas	1.34	3.317
Total Area (Sq km)				**247.833**

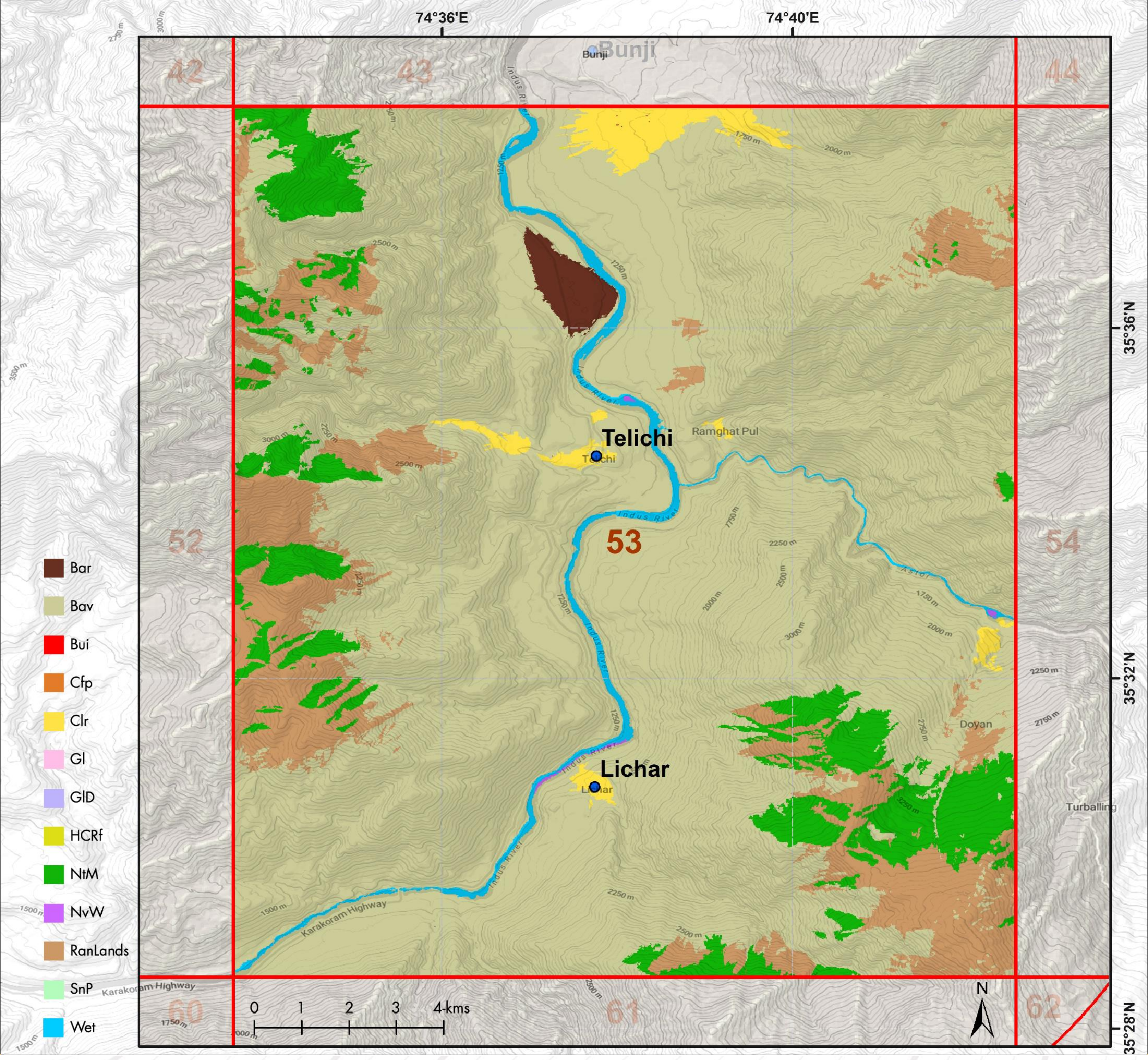
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



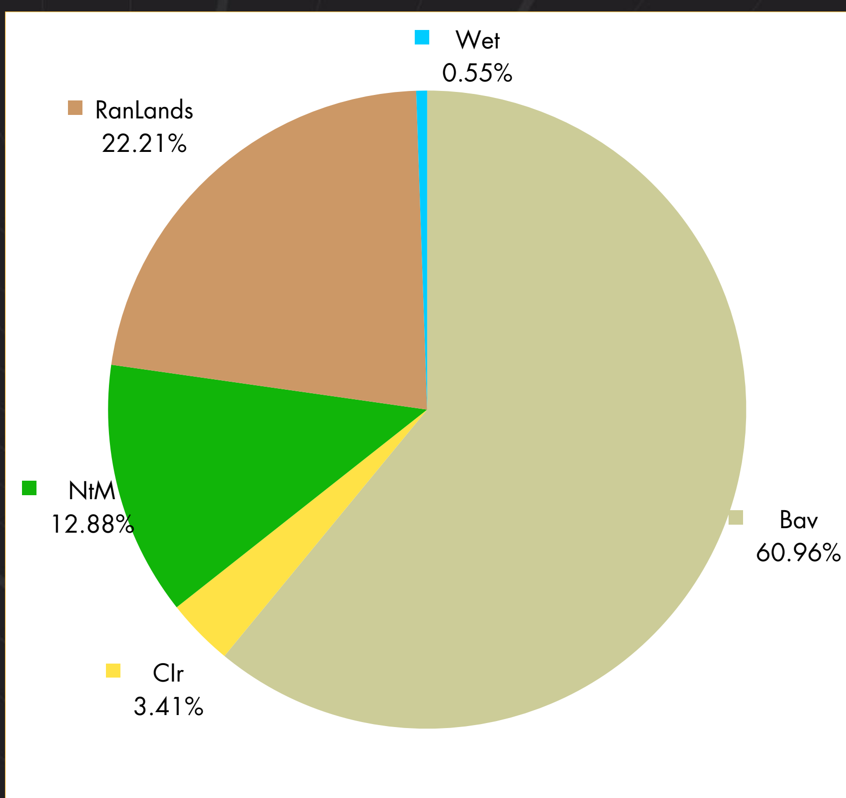
Map zone on the facing page.


74°36'E
74°40'E
35°36'N
35°32'N
35°28'N
Daro
Bunji
Telichi
Ramghat Pul
Lichar
Doyan
Turballing
Indus River
Karakoram Highway
42
43
44
52
53
54
60
61
62
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4 kms
N

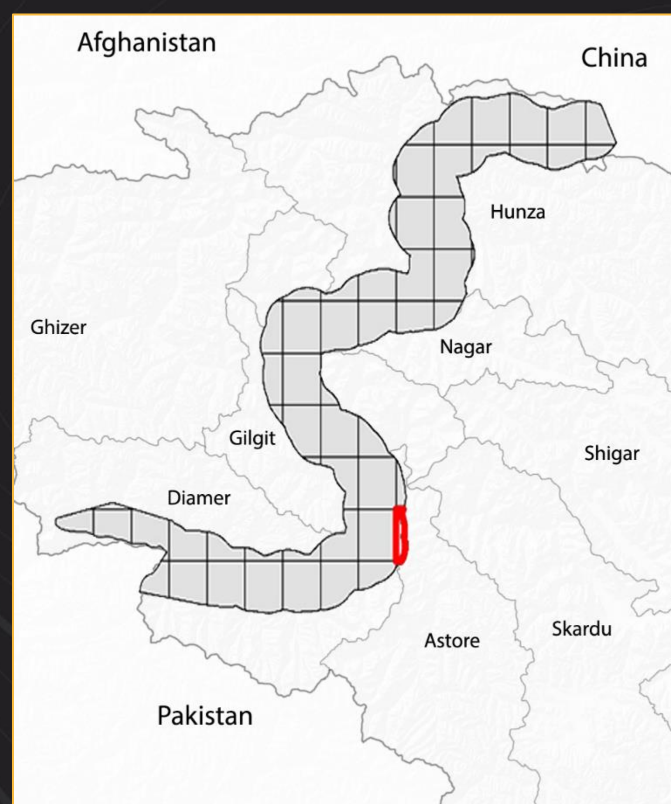
Land Use and Land Cover (LULC) Statistics Map of Zone 54

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	60.96	29.912
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	3.41	1.672
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	12.88	6.320
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	22.21	10.896
SnP		Snow Permanent	0	0
Wet		Wet Areas	0.55	0.269
Total Area (Sq km)				**49.069**

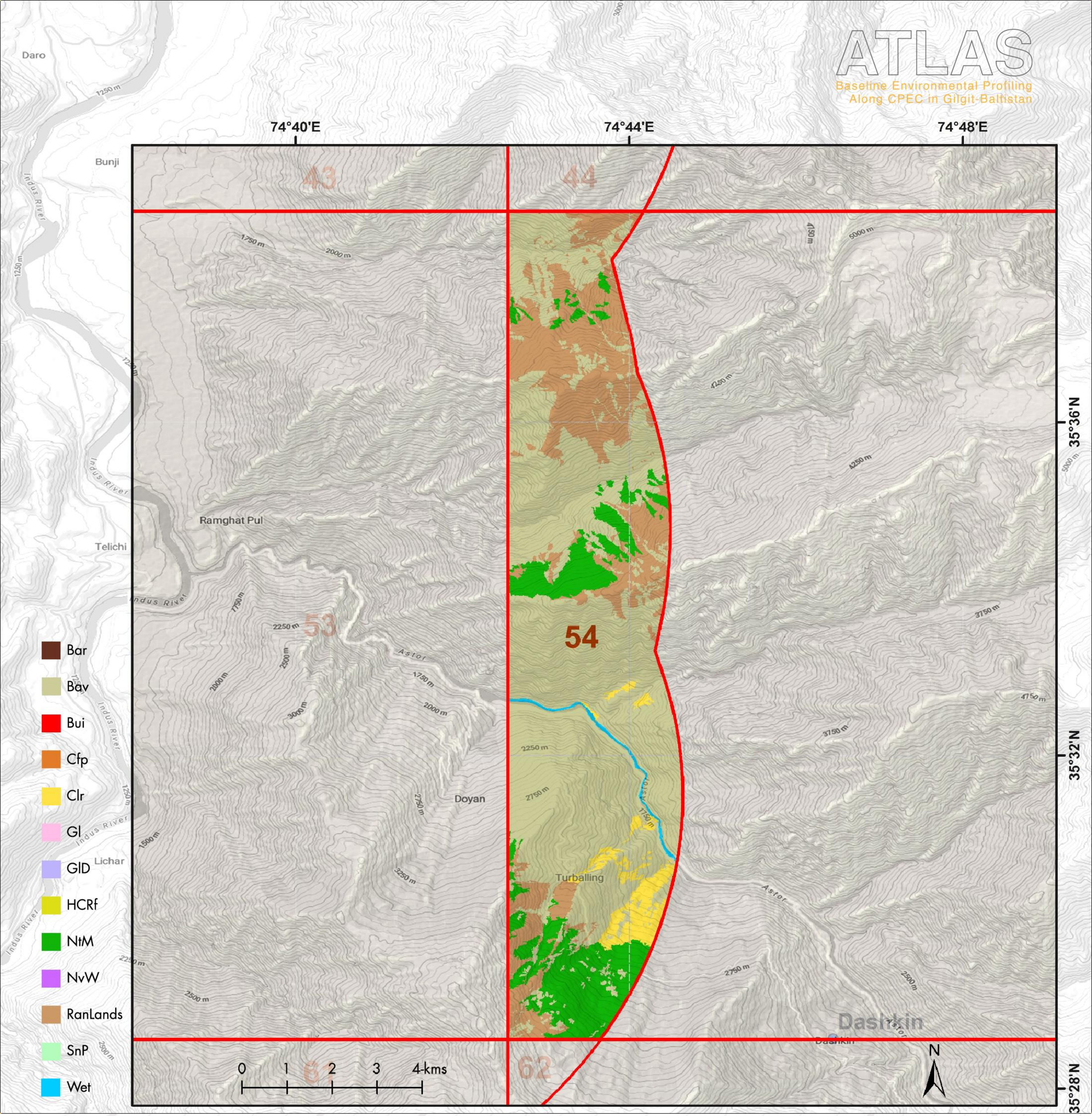
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



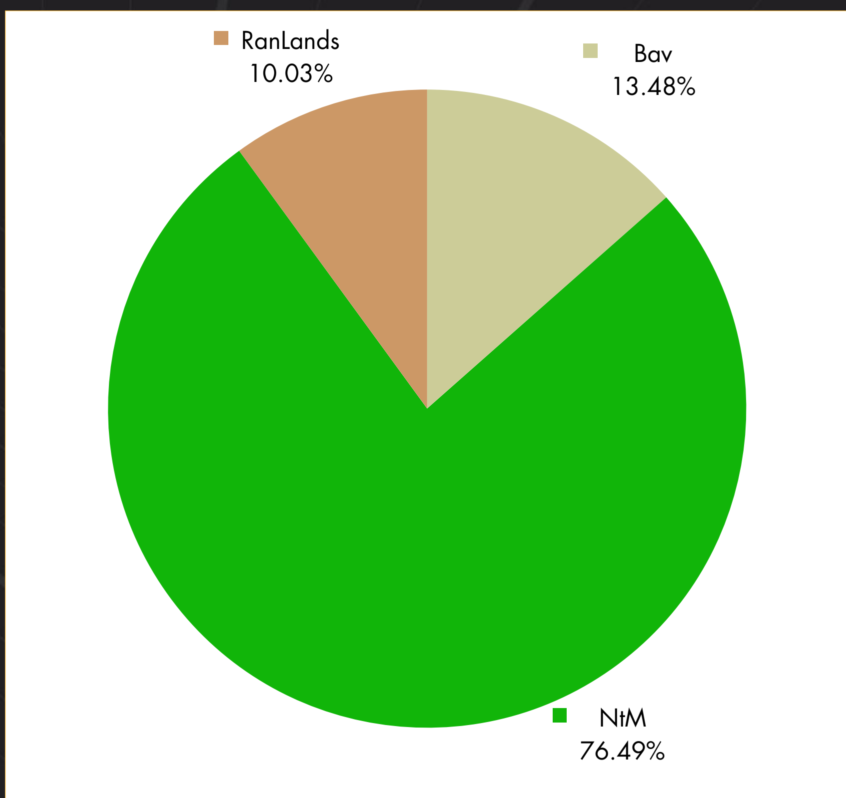
Map zone on the facing page.


74°40'E
74°44'E
74°48'E
35°36'N
35°32'N
35°28'N
43
44
53
54
61
62
Daro
Bunji
Ramghat Pul
Telichi
Doyan
Lichar
Turballing
Dashkin
Indus River
Astor
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4 kms
N

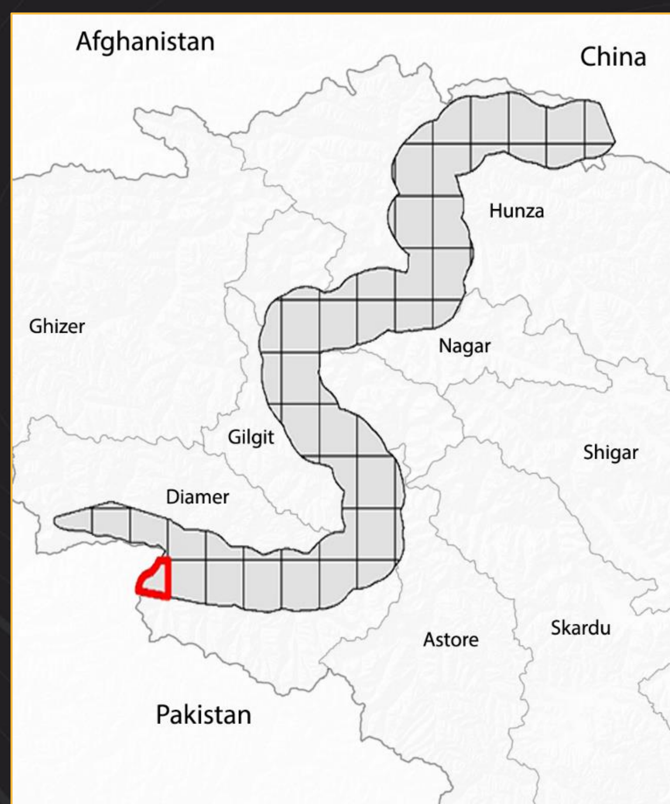
Land Use and Land Cover (LULC) Statistics Map of Zone 55

Legend	*Class Code*	*Abbreviation*	*Percentage (%)*	*Area (Sq Km)*
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	13.48	12.399
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	0.03	0.023
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	76.49	70.345
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	10.03	9.221
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
Total Area (Sq km)				**91.988**

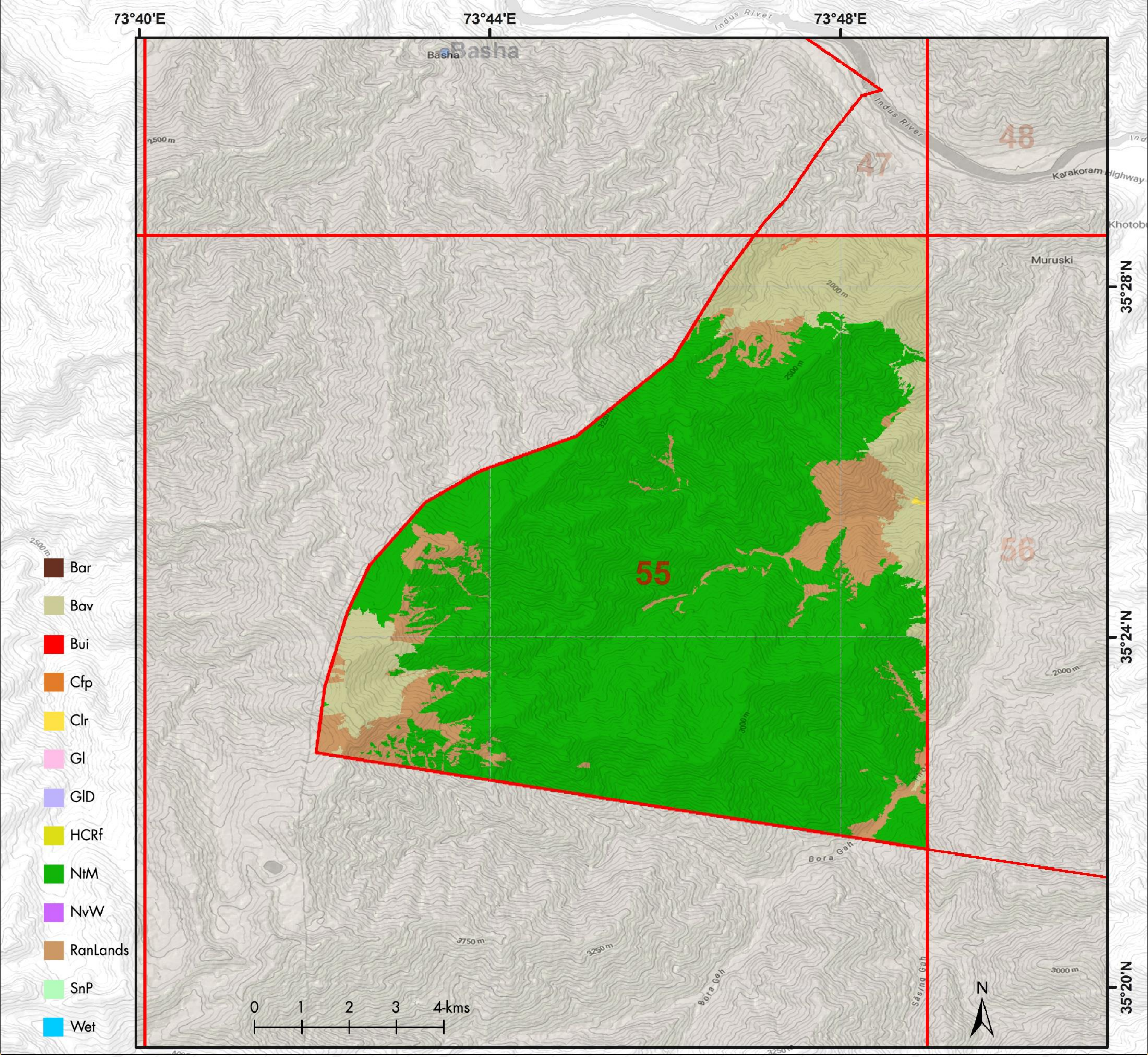
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



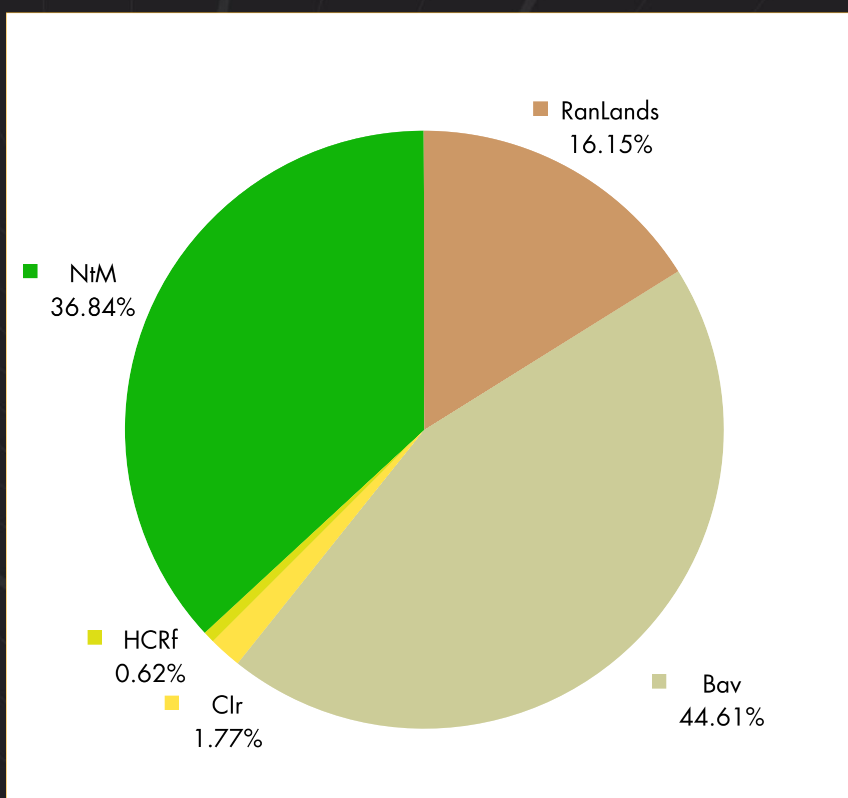
Map zone on the facing page.


73°40'E
73°44'E
73°48'E
35°28'N
35°24'N
35°20'N
Basha
Indus River
Karakoram Highway
Khotobu
Muruski
Bora Gah
Sasing Gah
47
48
55
56
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4-kms
N

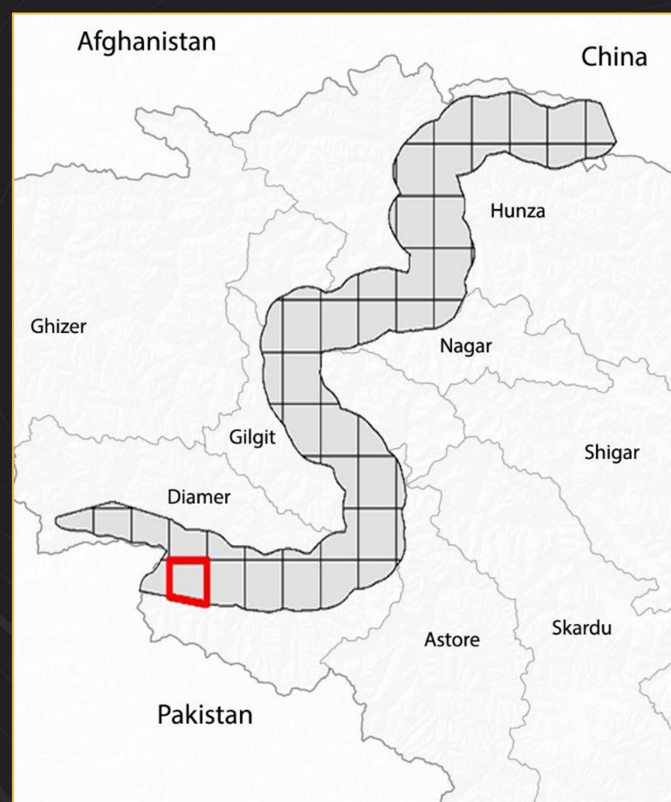
Land Use and Land Cover (LULC) Statistics Map of Zone 56

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	44.61	85.769
Bui		Built-up	0.15	0.291
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	1.77	3.404
GI		Glacier	0	0
GID		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0.62	1.201
NtM		Forest – Natural Vegetation and Trees	36.84	70.836
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	16.15	31.058
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
Total Area (Sq km)				**192.559**

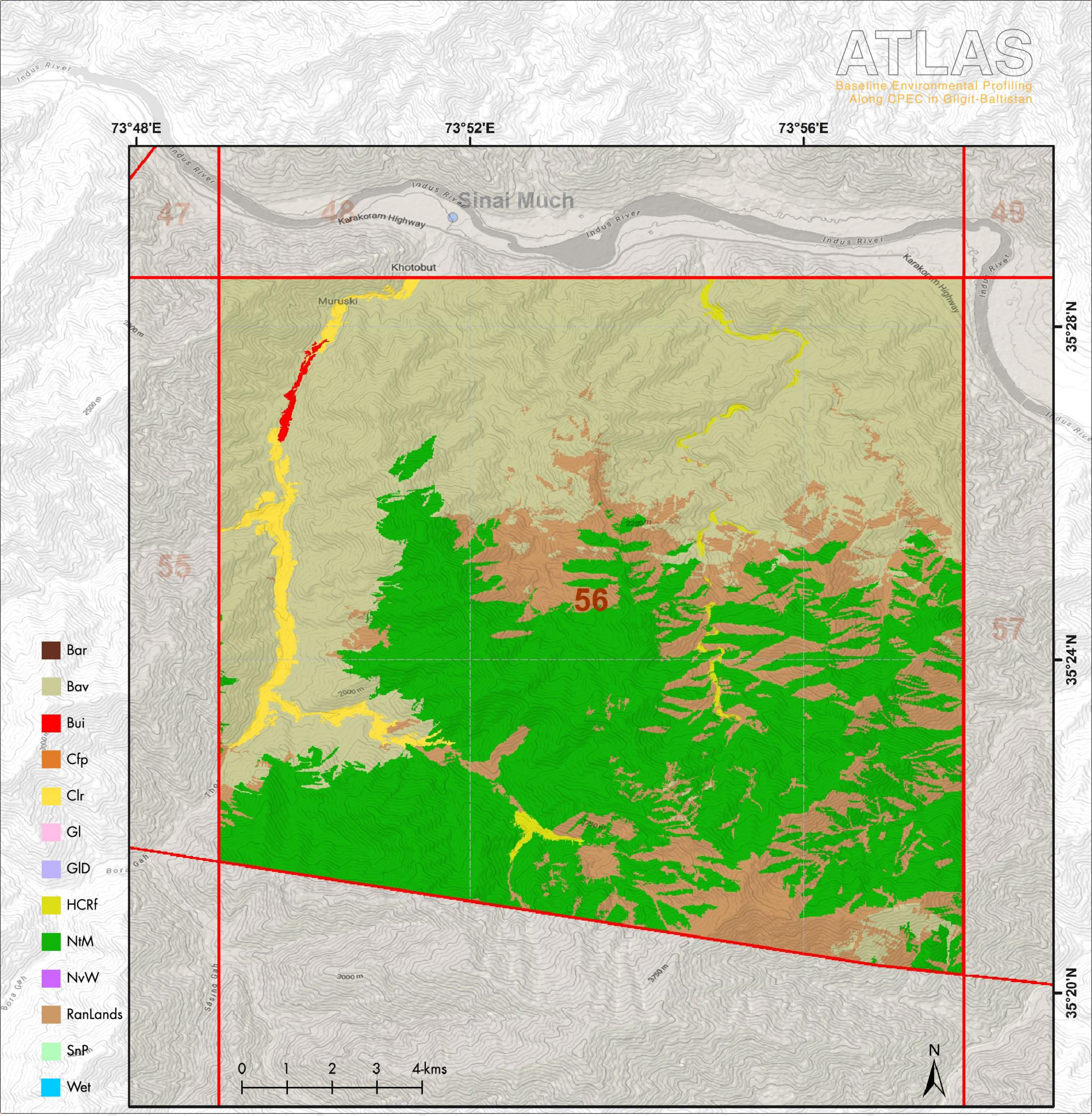
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

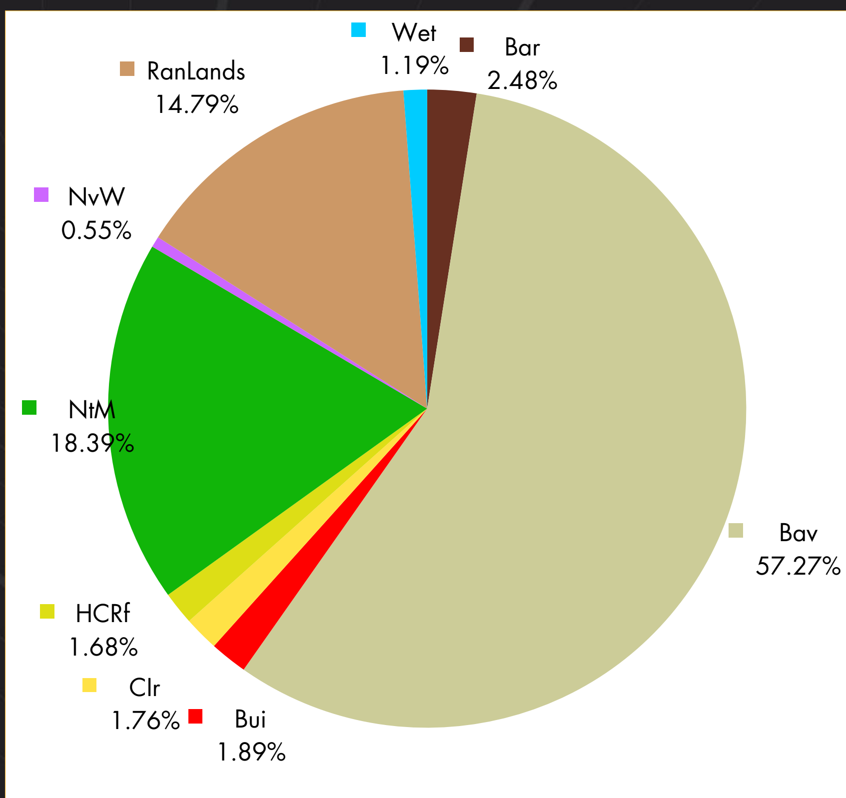


ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
73°48'E
73°52'E
73°56'E
35°28'N
35°24'N
35°20'N
Indus River
Sinai Much
Karakoram Highway
Khotobut
Muruski
47
48
49
55
56
57
2000 m
2250 m
2500 m
3000 m
3750 m
Bora Gah
Sasina Gah
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

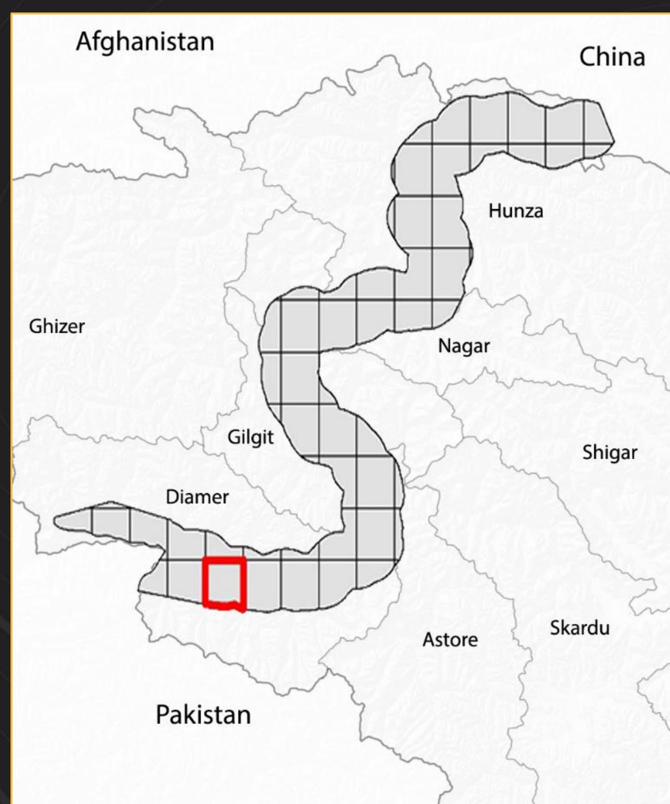
Land Use and Land Cover (LULC) Statistics Map of Zone 57

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	2.48	5.410
Bav		Bare Area with Sparse Natural Vegetation	57.27	124.734
Bui		Built-up	1.89	4.124
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	1.76	3.833
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	1.68	3.649
NtM		Forest – Natural Vegetation and Trees	18.39	40.063
NvW		Natural Vegetation in Wet Area	0.55	1.191
RanLands		Range Land	14.79	32.212
SnP		Snow Permanent	0	0
Wet		Wet Areas	1.19	2.587
Total Area (Sq km)				**217.803**

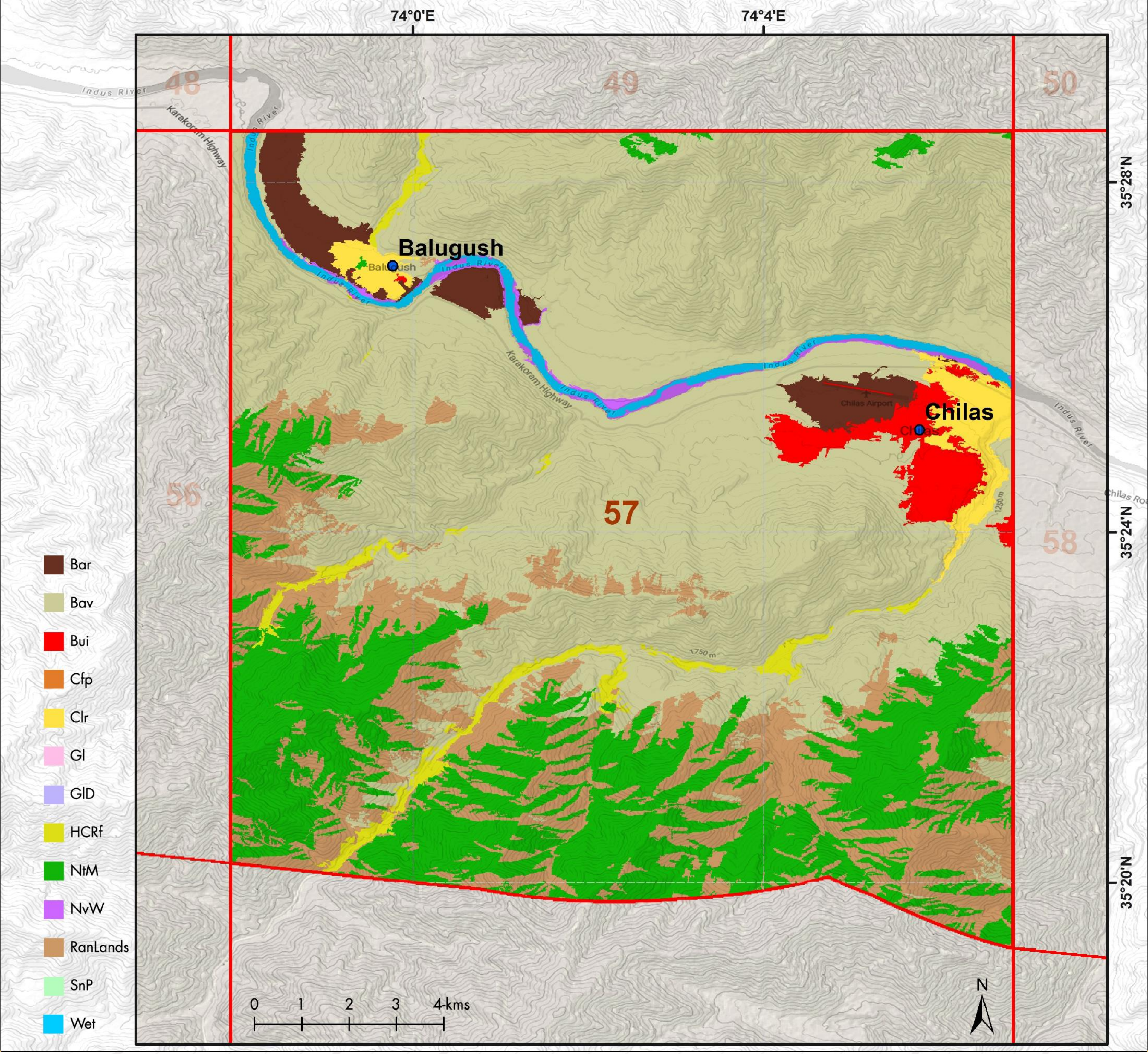
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



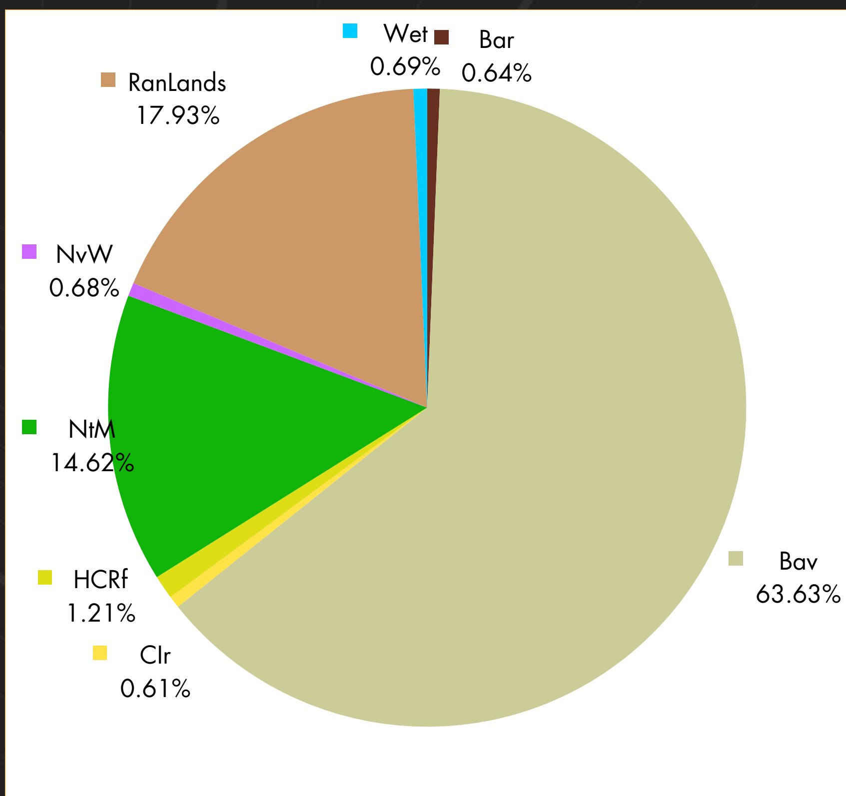
Map zone on the facing page.


74°0'E
74°4'E
35°28'N
35°24'N
35°20'N
48
49
50
56
57
58
Balugush
Chilas
Chilas Airport
Indus River
Karakoram Highway
1750 m
1250 m
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4 kms
N

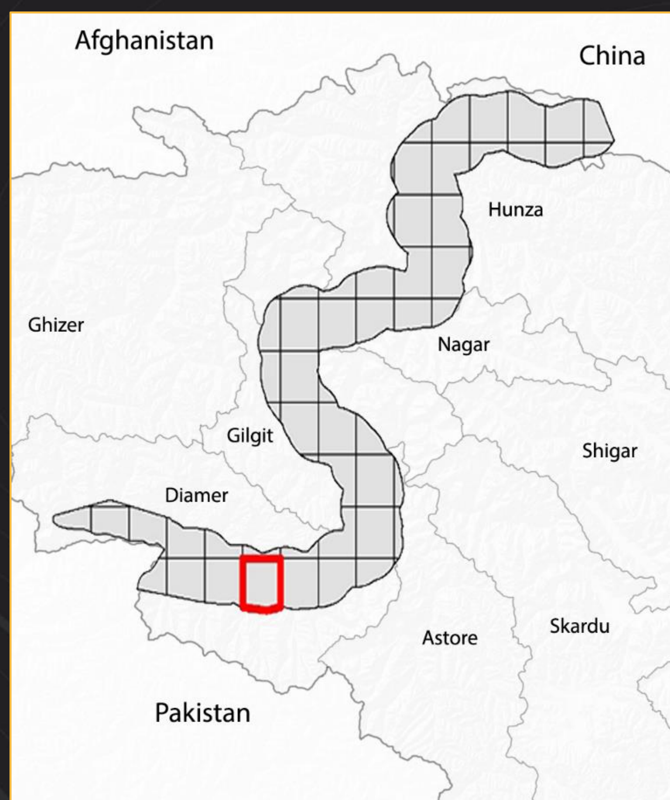
Land Use and Land Cover (LULC) Statistics Map of Zone 58

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0.63	1.527
Bav		Bare Area with Sparse Natural Vegetation	63.63	152.846
Bui		Built-up	0.28	0.676
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	0.60	1.456
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	1.20	2.902
NtM		Forest – Natural Vegetation and Trees	14.62	35.123
NvW		Natural Vegetation in Wet Area	0.67	1.625
RanLands		Range Land	17.93	43.058
SnP		Snow Permanent	0	0
Wet		Wet Areas	0.69	1.655
Total Area (Sq km)				**240.868**

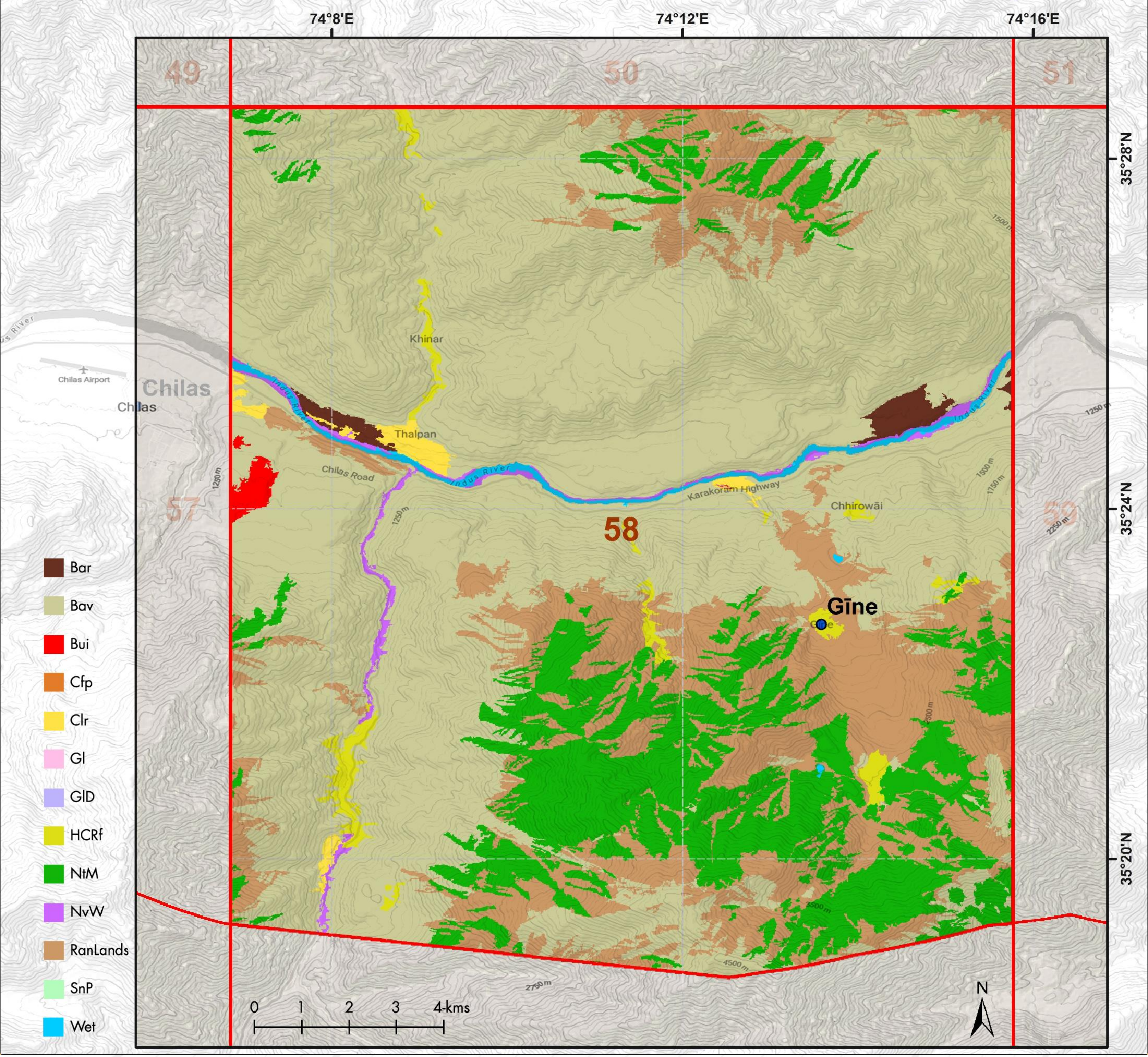
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



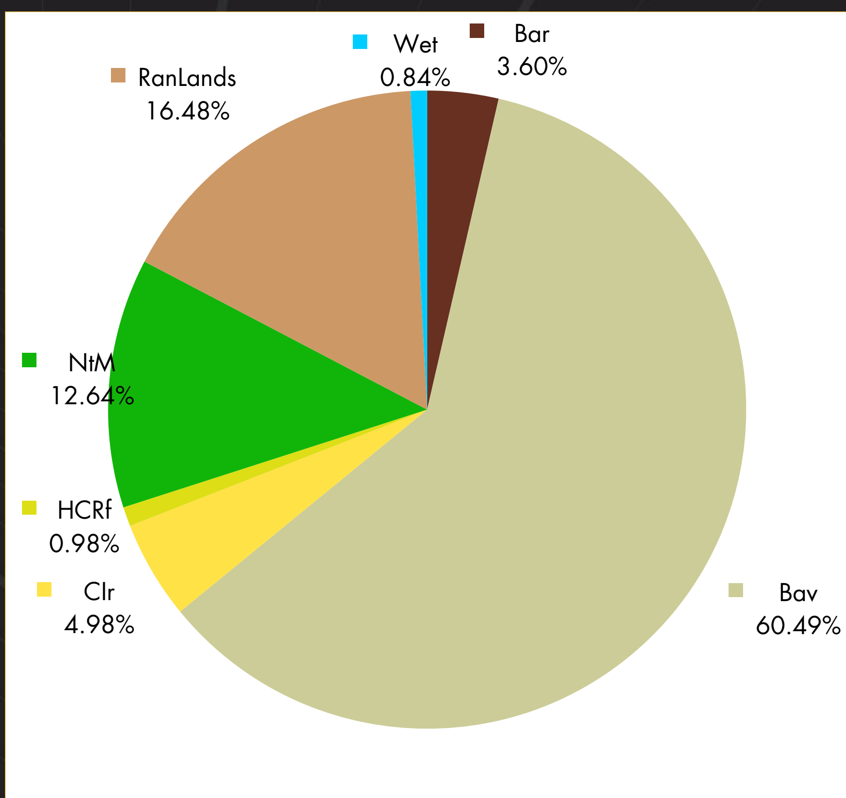
Map zone on the facing page.


74°8'E
74°12'E
74°16'E
35°28'N
35°24'N
35°20'N
49
50
51
57
58
59
Khinar
Thalpan
Chilas
Chilas Airport
Chilas Road
Indus River
Karakoram Highway
Chhirowāi
Gīne
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4-kms
N

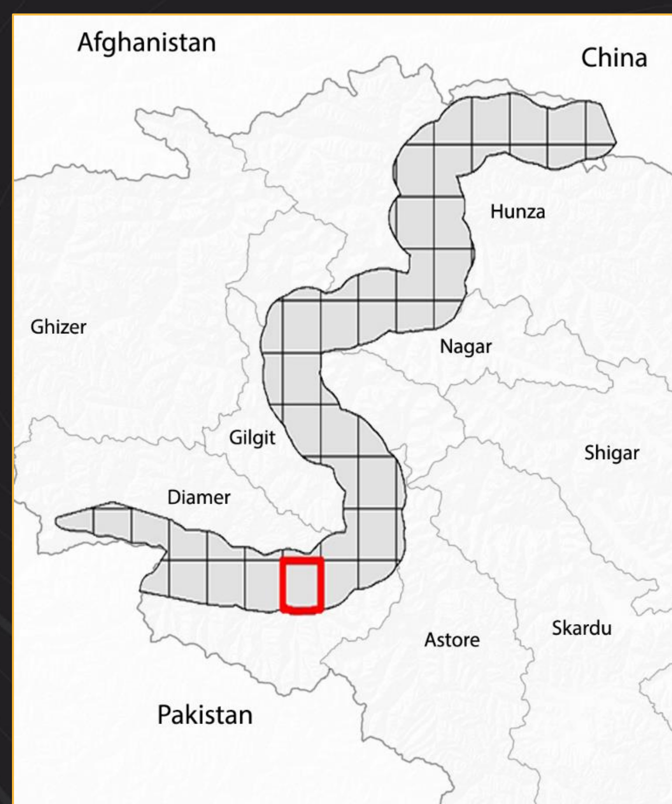
Land Use and Land Cover (LULC) Statistics Map of Zone 59

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	3.6	8.5
Bav		Bare Area with Sparse Natural Vegetation	60.49	143.1
Bui		Built-up	0.1	0.2
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	4.98	11.8
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	1.0	2.3
NtM		Forest – Natural Vegetation and Trees	12.64	29.9
NvW		Natural Vegetation in Wet Area	0.4	1.1
RanLands		Range Land	16.48	39.0
SnP		Snow Permanent	0	0
Wet		Wet Areas	0.8	2.0
		Total Area (Sq km)		**237.891**

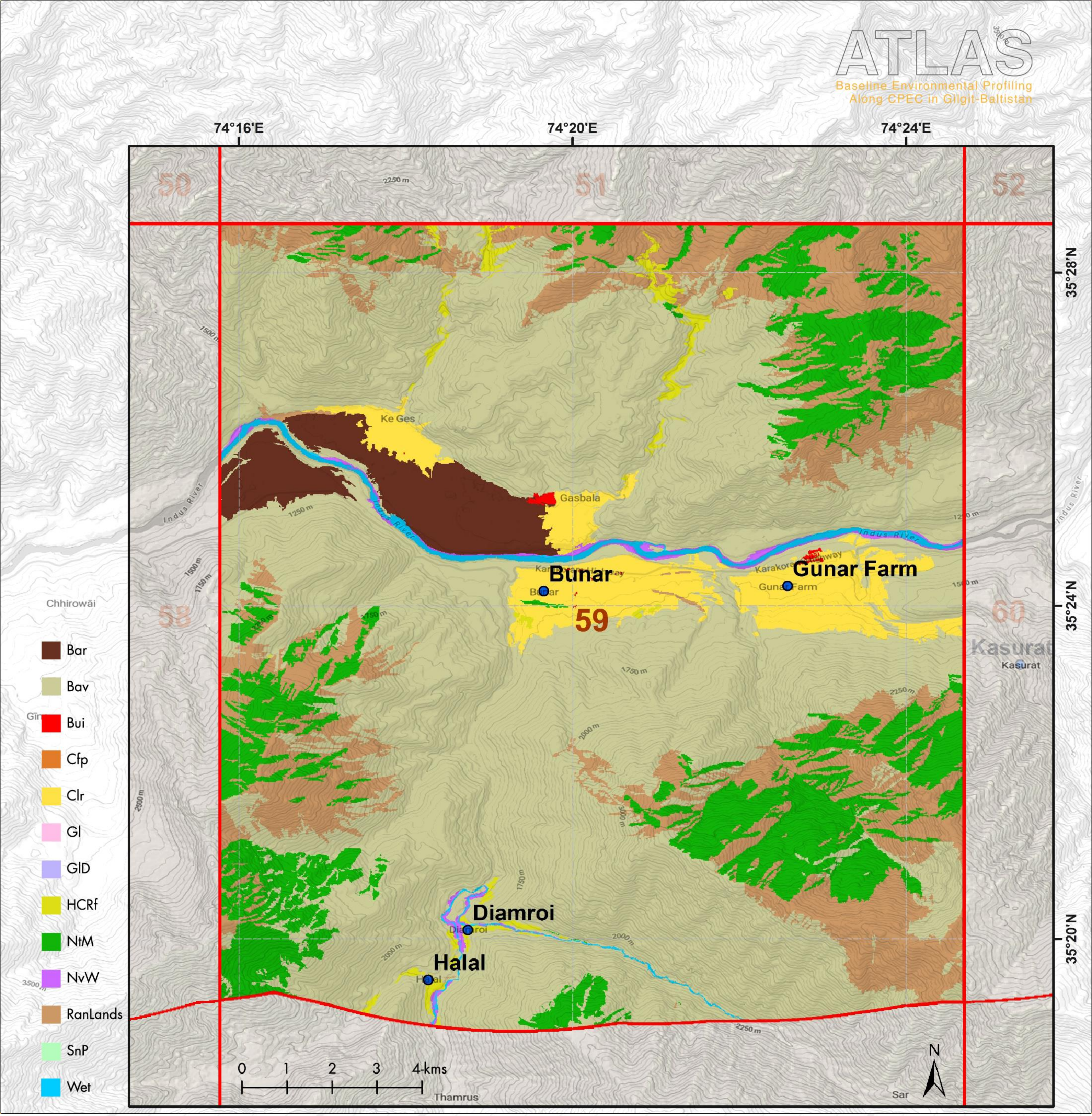
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

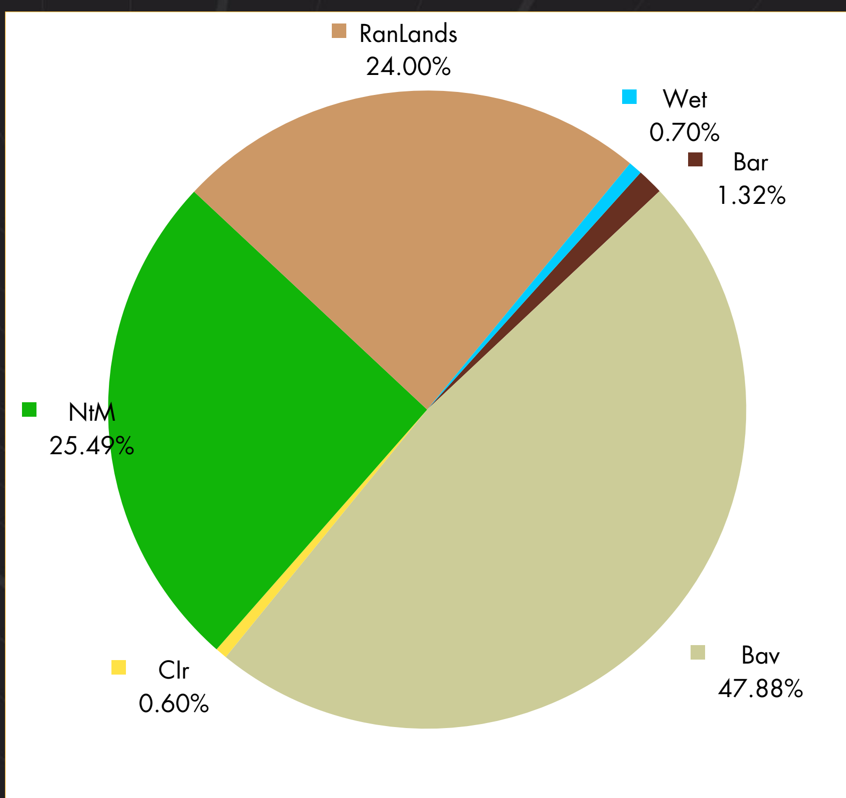


ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
74°16'E
74°20'E
74°24'E
35°28'N
35°24'N
35°20'N
50
51
52
58
59
60
Ke Ges
Gasbala
Indus River
Bunar
Gunar Farm
Kasurat
Diamroi
Halal
Chhirowāi
Thamrus
Sar
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4 kms
N

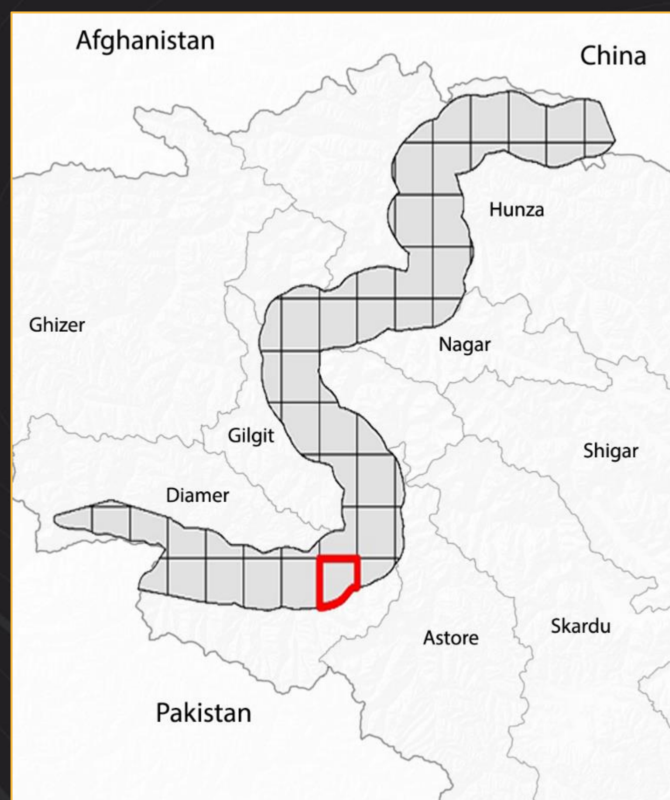
Land Use and Land Cover (LULC) Statistics Map of Zone 60

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	1.32	2.590
Bav		Bare Area with Sparse Natural Vegetation	47.88	93.636
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
Clr		Crop Irrigated	0.60	1.171
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0.05	0.102
NtM		Forest – Natural Vegetation and Trees	25.49	49.852
NvW		Natural Vegetation in Wet Area	0.24	0.468
RanLands		Range Land	24.00	46.936
SnP		Snow Permanent	0	0
Wet		Wet Areas	0.70	1.366
Total Area (Sq km)				**196.121**

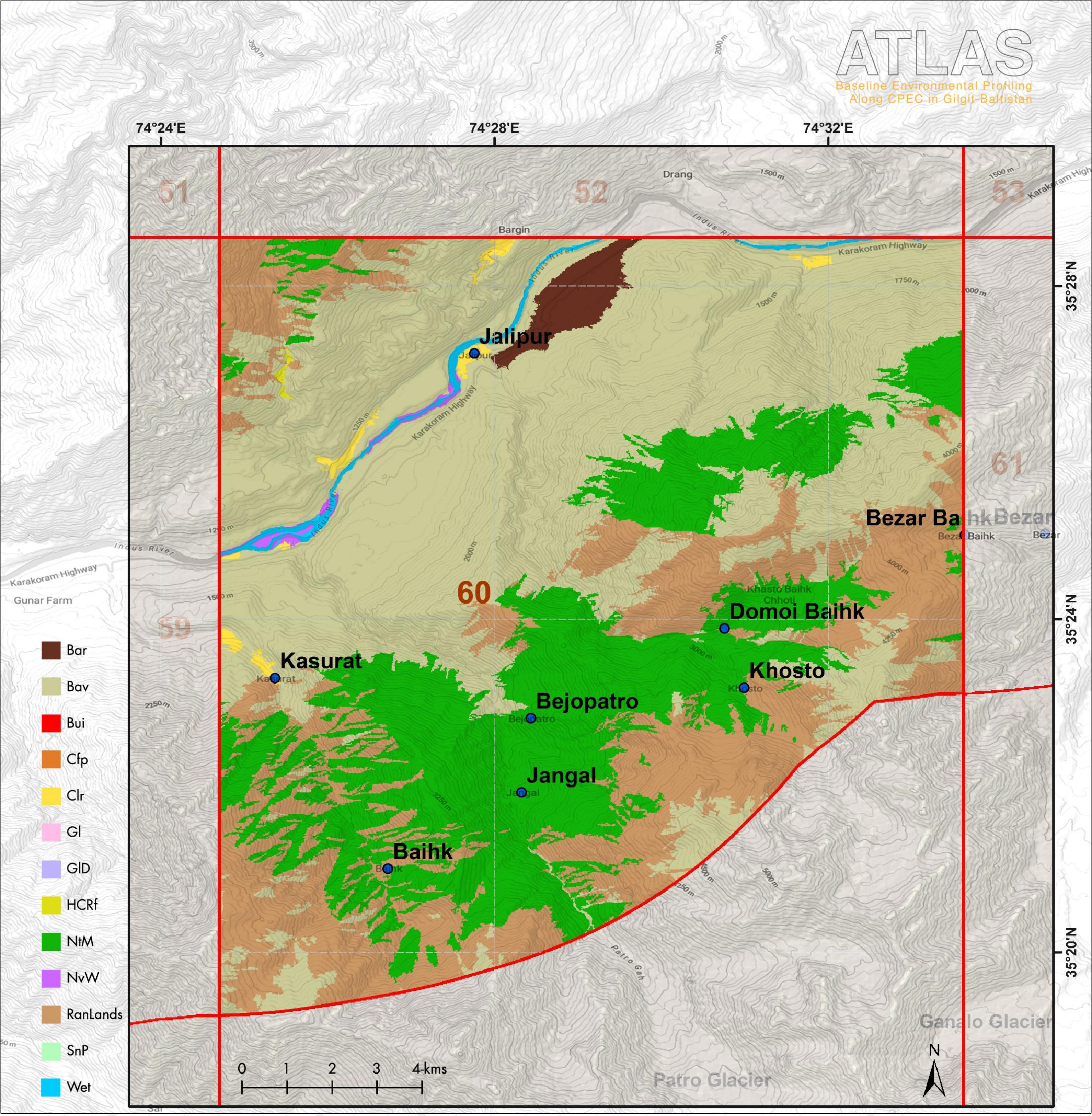
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.

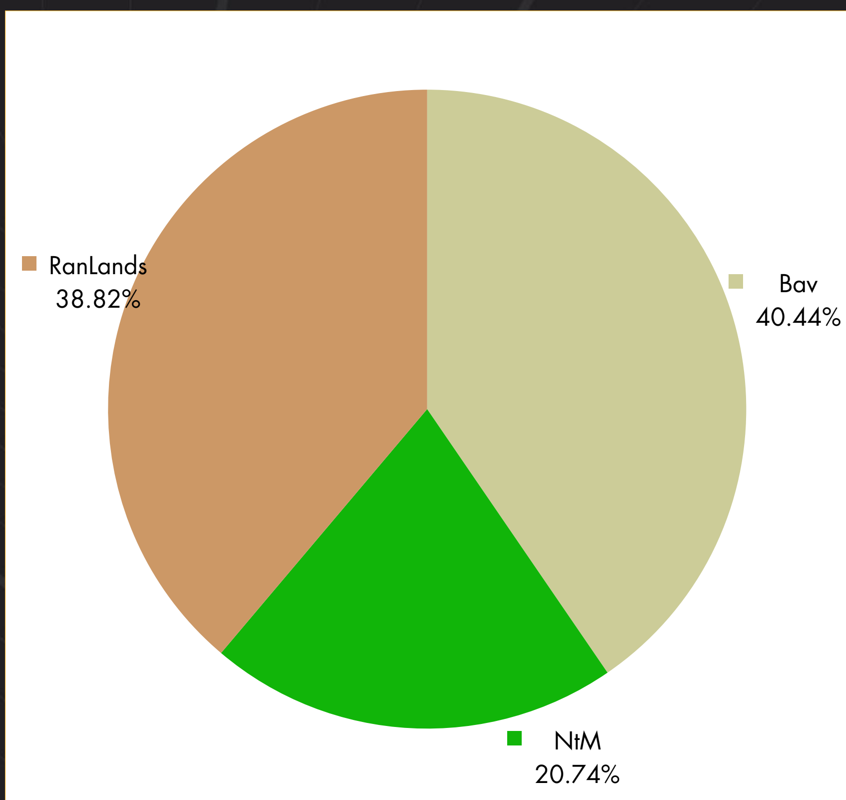


ATLAS
Baseline Environmental Profiling
Along CPEC in Gilgit-Baltistan
74°24'E
74°28'E
74°32'E
35°28'N
35°24'N
35°20'N
51
52
53
59
60
61
Drang
Bargin
Indus River
Karakoram Highway
Jalipur
Kasurat
Bejopatro
Jangal
Baihk
Khosto
Domoi Baihk
Khasto Baihk
Chhoti
Bezar Baihk
Bezar
Gunar Farm
Patro Gah
Ganalo Glacier
Patro Glacier
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4 kms
N

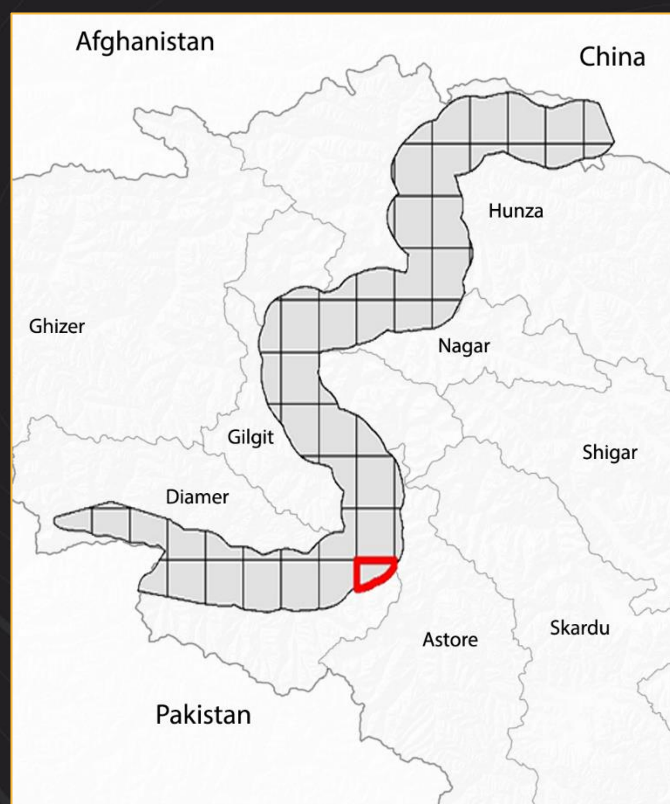
Land Use and Land Cover (LULC) Statistics Map of Zone 61

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	40.44	40.906
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0.26	0.260
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	20.74	20.980
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	38.82	39.274
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
Total Area (Sq km)				**101.419**

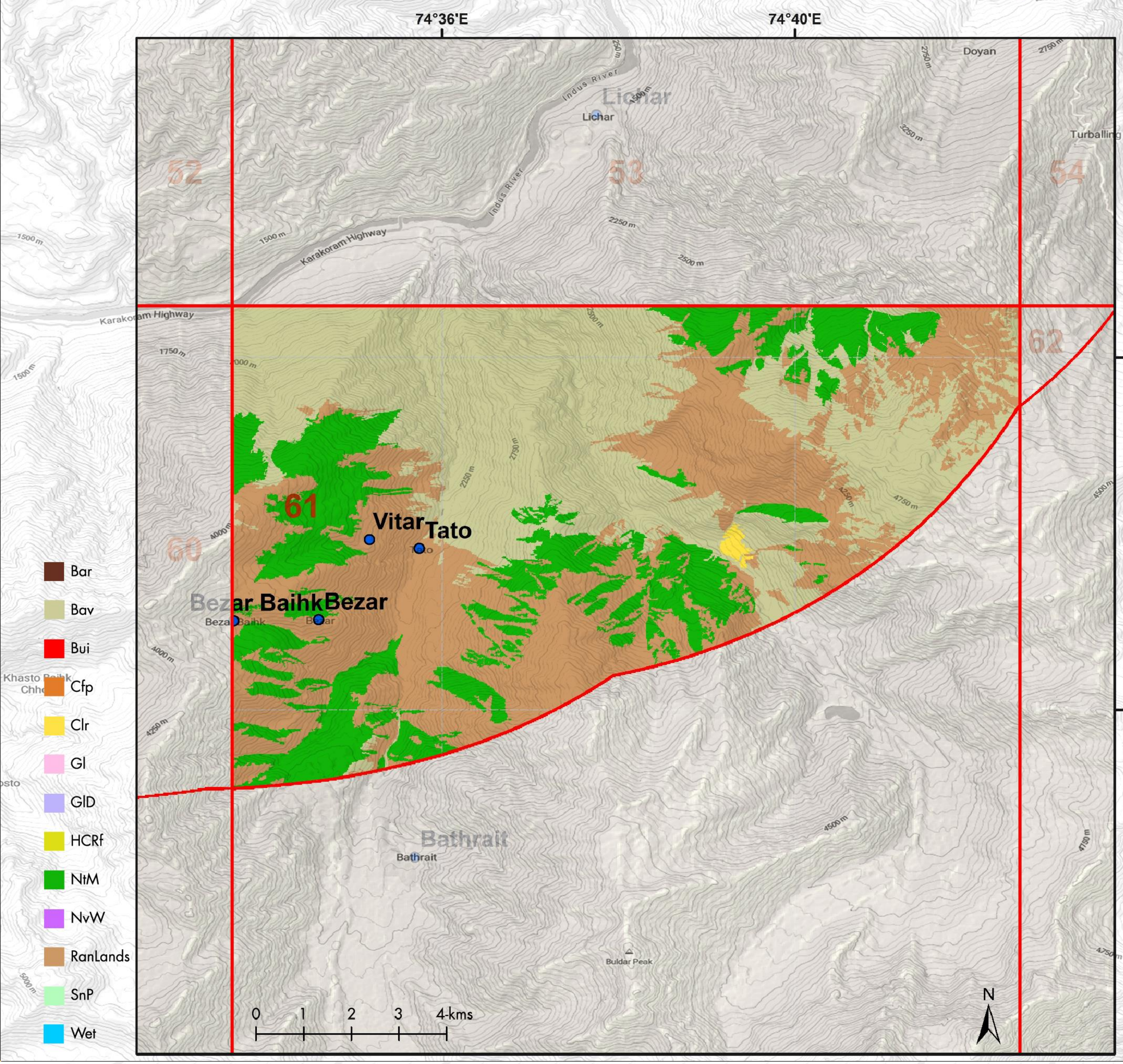
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



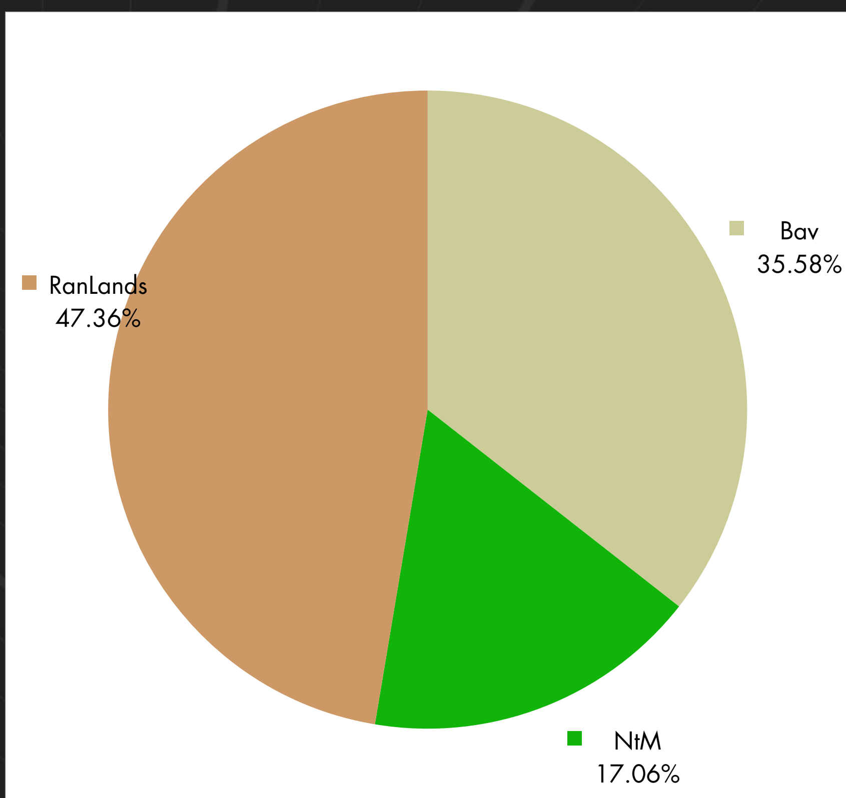
Map zone on the facing page.


74°36'E
74°40'E
35°28'N
35°24'N
52
53
54
60
61
62
Lichar
Doyan
Turballing
Indus River
Karakoram Highway
Vitar
Tato
Bezar Baihk
Bezar
Bathrait
Buldar Peak
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0
1
2
3
4-kms
N

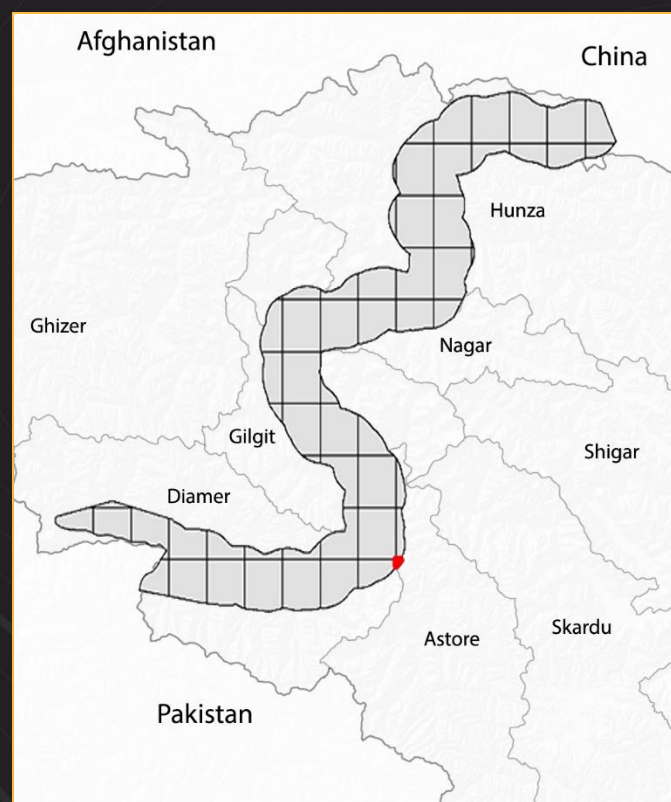
Land Use and Land Cover (LULC) Statistics Map of Zone 62

Legend	Class Code	Abbreviation	Percentage (%)	Area (Sq Km)
Bar		Bare Land	0	0
Bav		Bare Area with Sparse Natural Vegetation	35.58	0.680
Bui		Built-up	0	0
Cfp		Crop in Flood Plain	0	0
CIr		Crop Irrigated	0	0
Gl		Glacier	0	0
GlD		Glacier with Debris	0	0
HCRf		Herbaceous Crop Rainfed	0	0
NtM		Forest – Natural Vegetation and Trees	17.06	0.326
NvW		Natural Vegetation in Wet Area	0	0
RanLands		Range Land	47.36	0.905
SnP		Snow Permanent	0	0
Wet		Wet Areas	0	0
Total Area (Sq km)				**1.911**

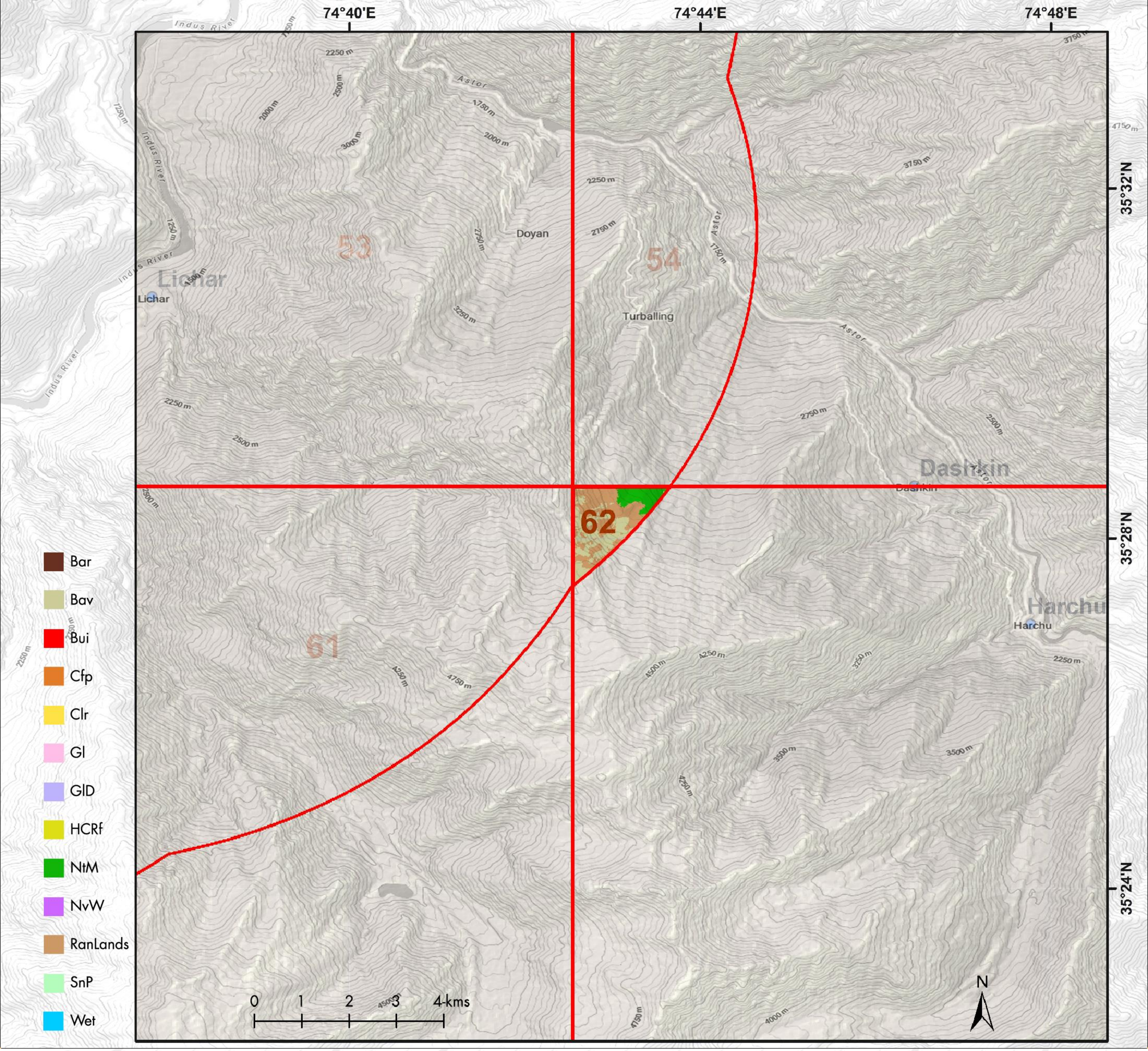
LULC Statistic of Zone on the facing page.



Note: *Area less than 0.5% is not shown in graph.*



Map zone on the facing page.


74°40'E
74°44'E
74°48'E
35°32'N
35°28'N
35°24'N
Ramghat Pul
Telichi
Indus River
Astor
Doyan
Lichar
Turballing
Dashkin
Harchu
53
54
61
62
Bar
Bav
Bui
Cfp
Clr
Gl
GlD
HCRf
NtM
NvW
RanLands
SnP
Wet
0 1 2 3 4 kms
N

05

ANNEXURES

Chapter Five

Annex-I

Hourly Data of Air Pollutants and Noise Levels in GB during Winter

TABLE 1		SITE NAME: SOST CHECK POST (S1) COORDINATES: 36°41'28.48"N, 74°49'14.87"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
1	11/26/2019	1600	2.1	12.2	14.0	8.9	27.2	2.8	60.5
2	11/26/2019	1700	1.6	12.8	20.7	14.5	25.6	3.0	64.2
3	11/26/2019	1800	2.1	14.0	17.7	12.0	23.8	3.7	61.7
4	11/26/2019	1900	2.9	13.0	15.6	10.3	22.5	2.6	62.8
5	11/26/2019	2000	2.8	11.1	13.9	8.9	21.3	2.8	52.8
6	11/26/2019	2100	2.8	10.9	11.4	6.8	19.1	3.0	50.2
7	11/26/2019	2200	2.0	13.8	12.5	7.7	18.9	2.8	49.1
8	11/26/2019	2300	1.8	10.0	16.9	11.3	14.3	2.0	49
9	11/27/2019	0000	2.1	7.7	12.6	8.0	13.9	3.3	48.2
10	11/27/2019	0100	1.6	6.5	12.5	8.6	10.1	2.6	48.0
11	11/27/2019	0200	1.3	7.8	14.4	7.8	8.7	3.7	43.7
12	11/27/2019	0300	1.3	7.7	13.9	7.5	9.0	3.1	41.1
13	11/27/2019	0400	1.3	5.9	13.2	7.0	9.7	3.2	41.5
14	11/27/2019	0500	0.9	6.8	9.8	6.7	10.3	2.4	42.7
15	11/27/2019	0600	0.8	7.5	9.4	6.5	10.1	2.4	42.0
16	11/27/2019	0700	0.7	8.7	14.0	7.6	10.3	2.7	51.6
17	11/27/2019	0800	1.0	7.1	18.2	10.5	12.1	1.7	62.7
18	11/27/2019	0900	1.3	8.1	20.0	11.8	16.0	1.9	61.8
19	11/27/2019	1000	2.3	10.0	14.0	8.3	16.2	1.8	63.0
20	11/27/2019	1100	2.8	10.1	18.8	12.0	18.3	2.0	64.0
21	11/27/2019	1200	2.8	11.6	17.2	10.8	17.3	2.2	64.3
22	11/27/2019	1300	2.1	11.3	18.5	11.8	18.6	1.9	63.6
23	11/27/2019	1400	1.5	12.2	13.6	8.0	23.0	1.8	62.8
24	11/27/2019	1500	1.8	11.4	16.2	10.0	25.7	2.2	63.2
Max			2.9	14.0	20.7	14.5	27.2	3.7	64.3
Min			0.7	5.9	9.4	6.5	8.7	1.7	41.1
Avg			**1.8**	**9.9**	**15.0**	**9.3**	**16.7**	**2.6**	**54.7**

TABLE 2		SITE NAME: SOST - KHUDABAD (S2) COORDINATES: 36°41'16.12"N, 74°48'58.72"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	NO (µg/m^3)	O_3 (µg/m^3)	BC (µg/m^3)	Noise dBA
1	11/27/19	1700	2.2	11.1	14.6	8.8	23.8	2.3	53.1
2	11/27/19	1800	2.0	7.6	14.8	9.0	23.2	2.6	54.1
3	11/27/19	1900	2.1	12.4	14.1	8.4	20.3	2.0	46.2
4	11/27/19	2000	2.3	6.8	13.4	8.5	16.8	2.8	43.0
5	11/27/19	2100	2.3	7.0	12.4	7.6	14.6	1.7	42.4
6	11/27/19	2200	2.5	12.3	11.3	6.7	17.8	1.4	42.7
7	11/27/19	2300	2.6	14.8	14.1	9.0	17.0	2.6	42.6
8	11/28/19	0000	2.8	16.1	14.1	9.0	16.9	1.9	42.3
9	11/28/19	0100	2.4	12.1	15.1	9.9	13.3	2.8	43.9
10	11/28/19	0200	1.9	8.8	17.2	11.6	10.3	2.8	41.5
11	11/28/19	0300	1.4	14.0	15.6	10.2	8.6	2.9	41.6
12	11/28/19	0400	1.6	15.5	12.1	7.3	8.8	2.7	42.1
13	11/28/19	0500	1.0	8.1	12.1	7.4	6.8	2.8	43.5
14	11/28/19	0600	1.0	10.8	10.4	5.9	8.6	2.6	45.6
15	11/28/19	0700	2.0	10.4	11.4	6.7	9.3	2.2	48.6
16	11/28/19	0800	1.7	11.3	13.2	8.3	13.8	2.1	52.3
17	11/28/19	0900	2.1	12.0	13.3	8.3	15.1	1.8	61.6
18	11/28/19	1000	2.3	11.8	16.0	10.6	16.1	2.6	57.1
19	11/28/19	1100	2.3	17.4	16.9	11.3	16.9	3.1	61.0
20	11/28/19	1200	2.6	11.8	17.9	12.2	17.5	2.6	62.1
21	11/28/19	1300	1.8	13.8	18.7	12.8	21.1	3.2	45.8
22	11/28/19	1400	2.1	14.2	18.3	12.5	21.1	2.4	45.9
23	11/28/19	1500	2.1	16.8	17.8	12.1	22.4	2.6	48.7
24	11/28/19	1600	2.2	16.4	19.7	13.6	20.7	1.7	51.3
Max			2.8	17.4	19.7	13.6	23.8	3.2	62.1
Min			1.0	6.8	10.4	5.9	6.8	1.4	41.5
Avg			**2.1**	**12.2**	**14.8**	**9.5**	**15.9**	**2.4**	**48.3**

TABLE 3		SITE NAME: SOST - GIRCHA (S3) COORDINATES: 36°39'41.42"N , 74°50'21.25"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
1	11/28/2019	1500	2.6	19.9	17.8	12.1	27.9	1.5	46.6
2	11/28/2019	1600	2.2	16.9	15.8	10.4	27.1	1.6	48.4
3	11/28/2019	1700	2.7	14.6	13.4	8.5	30.7	2	45.9
4	11/28/2019	1800	2.4	16.9	14	8.9	24.2	1.8	43.8
5	11/28/2019	1900	2.4	12.9	15.8	10.4	21.1	2	44
6	11/28/2019	2000	2.7	13.5	13.3	8.4	20.2	1.9	41.2
7	11/28/2019	2100	2.4	12.1	16.3	10.8	16.6	2.7	40.1
8	11/28/2019	2200	1.9	11.3	17	11.4	13.1	3.1	40.3
9	11/28/2019	2300	1.9	12	15.7	10.3	13.1	3	40.8
10	11/29/2019	0000	1.9	10.1	14	7.7	13.6	2.3	41.9
11	11/29/2019	0100	2.7	7.1	11.7	6.1	12	2.5	40.8
12	11/29/2019	0200	2.3	6.8	12.7	7.5	9.9	1.8	40.9
13	11/29/2019	0300	1.6	6.9	9.4	5.8	6.7	1.8	40.6
14	11/29/2019	0400	1.3	6	7.5	5.2	5.3	1.8	41.2
15	11/29/2019	0500	1.3	4.7	5.7	4.6	7.6	0.8	41.9
16	11/29/2019	0600	2.1	4.5	9.2	4.8	8.7	0.8	44.8
17	11/29/2019	0700	1.6	4.9	9.5	10.2	10.8	1.1	46.6
18	11/29/2019	0800	1.8	5.4	15.3	10	11.6	1.2	46.3
19	11/29/2019	0900	1.9	8.2	16.9	11.3	12.9	1.8	48.5
20	11/29/2019	1000	1.1	8.8	17.5	11.8	15.1	1.4	52
21	11/29/2019	1100	1.3	10.6	18.3	12.5	17.2	1.2	53.6
22	11/29/2019	1200	1.4	9.7	19.8	16.2	17.1	0.9	50.9
23	11/29/2019	1300	2.3	4.9	20.7	14.5	18.4	0.9	52.2
24	11/29/2019	1400	2.4	11.4	20.9	13.9	21.2	0.9	52.1
25	11/29/2019	1500	2.4	19	19.9	12.1	22.8	0.8	49.8
26	11/29/2019	1600	2.4	20.6	18.9	11.3	23.5	0.8	48.5
27	11/29/2019	1700	2.5	18.2	16.7	10.8	25.2	0.5	45.7
28	11/29/2019	1800	2.3	15.3	17.1	10.9	21.5	0.6	43.1
29	11/29/2019	1900	2.4	14.3	16.5	11	17.5	1.2	42.2
30	11/29/2019	2000	2.4	12.3	15.9	11.3	16.5	1.3	40.9

TABLE 3		SITE NAME: SOST - GIRCHA (S3) COORDINATES: 36°39'41.42"N , 74°50'21.25"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	NO (µg/m^3)	O_3 (µg/m^3)	BC (µg/m^3)	Noise dBA
31	11/29/2019	2100	2.4	13.4	13.2	7.6	15.5	2	40.8
32	11/29/2019	2200	2.3	13.4	12.2	6.8	18	1.8	40.1
33	11/29/2019	2300	1.9	16.5	10.7	5.8	10.3	1.8	40.1
34	11/30/2019	0000	1.4	10.5	11	6.4	10.6	1.8	40.7
35	11/30/2019	0100	1.9	8.1	12	7.4	10.9	1.8	39.7
36	11/30/2019	0200	1.3	9	12.5	3.2	12.7	1.8	39.7
37	11/30/2019	0300	1.2	10.1	12.9	5.3	11.2	2.5	40.5
38	11/30/2019	0400	1.6	10.3	11.5	6	9.1	2.9	40.4
39	11/30/2019	0500	1.9	10.6	8.3	4.8	9.4	3.1	41.5
40	11/30/2019	0600	1.6	10.9	10.9	9.5	8.4	2.2	42.6
41	11/30/2019	0700	2.1	11.1	13	7.4	9.7	2	42.7
42	11/30/2019	0800	2.7	10.4	13.1	9.8	10.1	2	43.9
Max			2.7	20.6	20.9	16.2	30.7	3.1	53.6
Min			1.1	4.5	5.7	3.2	5.3	0.5	39.7
Avg			**2.0**	**11.3**	**14.2**	**9.1**	**15.3**	**1.7**	**44.0**

TABLE 4		SITE NAME: HUNZA – KARIMABABD (H1) COORDINATES: 36°18'59.07"N, 74°40'3.41"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
1	11/30/2019	1900	1.7	10.1	25.6	17.3	28.7	3.1	60.5
2	11/30/2019	2000	1.7	12.3	24.9	16.7	26.1	3.0	65.0
3	11/30/2019	2100	2.4	12.0	24.3	16.2	20.8	3.5	62.1
4	11/30/2019	2200	2.9	11.7	22.2	15.3	19.1	3.4	61.1
5	11/30/2019	2300	2.2	12.0	19.9	15.1	17.4	3.0	61.1
6	12/1/2019	0000	1.7	10.8	20.1	12.8	16.5	3.3	55.2
7	12/1/2019	0100	1.4	9.2	21.2	11.4	15.6	3.3	50.7
8	12/1/2019	0200	1.4	8.4	20.0	12.1	13.2	4.4	47.0
9	12/1/2019	0300	1.5	8.5	18.1	13.0	13.1	3.8	46.5
10	12/1/2019	0400	1.4	9.3	19.6	12.6	12.9	4.0	44.6
11	12/1/2019	0500	1.3	8.2	17.3	10.7	11.0	3.2	43.6
12	12/1/2019	0600	1.3	11.2	14.3	10.7	13.5	3.9	43.2
13	12/1/2019	0700	1.6	17.0	18.3	11.6	13.4	3.6	56.3
14	12/1/2019	0800	1.9	19.2	20.8	13.6	13.8	3.6	62.4
15	12/1/2019	0900	2.3	16.4	20.6	12.9	15.6	4.3	67.9
16	12/1/2019	1000	2.4	18.5	18.1	10.9	18.7	3.2	74.2
17	12/1/2019	1100	1.6	22.4	17.4	10.4	22.8	2.3	70.6
18	12/1/2019	1200	2.3	15.5	22.9	14.6	24.1	3.0	65.2
19	12/1/2019	1300	2.3	13.6	22.8	14.6	24.2	3.1	67.2
20	12/1/2019	1400	2.9	10.0	28.4	19.0	27.5	4.1	76.4
21	12/1/2019	1500	2.6	8.7	29.3	19.6	29.8	3.9	67.3
22	12/1/2019	1600	3.1	13.0	26.3	17.3	28.6	3.9	76.8
23	12/1/2019	1700	2.1	13.5	22.2	13.9	27.3	3.2	73.4
24	12/1/2019	1800	2.8	13.1	21.9	13.7	29.2	3.4	67.0
25	12/1/2019	1900	2.5	11.1	19.7	12.0	27.7	3.8	64.0
26	12/1/2019	2000	2.9	12.1	17.2	10.1	28.9	4.3	62.7
27	12/1/2019	2100	3.2	13.1	17.7	10.5	23.0	5.8	55.7
28	12/1/2019	2200	2.3	10.6	18.6	11.1	18.3	5.1	53.2
29	12/1/2019	2300	2.5	10.6	20.1	12.9	18.3	4.2	42.8
30	12/2/2019	0000	2.5	10.5	19.3	12.3	16.8	3.5	41.3

TABLE 4		SITE NAME: HUNZA – KARIMABABD (H1) COORDINATES: 36°18'59.07"N, 74°40'3.41"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	NO (µg/m^3)	O_3 (µg/m^3)	BC (µg/m^3)	Noise dBA
31	12/2/2019	0100	1.8	10.4	18.9	11.9	14.5	4.1	40.1
32	12/2/2019	0200	1.7	10.6	20.0	12.9	13.6	3.6	40.9
33	12/2/2019	0300	2.2	8.3	12.4	10.7	13.1	3.1	41.3
34	12/2/2019	0400	1.8	10.2	10.7	10.2	13.0	2.6	40.3
35	12/2/2019	0500	1.7	10.4	9.8	8.6	12.5	3.4	39.1
36	12/2/2019	0600	1.8	10.4	12.2	9.8	12.1	3.5	41.2
37	12/2/2019	0700	2.1	11.2	17.3	10.6	14.5	4.3	64.0
38	12/2/2019	0800	2.2	11.3	21.0	13.7	14.7	5.3	67.0
39	12/2/2019	0900	3.0	13.3	21.9	14.4	17.5	4.9	71.7
40	12/2/2019	1000	3.4	13.7	24.6	16.6	19.9	4.4	71.2
41	12/2/2019	1100	3.1	14.6	28.1	19.4	21.4	4.5	73.8
42	12/2/2019	1200	3.3	14.3	28.0	19.4	22.7	5.4	71.2
43	12/2/2019	1300	3.4	16.3	28.9	20.1	26.0	3.6	71.4
44	12/2/2019	1400	2.8	18.4	29.4	20.5	27.0	5.1	73.3
45	12/2/2019	1500	3.1	19.8	30.5	23.4	28.9	5.2	69.9
46	12/2/2019	1600	3.2	15.4	24.1	16.2	25.2	4.4	68.8
47	12/2/2019	1700	2.7	18.4	22.5	14.9	22.8	4.2	65.2
48	12/2/2019	1800	2.0	14.3	20.3	13.1	20.5	4.5	61.9
49	12/2/2019	1900	2.1	11.5	21.8	14.3	19.8	4.4	56.5
50	12/2/2019	2000	1.9	14.5	25.7	17.5	20.4	3.1	49.8
51	12/2/2019	2100	1.8	16.3	23.5	15.7	23.6	2.9	45.7
52	12/2/2019	2200	1.6	13.0	19.4	12.3	23.7	3.7	43.1
53	12/2/2019	2300	1.5	9.8	21.2	13.8	20.9	2.4	40.8
54	12/3/2019	0000	2.2	8.2	18.3	11.4	18.1	3.2	40.1
55	12/3/2019	0100	2.2	8.7	17.3	10.6	16.0	3.0	41.2
56	12/3/2019	0200	2.4	8.6	16.4	9.9	13.1	4.5	39.1
57	12/3/2019	0300	2.6	8.3	15.0	8.8	12.7	3.5	41.1
58	12/3/2019	0400	2.2	10.4	15.8	9.4	10.1	2.3	41.0
59	12/3/2019	0500	1.5	9.2	16.3	9.8	10.0	2.5	40.7
60	12/3/2019	0600	1.5	10.5	16.9	10.3	11.1	2.3	41.5

TABLE 4		SITE NAME: HUNZA – KARIMABABD (H1) COORDINATES: 36°18'59.07"N, 74°40'3.41"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
61	12/3/2019	0700	1.4	10.5	17.3	10.6	11.9	3.3	44.2
62	12/3/2019	0800	1.8	11.5	19.0	12.0	16.2	3.8	46.6
63	12/3/2019	0900	1.6	14.8	20.7	13.4	17.8	3.4	51.2
64	12/3/2019	1000	1.9	14.3	23.5	15.7	18.6	4.5	57.1
65	12/3/2019	1100	1.9	13.3	27.1	18.7	21.0	3.7	66.0
66	12/3/2019	1200	2.1	12.1	27.7	19.1	19.2	2.3	74.9
67	12/3/2019	1300	2.2	14.5	25.5	17.7	23.8	2.9	77.1
Max			3.4	22.4	30.5	23.4	29.8	5.8	77.1
Min			1.3	8.2	9.8	8.6	10.0	2.3	39.1
Avg			**2.2**	**12.4**	**20.9**	**13.8**	**19.2**	**3.7**	**56.6**

TABLE 5	SITE NAME HUNZA – ALIABAD (H2) COORDINATES: 36°18'21.14"N, 74°36'40.72"E								
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
1	12/3/2019	1500	2.1	16.2	18.3	11.7	35.6	3.5	70.4
2	12/3/2019	1600	2.5	17.8	18.1	11.5	37.0	3.2	73.9
3	12/3/2019	1700	3.0	19.8	15.8	9.6	34.0	3.1	73.2
4	12/3/2019	1800	3.2	24.8	16.6	10.2	30.3	3.2	64.7
5	12/3/2019	1900	3.3	20.5	15.9	9.6	28.1	2.4	61.6
6	12/3/2019	2000	3.2	19.5	16.3	10.0	21.6	3.6	62.2
7	12/3/2019	2100	3.2	19.7	13.6	7.7	17.8	1.9	56.0
8	12/3/2019	2200	3.0	17.2	14.8	8.7	15.0	1.3	47.9
9	12/3/2019	2300	3.2	14.3	18.5	11.8	13.4	1.3	45.4
10	12/4/2019	0000	3.2	13.0	18.2	11.6	14.9	2.1	41.6
11	12/4/2019	0100	3.3	11.2	21.1	14.0	13.3	1.2	43.5
12	12/4/2019	0200	2.0	12.6	16.7	10.3	10.3	0.9	46.3
13	12/4/2019	0300	2.0	10.5	17.2	10.7	8.8	2.3	45.2
14	12/4/2019	0400	2.6	9.5	15.8	9.6	9.5	3.2	42.4
15	12/4/2019	0500	2.2	9.4	15.4	9.3	10.6	2.2	45.7
16	12/4/2019	0600	2.0	8.1	17.4	10.9	14.0	1.3	42.1
17	12/4/2019	0700	2.3	12.9	14.6	8.5	15.0	2.0	58.7
18	12/4/2019	0800	2.6	12.5	18.1	11.5	15.6	2.9	69.0
19	12/4/2019	0900	2.7	12.2	19.6	12.7	19.5	3.9	72.3
20	12/4/2019	1000	3.1	17.5	20.1	13.2	22.1	3.6	70.3
21	12/4/2019	1100	3.4	16.1	17.5	11.0	15.6	1.8	72.7
22	12/4/2019	1200	3.4	17.5	17.8	11.2	24.2	1.9	70.4
23	12/4/2019	1300	3.4	19.1	14.9	8.8	25.3	1.7	71.2
24	12/4/2019	1400	3.2	24.1	17.9	11.3	24.8	1.7	73.2
25	12/4/2019	1500	3.0	21.8	18.8	12.1	21.2	2.1	74.7
26	12/4/2019	1600	3.0	20.5	21.2	14.1	33.5	3.3	71.2
27	12/4/2019	1700	3.4	19.3	21.7	14.5	35.9	4.5	71.5
28	12/4/2019	1800	3.2	20.5	15.2	9.1	36.9	5.8	68.4
29	12/4/2019	1900	3.4	18.1	11.6	8.0	31.8	3.7	68.5
30	12/4/2019	2000	3.4	17.4	15.5	9.3	28.6	3.3	63.6

TABLE 5		SITE NAME HUNZA – ALIABAD (H2) COORDINATES: 36°18'21.14"N, 74°36'40.72"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
31	12/4/2019	2100	3.4	15.8	20.3	13.4	26.2	3.5	58.3
32	12/4/2019	2200	3.3	11.6	18.7	12.0	20.8	2.8	55.3
33	12/4/2019	2300	3.2	12.0	17.5	11.0	19.8	2.3	40.5
34	12/5/2019	0000	2.6	11.0	17.8	11.2	16.6	2.2	39.7
35	12/5/2019	0100	3.0	9.9	17.7	11.2	16.4	3.1	39.4
36	12/5/2019	0200	2.8	10.0	19.5	12.7	13.8	2.2	45.6
37	12/5/2019	0300	2.6	10.0	14.3	8.3	12.2	1.8	45.9
38	12/5/2019	0400	2.4	10.8	17.4	10.9	12.8	2.1	45.1
39	12/5/2019	0500	2.7	11.4	14.5	8.5	12.5	2.1	47.7
40	12/5/2019	0600	2.8	9.9	15.9	9.6	12.0	2.2	48.9
41	12/5/2019	0700	3.5	11.0	15.3	9.2	11.7	2.6	56.7
42	12/5/2019	0800	3.2	12.9	18.3	11.7	10.9	3.8	57.5
43	12/5/2019	0900	3.4	13.1	19.7	12.9	14.3	3.9	62.6
44	12/5/2019	1000	3.5	14.3	21.9	14.7	14.7	3.3	70.4
Max			3.5	24.8	21.9	14.7	37.0	5.8	74.7
Min			2.0	8.1	11.6	7.7	8.8	0.9	39.4
Avg			**2.9**	**14.9**	**17.3**	**10.9**	**20.0**	**2.6**	**58.0**

TABLE 6		SITE NAME: GILGIT – DANYOR (G1) COORDINATES: 35°54'19.10"N 74°23'35.36"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
1	12/5/2019	1500	2.6	30.3	44.2	29.6	40.5	10.4	58.9
2	12/5/2019	1600	3.0	35.3	42.8	28.4	41.1	9.8	69.4
3	12/5/2019	1700	3.8	33.5	44.0	29.4	37.5	11.1	60.5
4	12/5/2019	1800	3.8	30.4	46.9	31.8	33.2	11.5	59.5
5	12/5/2019	1900	4.0	29.5	37.6	24.3	28.0	9.3	60.9
6	12/5/2019	2000	4.2	27.6	32.4	20.0	24.5	8.4	55.2
7	12/5/2019	2100	3.5	22.8	32.0	19.6	23.8	7.6	57.4
8	12/5/2019	2200	4.1	20.1	29.3	17.5	24.6	8.6	47.9
9	12/5/2019	2300	4.1	23.9	23.3	16.7	24.5	7.2	45.1
10	12/6/2019	0000	3.8	24.1	23.4	14.0	25.2	5.7	44.0
11	12/6/2019	0100	3.1	26.2	22.4	16.4	25.0	5.4	41.6
12	12/6/2019	0200	2.6	25.9	21.1	11.6	25.1	6.2	45.5
13	12/6/2019	0300	2.7	21.8	23.2	17.3	25.2	6.9	42.6
14	12/6/2019	0400	2.6	19.4	20.8	14.5	25.0	6.4	43.7
15	12/6/2019	0500	2.6	17.4	16.0	12.0	25.4	5.6	39.2
16	12/6/2019	0600	2.7	13.2	15.7	13.8	25.2	5.4	55.5
17	12/6/2019	0700	3.8	16.6	17.9	17.2	25.3	5.5	61.9
18	12/6/2019	0800	3.3	19.9	23.9	14.1	24.7	7.5	66.5
19	12/6/2019	0900	3.3	23.3	37.9	19.9	25.8	8.8	68.6
20	12/6/2019	1000	3.0	27.8	33.2	22.1	25.5	10.3	67.7
21	12/6/2019	1100	2.7	32.0	28.7	17.4	28.9	11.4	68.6
22	12/6/2019	1200	3.0	29.6	27.8	24.1	30.7	8.5	68.1
23	12/6/2019	1300	2.4	28.3	28.0	19.0	31.3	8.5	64.7
24	12/6/2019	1400	3.2	53.4	25.8	14.9	32.4	11.1	68.3
25	12/6/2019	1500	3.9	26.2	29.5	16.4	36.4	11.6	65.3
26	12/6/2019	1600	4.0	27.4	32.3	13.5	35.5	10.1	64.4
27	12/6/2019	1700	4.4	32.2	39.8	17.0	32.6	10.0	57.8
28	12/6/2019	1800	4.3	28.5	38.0	14.4	31.9	9.6	55.3
29	12/6/2019	1900	3.9	28.4	29.6	14.7	30.9	9.3	55.5
30	12/6/2019	2000	3.9	24.6	30.6	13.9	27.9	11.6	49.2

TABLE 6		SITE NAME: GILGIT – DANYOR (G1) COORDINATES: 35°54'19.10"N 74°23'35.36"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
31	12/6/2019	2100	3.5	23.4	29.6	13.3	26.9	12.5	50.0
32	12/6/2019	2200	3.2	25.0	28.6	13.1	25.2	8.8	48.4
33	12/6/2019	2300	2.6	26.0	26.7	13.0	24.4	7.8	45.4
34	12/7/2019	0000	3.1	25.8	24.2	13.7	23.6	8.6	46.2
35	12/7/2019	0100	2.4	24.9	24.8	12.4	20.5	6.2	43.3
36	12/7/2019	0200	2.2	21.3	19.6	11.0	14.7	5.3	40.0
37	12/7/2019	0300	2.0	20.7	19.7	12.3	13.3	5.5	40.2
38	12/7/2019	0400	2.1	21.6	19.2	10.2	10.4	5.0	39.1
39	12/7/2019	0500	1.9	17.5	20.5	11.2	10.2	4.4	48.8
40	12/7/2019	0600	2.2	14.3	21.4	11.7	13.9	3.5	65.7
41	12/7/2019	0700	3.1	15.4	23.0	15.7	14.0	4.6	63.9
42	12/7/2019	0800	3.9	17.4	28.4	11.4	16.3	5.8	65.8
43	12/7/2019	0900	3.5	19.6	37.0	14.1	15.8	7.5	65.6
44	12/7/2019	1000	3.1	23.9	34.6	16.8	16.5	9.2	64.8
45	12/7/2019	1100	2.7	29.5	26.6	15.7	20.1	11.2	60
46	12/7/2019	1200	4.7	27.2	22.1	16.4	23.7	14.2	58.9
47	12/7/2019	1300	4.7	27.8	30.5	19.4	24.7	12.6	67.3
48	12/7/2019	1400	3.6	29.5	33.7	22.8	24.2	11.0	64.0
Max			4.7	35.4	46.9	31.8	41.1	14.2	69.4
Min			1.9	13.2	15.7	10.2	10.2	3.5	39.1
Avg			**3.3**	**24.8**	**28.5**	**16.9**	**25.2**	**8.4**	**56.0**

TABLE 7		SITE NAME: GILGIT – NEAR AIRPORT (G2) COORDINATES: 35°54'35.90"N 74°20'10.37"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
1	12/7/2019	1600	4.9	42.6	46.2	37.1	39.8	16.2	52.8
2	12/7/2019	1700	4.8	37.6	44.0	33.4	39.8	14.1	48.7
3	12/7/2019	1800	4.2	36.7	38.3	33.1	38.8	15.5	46.1
4	12/7/2019	1900	4.7	30.0	35.5	38.0	34.2	13.5	47.2
5	12/7/2019	2000	4.3	28.4	35.0	38.6	32.5	12.8	44.1
6	12/7/2019	2100	5.5	28.6	31.1	31.7	30.5	10.3	44.1
7	12/7/2019	2200	5.0	25.2	28.9	25.2	28.9	11.1	44
8	12/7/2019	2300	4.5	24.1	26.9	27.2	27.5	7.7	43.8
9	12/8/2019	0000	3.4	22.7	24.6	27.6	26.5	8.1	44.5
10	12/8/2019	0100	2.8	25.3	21.8	17.9	25.1	11.1	43.6
11	12/8/2019	0200	3.3	20.4	23.9	16.8	22.9	10.9	45
12	12/8/2019	0300	3.4	19.5	23.0	10.5	19.9	9.3	47.2
13	12/8/2019	0400	3.8	16.4	21.6	12.4	19.9	12.2	49.6
14	12/8/2019	0500	3.1	17.1	23.0	17.4	19.0	11.9	54.3
15	12/8/2019	0600	3.1	18.0	21.9	17.5	20.7	11.1	60.1
16	12/8/2019	0700	4.0	17.6	25.7	22.3	23.4	12.9	69
17	12/8/2019	0800	4.2	22.0	28.4	20.0	23.3	13.0	77.9
18	12/8/2019	0900	4.3	23.2	30.6	27.5	28.5	13.4	80.1
19	12/8/2019	1000	4.3	26.8	34.8	34.0	30.4	8.9	72.1
20	12/8/2019	1100	4.6	26.9	40.4	35.7	30.2	8.4	70.5
21	12/8/2019	1200	4.1	32.9	44.3	34.6	34.1	11.6	72.6
22	12/8/2019	1300	5.3	47.1	48.4	30.7	38.8	10.5	61.3
23	12/8/2019	1400	5.4	41.8	44.8	26.9	40.4	8.9	72.1
24	12/8/2019	1500	5.1	38.1	38.0	21.4	40.0	9.9	54.3
25	12/8/2019	1600	3.9	36.7	39.0	21.8	37.8	10.4	58.2
26	12/8/2019	1700	4.1	30.5	45.2	24.9	36.2	12.5	58.8
27	12/8/2019	1800	4.7	39.7	51.2	17.5	35.0	11.1	52.6
28	12/8/2019	1900	4.6	38.9	44.1	16.8	35.4	9.8	44.5
29	12/8/2019	2000	5.0	36.6	34.7	16.1	34.7	9.4	42.0
30	12/8/2019	2100	4.0	25.7	37.7	18.4	30.3	8.9	40.4

TABLE 7		SITE NAME: GILGIT – NEAR AIRPORT (G2) COORDINATES: 35°54'35.90"N 74°20'10.37"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
31	12/8/2019	2200	3.6	21.2	31.8	15.5	29.3	7.4	40.4
32	12/8/2019	2300	3.7	17.6	33.6	12.1	30.3	10.3	44.3
33	12/8/2019	0000	4.1	16.1	29.8	16.7	28.3	9.8	43.2
34	12/9/2019	0100	3.0	20.7	26.3	12.8	25.3	10.8	40.4
35	12/9/2019	0200	2.9	19.5	21.7	13.4	23.3	8.0	43.8
36	12/9/2019	0300	2.9	17.7	19.7	12.1	20.2	6.9	50.1
37	12/9/2019	0400	3.2	11.6	20.1	11.5	18.2	6.6	56.8
38	12/9/2019	0500	2.8	9.8	21.8	12.2	19.2	7.1	67.0
39	12/9/2019	0600	2.4	12.0	22.2	13.4	20.2	10.1	73.9
40	12/9/2019	0700	3.4	15.7	21.8	18.2	25.2	8.9	72.9
41	12/9/2019	0800	3.5	18.9	34.7	22.5	25.6	8.7	72.5
42	12/9/2019	0900	4.1	16.8	51.0	18.2	27.8	8.7	72.2
43	12/9/2019	1000	4.0	25.9	51.7	21.9	32.8	9.1	79.2
44	12/9/2019	1100	4.3	26.3	54.0	16.7	35.2	10.3	76.5
45	12/9/2019	1200	5.1	33.1	46.6	22.8	40.0	11.5	82.3
46	12/9/2019	1300	4.7	39.3	38.0	23.4	37.4	12.8	73.6
47	12/9/2019	1400	5.2	44.7	44.4	38.7	42.7	10.7	73.9
48	12/9/2019	1500	5.4	32.3	47.8	37.4	26.8	10.3	68.6
49	12/9/2019	1800	4.2	30.3	40.6	31.8	28.8	10.5	66.6
50	12/9/2019	1900	4.4	25.6	37.6	36.6	29.3	7.8	54.5
51	12/9/2019	2000	4.2	22.2	35.1	31.1	26.7	7.3	54.5
52	12/9/2019	2100	3.6	21.4	31.9	30.6	27.2	7.2	42.5
53	12/9/2019	2200	3.8	19.6	27.9	32.1	25.1	8.1	43.6
54	12/9/2019	2300	3.9	19.7	35.6	26.9	25.5	7.2	43.9
55	12/9/2019	0000	2.7	19.0	31.1	22.2	20.4	6.8	43.1
56	12/10/2019	0100	3.3	21.3	27.3	17.0	17.5	7.1	45.7
57	12/10/2019	0200	2.9	20.2	30.5	15.6	17.3	7.1	43.2
58	12/10/2019	0300	3.3	22.8	29.1	14.0	15.5	7.2	39.4
59	12/10/2019	0400	3.0	19.6	27.3	16.3	12.4	7.6	42
60	12/10/2019	0500	3.1	18.8	28.1	17.7	10.6	8.8	47.1

TABLE 7		SITE NAME: GILGIT – NEAR AIRPORT (G2) COORDINATES: 35°54'35.90"N 74°20'10.37"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
61	12/10/2019	0600	3.0	19.9	32.5	18.9	12.0	8.9	58
62	12/10/2019	0700	3.5	20.5	32.1	19.5	16.2	8.3	54.6
63	12/10/2019	0800	4.0	21.9	34.5	23.5	23.2	6.3	51
64	12/10/2019	0900	4.8	24.2	40.8	27.9	25.6	10.8	61.4
65	12/10/2019	1000	5.2	25.0	43.2	33.4	28.3	8.3	68.8
66	12/10/2019	1100	5.1	29.2	45.9	36.2	29.2	6.4	75
67	12/10/2019	1200	4.7	27.5	55.1	35.2	31.8	11.8	74.2
68	12/10/2019	1300	5.4	26.9	52.3	28.7	34.9	13.4	74.3
69	12/10/2019	1400	4.7	27.0	51.0	30.1	35.1	12.8	79.4
70	12/10/2019	1500	5.3	27.7	50.6	27.5	37.0	14.8	78.8
71	12/10/2019	1600	4.3	27.9	50.5	24.6	34.9	14.9	82.7
72	12/10/2019	1700	4.7	27.8	47.9	22.7	34.2	12.3	78.5
Max			5.4	44.7	55.1	38.7	42.7	14.9	82.7
Min			2.4	9.8	19.7	11.5	10.6	6.3	39.4
Avg			**4.1**	**25.6**	**35.7**	**23.8**	**28.2**	**10.1**	**58.3**

TABLE 8		SITE NAME: JAGLOT (J1) COORDINATES: 35°41'6.89"N, 74°38'0.47"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
1	12/10/2019	1900	2.8	13.0	16.4	9.2	21.9	6.2	71.6
2	12/10/2019	2000	2.8	14.0	17.2	9.7	21.0	6.0	71.1
3	12/10/2019	2100	2.7	10.5	18.1	7.3	20.8	5.0	69.9
4	12/10/2019	2200	2.2	7.5	18.6	10.0	16.1	4.3	60.0
5	12/10/2019	2300	2.2	11.1	19.3	8.2	18.5	3.8	55.7
6	12/11/2019	0000	1.9	8.8	16.3	9.0	17.3	3.6	52.6
7	12/11/2019	0100	2.5	10.8	21.2	7.3	16.1	3.7	50.4
8	12/11/2019	0200	1.9	9.2	18.8	5.8	15.8	2.6	49.0
9	12/11/2019	0300	0.7	9.4	16.1	4.2	13.0	2.4	40.9
10	12/11/2019	0400	0.8	8.4	15.8	7.8	10.7	3.0	38.4
11	12/11/2019	0500	1.8	7.4	15.3	9.0	12.2	3.9	44.6
12	12/11/2019	0600	2.3	5.9	16.9	10.7	13.2	3.3	36.5
13	12/11/2019	0700	1.7	8.1	14.6	8.5	14.0	3.3	39.3
14	12/11/2019	0800	1.8	11.9	13.7	9.4	15.2	4.3	38.2
15	12/11/2019	0900	2.3	12.1	15.2	12.0	16.1	4.1	35.4
16	12/11/2019	1000	2.9	12.5	17.7	11.9	18.0	5.9	38.8
17	12/11/2019	1100	2.7	16.5	18.9	12.3	21.5	3.8	45.1
18	12/11/2019	1200	2.7	13.3	20.0	13.9	23.9	3.0	51.8
19	12/11/2019	1300	2.8	19.2	24.5	18.8	22.8	2.7	62.1
20	12/11/2019	1400	2.8	25.7	23.2	13.9	24.1	3.5	62.9
21	12/11/2019	1500	3.6	20.1	21.9	11.4	23.2	2.5	61.9
22	12/11/2019	1600	2.7	24.6	15.8	9.1	20.5	3.1	64.7
23	12/11/2019	1700	2.9	27.4	18.0	11.0	22.0	3.1	67.5
24	12/11/2019	1800	2.6	24.4	21.3	12.4	21.0	3.5	68.2
25	12/11/2019	1900	2.7	21.5	20.6	13.3	22.0	6.3	67.5
26	12/11/2019	2000	2.1	15.9	15.9	9.2	19.8	5.5	70.3
27	12/11/2019	2100	1.8	16.8	12.9	6.2	18.2	3.2	68.7
28	12/11/2019	2200	1.5	11.8	14.4	10.9	16.5	2.8	58.9
29	12/11/2019	2300	2.0	10.0	13.2	9.0	16.7	4.1	53.6
30	12/12/2019	0000	2.0	9.4	13.4	7.9	14.3	3.4	51.6

TABLE 8		SITE NAME: JAGLOT (J1) COORDINATES: 35°41'6.89"N, 74°38'0.47"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
31	12/12/2019	0100	2.5	6.2	14.6	6.1	11.3	3.6	56.7
32	12/12/2019	0200	2.7	5.9	15.8	6.7	11.5	4.5	51.4
33	12/12/2019	0300	2.1	5.3	15.9	7.3	11.7	4.2	48.3
34	12/12/2019	0400	1.7	5.7	14.7	6.2	11.6	2.7	49.5
35	12/12/2019	0500	1.0	5.5	12.8	5.3	11.7	2.0	41.7
36	12/12/2019	0600	1.4	5.6	11.4	7.5	11.9	2.2	37.5
37	12/12/2019	0700	1.6	5.5	12.6	5.7	14.2	1.9	38.6
38	12/12/2019	0800	1.9	5.3	13.3	8.7	15.0	1.6	38.9
39	12/12/2019	0900	2.6	7.3	14.1	10.4	15.1	3.3	38.1
40	12/12/2019	1000	1.8	9.9	15.6	11.1	15.9	4.1	40.7
41	12/12/2019	1100	2.3	8.1	17.5	16.3	17.5	5.0	41.9
42	12/12/2019	1200	2.6	11.3	21.5	11.9	21.4	5.4	49.7
43	12/12/2019	1300	3.2	16.6	17.6	13.4	20.7	5.1	50.5
44	12/12/2019	1400	2.7	18.5	15.4	15.2	20.7	3.5	55.7
45	12/12/2019	1500	2.8	15.3	20.5	16.7	21.1	4.9	66.9
46	12/12/2019	1600	2.0	10.6	22.3	15.5	21.2	2.9	56.3
47	12/12/2019	1700	2.3	13.6	15.2	12.5	23.2	2.0	56.7
48	12/12/2019	1800	1.8	17.6	20.7	10.2	22.4	3.3	56.6
49	12/12/2019	1900	2.4	16.3	15.4	9.9	18.7	5.1	55.3
50	12/12/2019	2000	3.2	14.3	17.9	10.2	18.7	6.2	49.6
51	12/12/2019	2100	2.5	10.3	16.9	12.0	16.7	5.5	47.2
52	12/12/2019	2200	2.2	12.2	14.0	8.2	17.7	4.3	51.6
53	12/12/2019	2300	1.5	10.4	12.7	6.8	16.3	7.4	46.1
54	12/13/2019	0000	1.3	12.1	13.7	5.3	15.8	4.6	40.9
55	12/13/2019	0100	1.4	11.1	14.3	6.9	14.1	2.4	40.6
56	12/13/2019	0200	0.7	8.2	15.7	7.3	12.5	3.1	44.6
57	12/13/2019	0300	1.4	8.3	13.3	7.0	10.1	2.3	45.9
58	12/13/2019	0400	1.7	6.2	9.5	6.1	8.4	1.7	45.9
59	12/13/2019	0500	1.8	5.2	7.5	5.5	7.8	2.3	56.1
60	12/13/2019	0600	1.8	6.6	10.6	10.3	9.0	2.1	65.9

TABLE 8		SITE NAME: JAGLOT (J1) COORDINATES: 35°41'6.89"N, 74°38'0.47"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
61	12/13/2019	0700	2.1	6.6	14.6	9.8	10.1	3.2	66.2
62	12/13/2019	0800	2.4	8.8	18.0	10.7	14.0	5.8	64.6
63	12/13/2019	0900	2.5	9.6	20.7	15.8	16.1	6.3	60.0
64	12/13/2019	1000	2.7	10.4	22.2	16.7	17.0	6.4	58.3
65	12/13/2019	1100	3.2	10.9	23.8	17.5	18.2	4.8	59.4
66	12/13/2019	1200	3.2	12.4	24.9	17.0	23.1	4.1	61.4
67	12/13/2019	1300	3.1	19.3	24.1	17.8	27.3	2.0	61.8
68	12/13/2019	1400	3.3	20.5	27.0	15.6	30.8	2.7	68.2
69	12/13/2019	1500	2.8	20.3	23.5	14.1	31.8	3.7	60.2
70	12/13/2019	1600	3.1	15.4	15.2	11.0	31.0	3.3	59.9
71	12/13/2019	1700	2.8	18.9	15.0	8.4	31.6	3.3	54.5
72	12/13/2019	1800	2.7	16.1	17.8	11.8	29.8	4.1	51.0
73	12/13/2019	1900	3.0	13.1	14.8	12.3	28.7	3.2	46.4
74	12/13/2019	2000	2.2	13.4	13.2	17.8	24.0	8.1	47.7
75	12/13/2019	2100	2.4	13.7	15.2	10.7	21.0	5.1	42.5
76	12/13/2019	2200	1.8	13.5	17.2	9.4	20.9	5.5	41.2
77	12/13/2019	2300	2.3	12.3	20.8	11.3	19.7	4.4	41.4
78	12/14/2019	0000	2.2	8.8	18.1	10.4	17.9	6.6	39.4
79	12/14/2019	0100	2.5	8.8	15.5	9.6	16.4	3.2	40.8
80	12/14/2019	0200	1.4	8.4	15.2	5.1	16.8	3.1	41.6
81	12/14/2019	0300	1.6	8.5	16.6	6.6	15.0	1.8	41.0
82	12/14/2019	0400	1.4	6.5	18.9	5.1	14.6	1.5	42.5
83	12/14/2019	0500	0.7	7.5	17.5	4.4	13.8	1.9	43.8
84	12/14/2019	0600	1.6	6.5	13.4	4.5	16.8	3.2	40.8
85	12/14/2019	0700	1.9	9.5	14.7	6.4	17.6	5.3	60.5
86	12/14/2019	0800	2.1	9.5	15.8	5.9	19.5	7.0	64.8
87	12/14/2019	0900	2.7	9.5	15.1	10.1	19.8	5.3	61.4
88	12/14/2019	1000	3.2	10.1	17.4	9.8	18.3	3.9	64.3
89	12/14/2019	1100	2.7	15.1	17.8	10.5	17.1	3.1	64.1
90	12/14/2019	1200	2.3	19.4	19.2	12.5	22.3	3.8	63.3

TABLE 8		SITE NAME: JAGLOT (J1) COORDINATES: 35°41'6.89"N, 74°38'0.47"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	NO (µg/m^3)	O_3 (µg/m^3)	BC (µg/m^3)	Noise dBA
91	12/14/2019	1300	2.6	30.4	18.0	13.7	25.4	4.2	62.5
92	12/14/2019	1400	3.3	27.5	22.0	12.5	26.6	2.6	59.8
93	12/14/2019	1500	2.9	23.8	26.3	18.7	27.9	3.1	55.3
94	12/14/2019	1600	3.4	19.5	23.7	15.9	30.1	4.0	50.4
95	12/14/2019	1700	3.4	16.2	24.7	10.6	30.5	3.9	41.4
96	12/14/2019	1800	3.0	14.5	14.2	10.9	27.5	3.8	39.1
97	12/14/2019	1900	3.2	12.4	13.9	12.6	24.5	3.8	38.6
98	12/14/2019	2000	3.5	10.9	14.0	11.4	18.6	7.4	38.3
99	12/14/2019	2100	3.5	10.4	15.5	10.1	20.0	7.8	38.3
100	12/14/2019	2200	3.0	10.4	17.7	10.9	19.4	3.1	36.5
101	12/14/2019	2300	3.2	9.5	15.6	7.8	19.1	1.9	35.8
102	12/15/2019	0000	2.5	7.5	16.3	6.8	20.1	2.1	35.8
103	12/15/2019	0100	2.4	7.4	16.2	8.1	17.9	1.3	36.2
104	12/15/2019	0200	1.6	6.5	17.7	7.3	16.7	1.0	35.5
105	12/15/2019	0300	1.0	8.5	18.2	7.6	15.8	1.0	38.0
106	12/15/2019	0400	1.0	7.6	20.7	10.4	12.3	1.0	39.1
107	12/15/2019	0500	1.0	9.4	16.4	5.5	11.7	1.1	42.1
108	12/15/2019	0600	1.8	10.5	14.2	6.6	11.6	1.4	47.4
109	12/15/2019	0700	1.9	11.6	15.6	9.4	14.4	4.3	54.6
110	12/15/2019	0800	2.3	14.5	13.8	12.9	17.1	3.6	63.9
111	12/15/2019	0900	2.5	13.5	17.2	15.7	21.2	4.7	61.3
112	12/15/2019	1000	3.0	13.7	16.2	12.2	20.8	3.2	64.2
113	12/15/2019	1100	2.9	14.4	15.6	11.1	21.7	2.1	63.6
Max			3.6	30.4	27.0	18.8	31.8	8.1	71.6
Min			0.7	5.2	7.5	4.2	7.8	1.0	35.4
Avg			**2.3**	**12.3**	**17.0**	**10.2**	**18.6**	**3.7**	**51.4**

TABLE 9		SITE NAME: CHILAS (C1) COORDINATES: 35°25'30.41"N 74°5'40.50"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
1	12/15/2019	1700	3.3	19.5	24.4	16.2	21.5	10.1	68.5
2	12/15/2019	1800	3.4	17.9	20.4	13.1	21.6	7.5	69.2
3	12/15/2019	1900	3.8	20.2	18.4	11.4	20.8	8.8	70.1
4	12/15/2019	2000	3.5	19.3	18.2	11.3	19.7	5.4	62.7
5	12/15/2019	2100	3.5	17.8	15.7	9.3	19	5.9	59.6
6	12/15/2019	2200	3	18.9	16	9.5	18.2	5	59.2
7	12/15/2019	2300	2.7	17.1	14.9	8.6	19.4	5.7	52.5
8	12/16/2019	0000	2.1	16.3	11.4	5.9	18.8	4.5	44.4
9	12/16/2019	0100	1.6	14.5	11.7	6.5	17.9	6.4	41.9
10	12/16/2019	0200	1.3	12.7	13.8	8.3	15.5	4.3	48.1
11	12/16/2019	0300	1.1	12.6	14.3	8.8	13.8	4.1	40
12	12/16/2019	0400	1.1	11.8	11.3	6.2	10.5	2.6	42.8
13	12/16/2019	0500	1.1	11.9	10.8	5.8	10.5	2.5	41.7
14	12/16/2019	0600	1.3	12.8	18	11.9	14.8	3.2	38.9
15	12/16/2019	0700	2.8	15.6	22.3	15.5	14.3	3	42.3
16	12/16/2019	0800	2.3	16	20.4	13.9	17.2	2.6	48.6
17	12/16/2019	0900	2.4	16.7	17.8	10.8	17.4	5	55.3
18	12/16/2019	1000	2.7	16.4	23.7	15.5	18.4	4	65.6
19	12/16/2019	1100	2.9	17.6	23.2	15.1	20.6	3.7	69.6
20	12/16/2019	1200	2.6	20.9	26.1	17.4	21.4	2.9	70.2
21	12/16/2019	1300	3.3	27.1	24.7	16.3	23.8	4.2	69.2
22	12/16/2019	1400	3.7	27.1	20.4	12.9	24.5	5.2	65.3
23	12/16/2019	1500	3.7	30.4	33.5	23.2	24.2	6.4	67.2
24	12/16/2019	1600	3.1	34.5	30.2	20.7	25.5	7.3	69.4
25	12/16/2019	1700	3.2	28.3	30	20.5	25.5	6.7	70.3
26	12/16/2019	1800	3.7	22.2	30.7	21.1	26.7	8.8	68.6
27	12/16/2019	1900	3.7	22.4	31.5	21.6	24.6	8.7	69.3
28	12/16/2019	2000	3.8	22.6	27.8	18.7	24.1	5.5	67.1
29	12/16/2019	2100	3.5	23.6	26.8	17.9	22.5	6	65.1
30	12/16/2019	2200	3.1	25.5	21.7	13.9	21.3	4.5	60.2

TABLE 9		SITE NAME: CHILAS (C1) COORDINATES: 35°25'30.41"N 74°5'40.50"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
31	12/16/2019	2300	2.9	18.9	15.1	8.7	22.8	3.5	54.9
32	12/17/2019	0000	2.3	18.6	11.8	6.2	21.8	3.3	51.8
33	12/17/2019	0100	1.3	15.6	15.7	9.2	19.6	4.8	53
34	12/17/2019	0200	1.1	15.6	14.3	8.1	17.4	6.1	45.2
35	12/17/2019	0300	2	12.5	12.2	6.5	17.7	3.7	41
36	12/17/2019	0400	2	10.5	14.9	9.1	16.7	2.5	42.1
37	12/17/2019	0500	2.2	11.4	17.4	11.3	16.3	2.2	42.4
38	12/17/2019	0600	2.6	11.4	13.1	7.7	18.5	3.2	41.6
39	12/17/2019	0700	3.1	12.5	13.9	8.4	18.5	4.1	44.2
40	12/17/2019	0800	3.3	14.7	15.5	9.7	20.2	4.6	45.4
41	12/17/2019	0900	3	16.6	18.4	12.1	19.3	6.1	53.2
42	12/17/2019	1000	2.2	16.6	21.8	15	21.3	4.3	54
43	12/17/2019	1100	2.6	19.8	23.4	16.3	18	5.7	59.2
44	12/17/2019	1200	2.6	28	22.8	15.8	20.8	3.5	66.2
45	12/17/2019	1300	2.7	26.4	32.6	24	23.3	8.2	59.8
46	12/17/2019	1400	2.7	23.1	22.3	15.4	24.2	7	67.2
47	12/17/2019	1500	3	21.6	36.1	24	28.5	11.8	60.1
48	12/17/2019	1600	3.4	23.2	36.3	22.1	28	7.7	58.8
49	12/17/2019	1700	3.1	21	35.7	20.6	25.8	5.8	53.1
50	12/17/2019	1800	3	19	29.3	20.1	23.8	6.4	50.7
51	12/17/2019	1900	3.1	17.2	26.7	18	25.1	6.3	55.1
52	12/17/2019	2000	3.3	15.6	24.1	15.9	22.1	8	49.6
53	12/17/2019	2100	3.2	15.6	25.9	17.4	22.1	5.9	44.4
54	12/17/2019	2200	2.9	15.5	26.4	17.8	21.1	6.8	44.1
55	12/17/2019	2300	3.1	15.8	24	15.9	19.5	4.6	48.1
56	12/18/2019	0000	2.8	19.2	27.4	18.5	16.9	4.5	49.4
57	12/18/2019	0100	2.8	15.5	15.5	9.1	15.1	4.3	49.3
58	12/18/2019	0200	1.4	14.6	14.3	8.2	19.3	4.1	59.6
59	12/18/2019	0300	1.9	14.5	16.7	10.1	17.1	3.5	69.4
60	12/18/2019	0400	1.7	14.3	16.5	9.9	12.8	2.8	68.8

TABLE 9		SITE NAME: CHILAS (C1) COORDINATES: 35°25'30.41"N 74°5'40.50"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
61	12/18/2019	0500	1.7	14.5	18.9	11.8	11	2.4	63.2
62	12/18/2019	0600	1.2	14.3	21.6	14	10.2	2.9	62.5
63	12/18/2019	0700	1.9	14.5	22.7	14.9	12.7	5	69.8
64	12/18/2019	0800	3.4	17.4	18.2	11.3	12.3	7.7	70.1
65	12/18/2019	0900	2.6	18.7	21.4	13.8	15.4	8.6	64
66	12/18/2019	1000	2.8	21.3	28.2	19.2	20.2	11.8	69.2
67	12/18/2019	1100	2	20.4	32.5	22.6	24	9.8	70.8
68	12/18/2019	1200	2.4	21.1	25.6	17.1	28.5	6.4	62.8
69	12/18/2019	1300	2.8	26.8	20.6	13.2	32.3	6.5	62.4
70	12/18/2019	1400	2.8	27.5	25.5	17	37.4	7.3	57
71	12/18/2019	1500	2.9	28.2	25.1	16.8	34.7	4.8	53.5
72	12/18/2019	1600	3.5	26.5	24.7	16.4	31.1	5.1	48.9
73	12/18/2019	1700	3.4	25.4	22.3	14.5	31	5.5	50.2
74	12/18/2019	1800	3.4	25.1	19	11.9	29	5.8	45.1
75	12/18/2019	1900	3.5	23.5	17.3	10.5	29.5	4.2	43.8
76	12/18/2019	2000	2.7	24.4	16.6	10	26.5	4.8	43.9
77	12/18/2019	2100	2.8	20.5	12.2	6.5	21.5	4.9	43.5
78	12/18/2019	2200	2.4	19.6	18.1	11.2	18.2	5.3	43.3
79	12/18/2019	2300	3.4	21.8	16.9	10.2	19.5	3.7	49.1
80	12/19/2019	0000	3.4	17.9	15.5	9.1	19	4.2	58.5
81	12/19/2019	0100	2.7	16.1	15.5	9.1	17	5.1	61
82	12/19/2019	0200	1.7	18.7	11.7	6.1	14.5	5	66.4
83	12/19/2019	0300	1.5	17.9	9.3	4.2	12.2	4.9	69.3
84	12/19/2019	0400	1.5	16.7	10.8	5.4	11	4.9	68.5
85	12/19/2019	0500	1.7	14.4	11.3	5.8	9.6	3.7	68.9
86	12/19/2019	0600	1.5	16.4	15.9	9.5	11	3.4	65.2
87	12/19/2019	0700	1.4	17.2	19.9	12.6	13.8	4.2	65.2
88	12/19/2019	0800	2.3	21.2	27.6	18.7	17.1	5.1	64.4
89	12/19/2019	0900	2.5	19.4	29.2	20.0	20.2	7.0	67.4
90	12/19/2019	1000	2.7	19.0	31.0	21.4	21.5	10.1	65.0

TABLE 9		SITE NAME: CHILAS (C1) COORDINATES: 35°25'30.41"N 74°5'40.50"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	NO (µg/m^3)	O_3 (µg/m^3)	BC (µg/m^3)	Noise dBA
91	12/19/2019	1100	2.7	19.1	29.9	20.5	24.7	8.7	62.4
92	12/19/2019	1200	2.7	22.6	36.3	23.7	24.7	9.2	57.9
93	12/19/2019	1300	3.8	24.7	26.4	17.8	24.3	11.0	52.9
94	12/19/2019	1400	3.8	23.4	26.4	17.8	23.3	10.9	44.0
95	12/19/2019	1500	3.2	23.6	28.9	19.8	22.5	10.9	41.7
96	12/19/2019	1600	3.0	23.5	21.0	13.5	23.0	10.1	41.1
97	12/19/2019	1700	2.9	23.8	28.3	19.3	23.5	8.8	40.8
98	12/19/2019	1800	2.8	23.4	25.3	16.9	23.9	4.7	40.8
99	12/19/2019	1900	2.8	22.6	22.0	14.3	22.5	4.7	39.0
100	12/19/2019	2000	2.3	22.9	21.1	13.6	22.6	5.5	38.3
101	12/19/2019	2100	2.8	22.0	18.1	11.2	19.5	3.4	38.3
102	12/19/2019	2200	2.7	21.7	17.1	10.4	21.4	3.0	38.8
103	12/19/2019	2300	2.7	21.9	17.4	10.7	20.2	2.6	38.1
104	12/20/2019	0000	2.4	21.4	16.5	9.9	18.5	3.1	40.5
105	12/20/2019	0100	1.9	21.2	13.3	7.4	16.7	4.9	41.6
106	12/20/2019	0200	1.6	20.9	13.6	7.6	13.7	4.3	44.7
107	12/20/2019	0300	1.6	21.6	11.7	6.1	14.7	3.9	49.9
108	12/20/2019	0400	1.6	22.5	13.1	7.2	12.5	4.0	57.1
109	12/20/2019	0500	1.7	23.2	14.0	7.9	12.0	3.4	66.5
110	12/20/2019	0600	1.6	22.5	16.0	9.6	11.8	4.0	69.3
Max			3.8	34.4	36.3	23.9	37.4	11.8	70.8
Min			1.0	10.5	9.3	4.2	9.6	2.2	38.1
Avg			**2.6**	**19.6**	**20.8**	**13.4**	**20.1**	**5.5**	**55.3**

Annex-II

Diurnal Variation of Air Pollutants & Noise Levels in GB during Winter

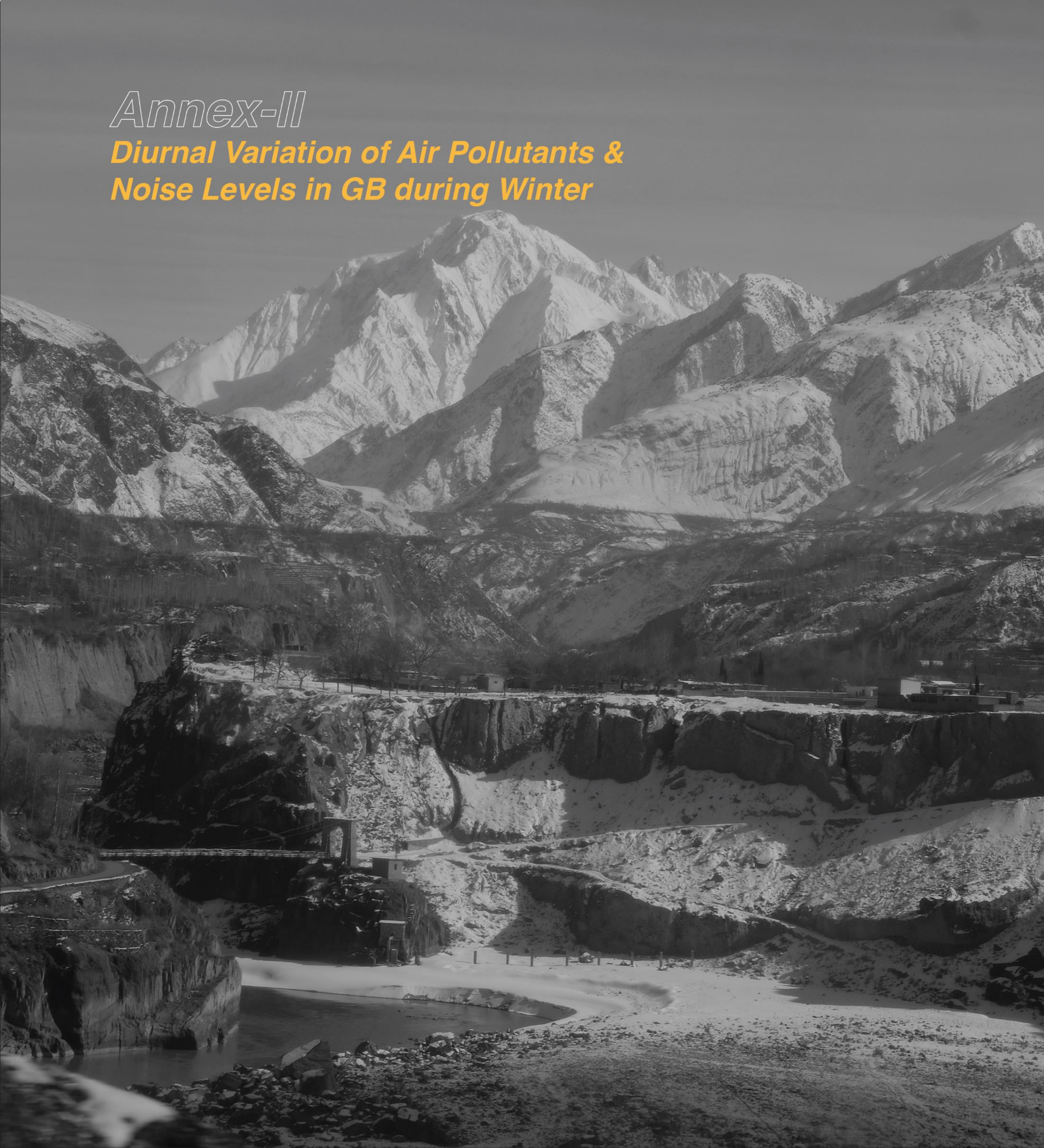
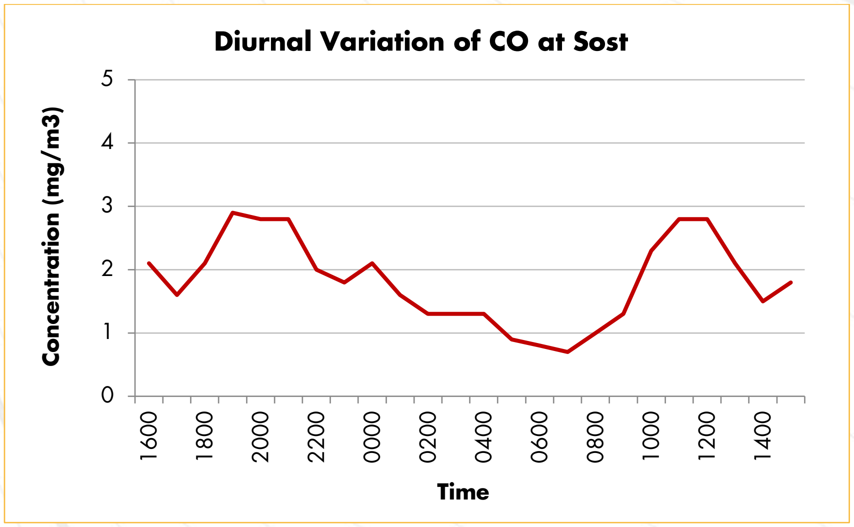
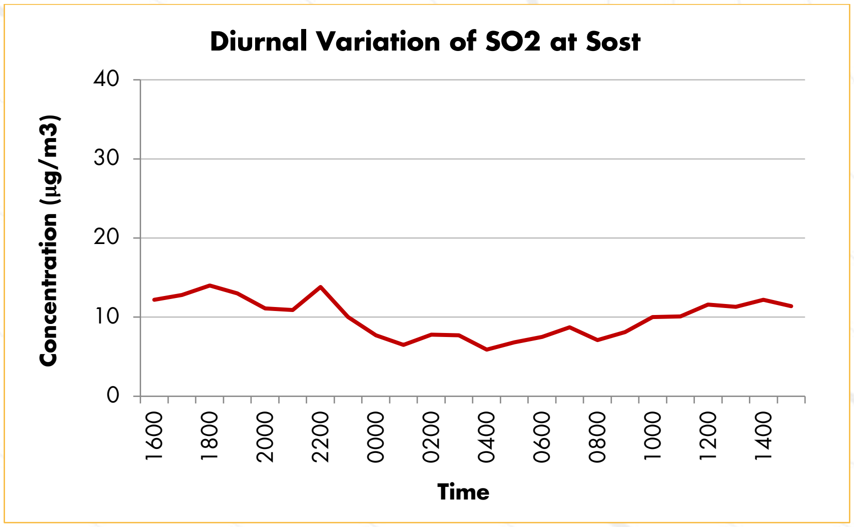
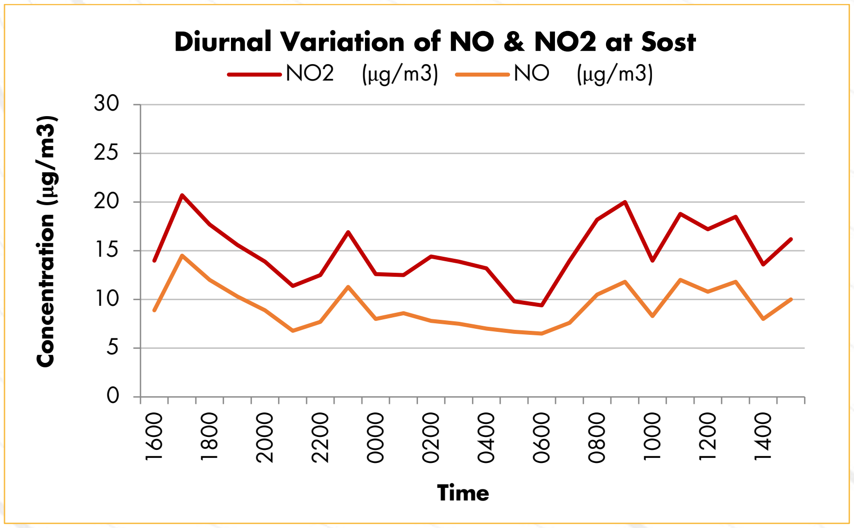
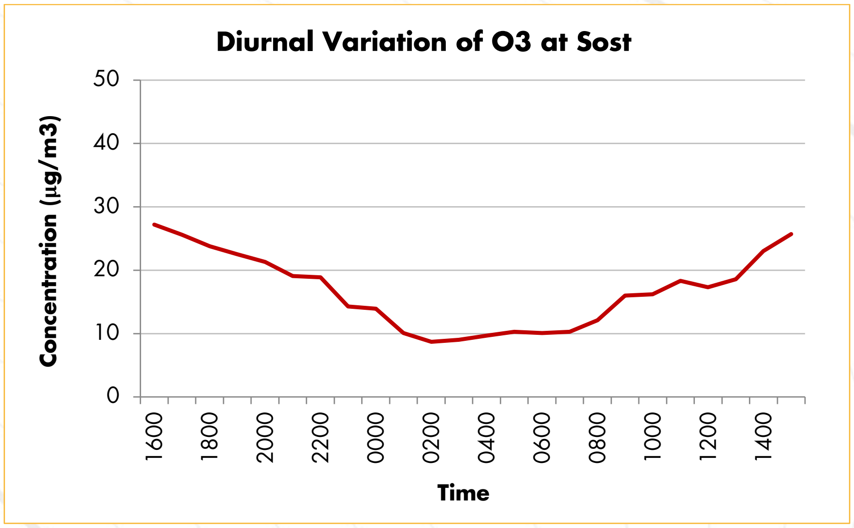


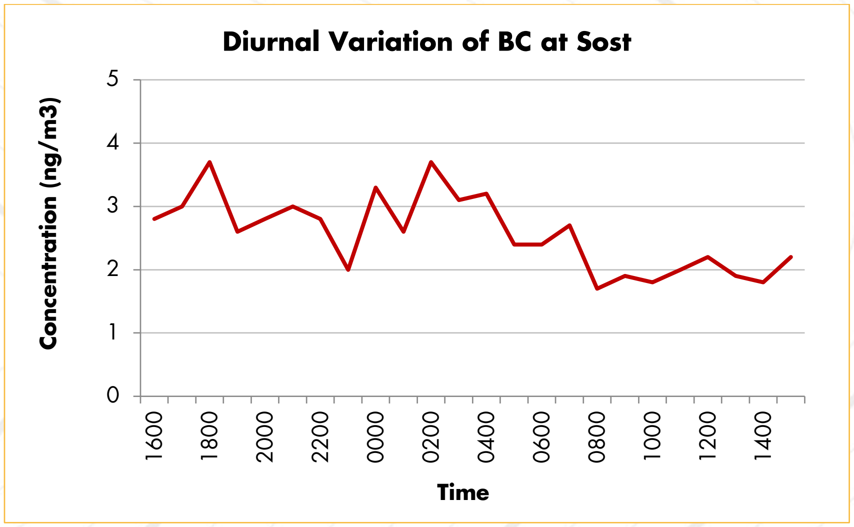
FIGURE 1: SOST (Sost Check Post – S1)











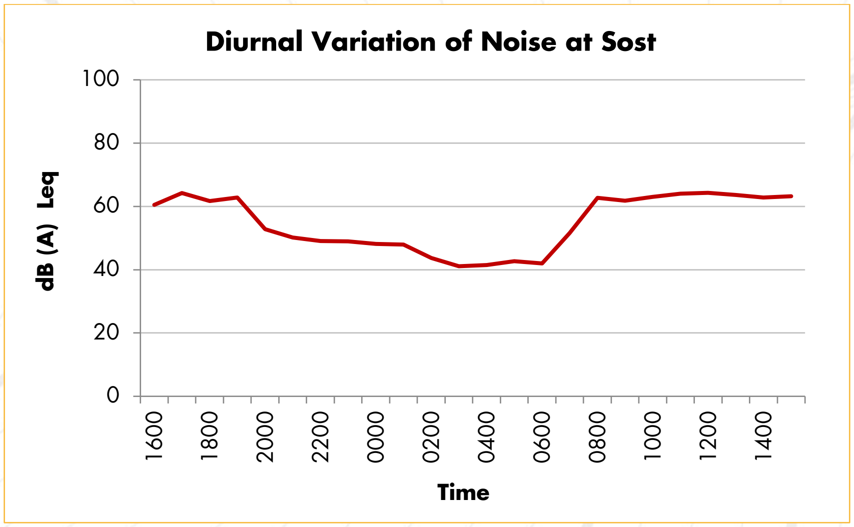


FIGURE 2: SOST (Khudabad – S2)

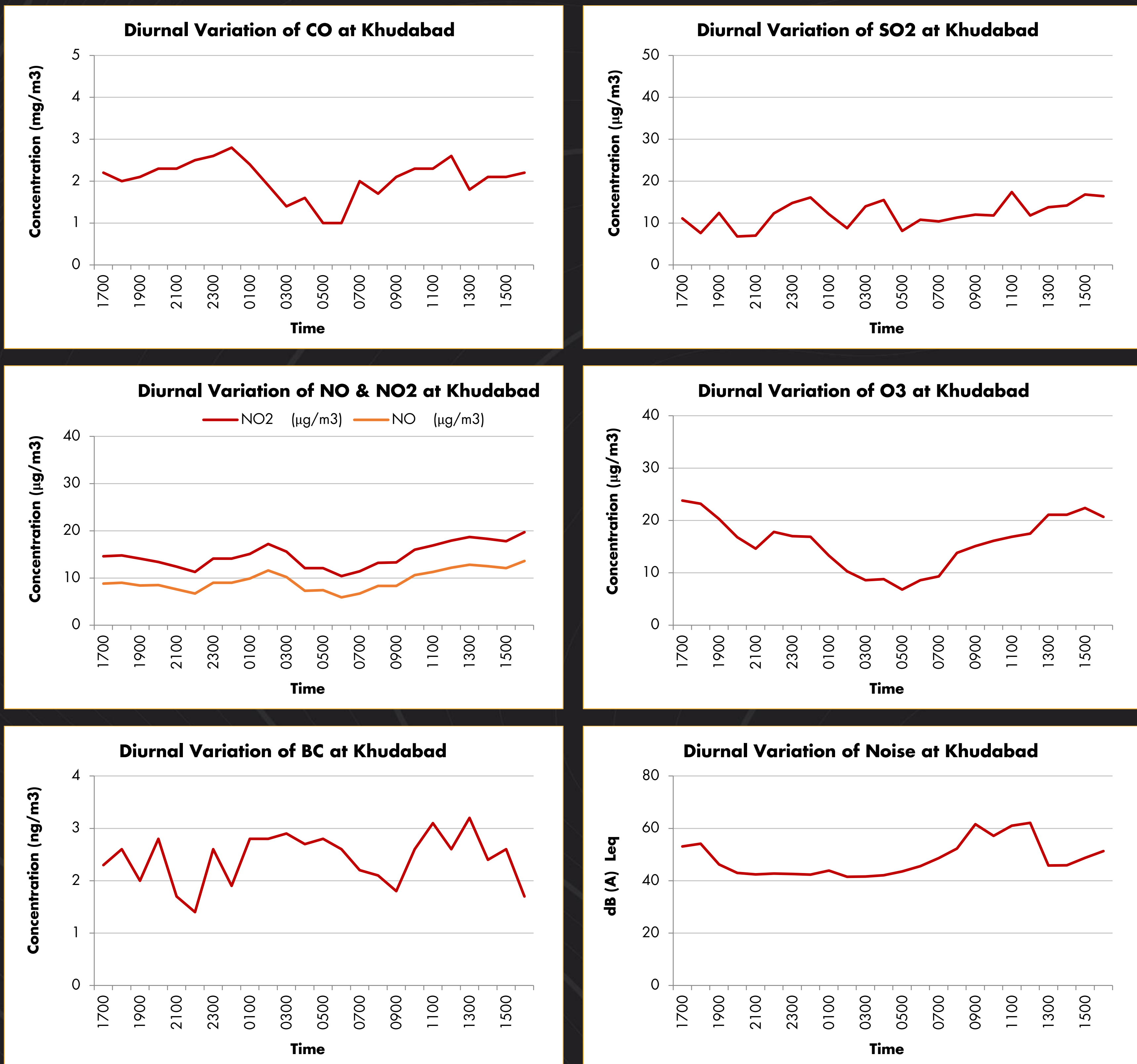


FIGURE 3: SOST (Gircha – S3)

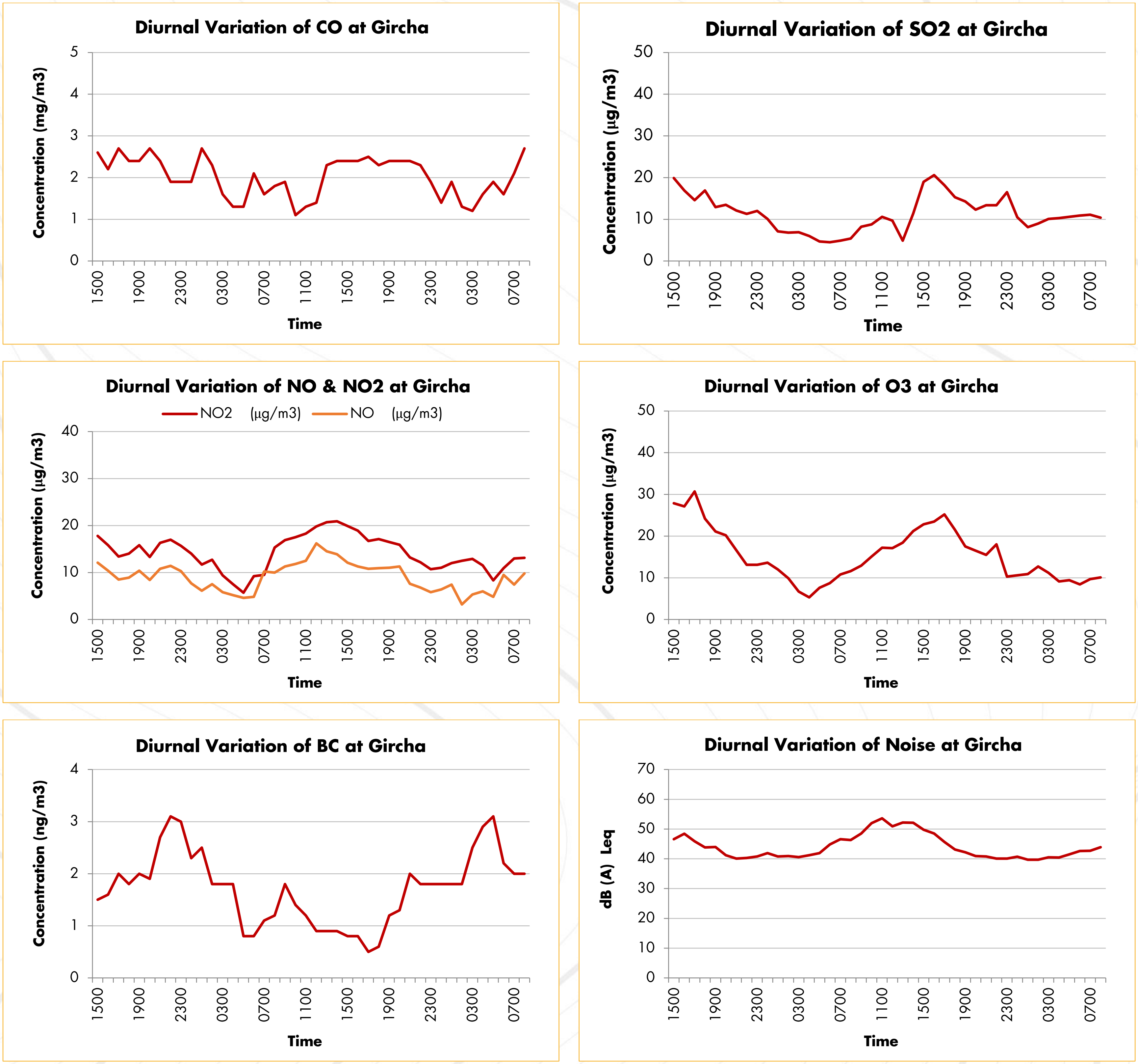


FIGURE 4: HUNZA (Karimabad – H1)

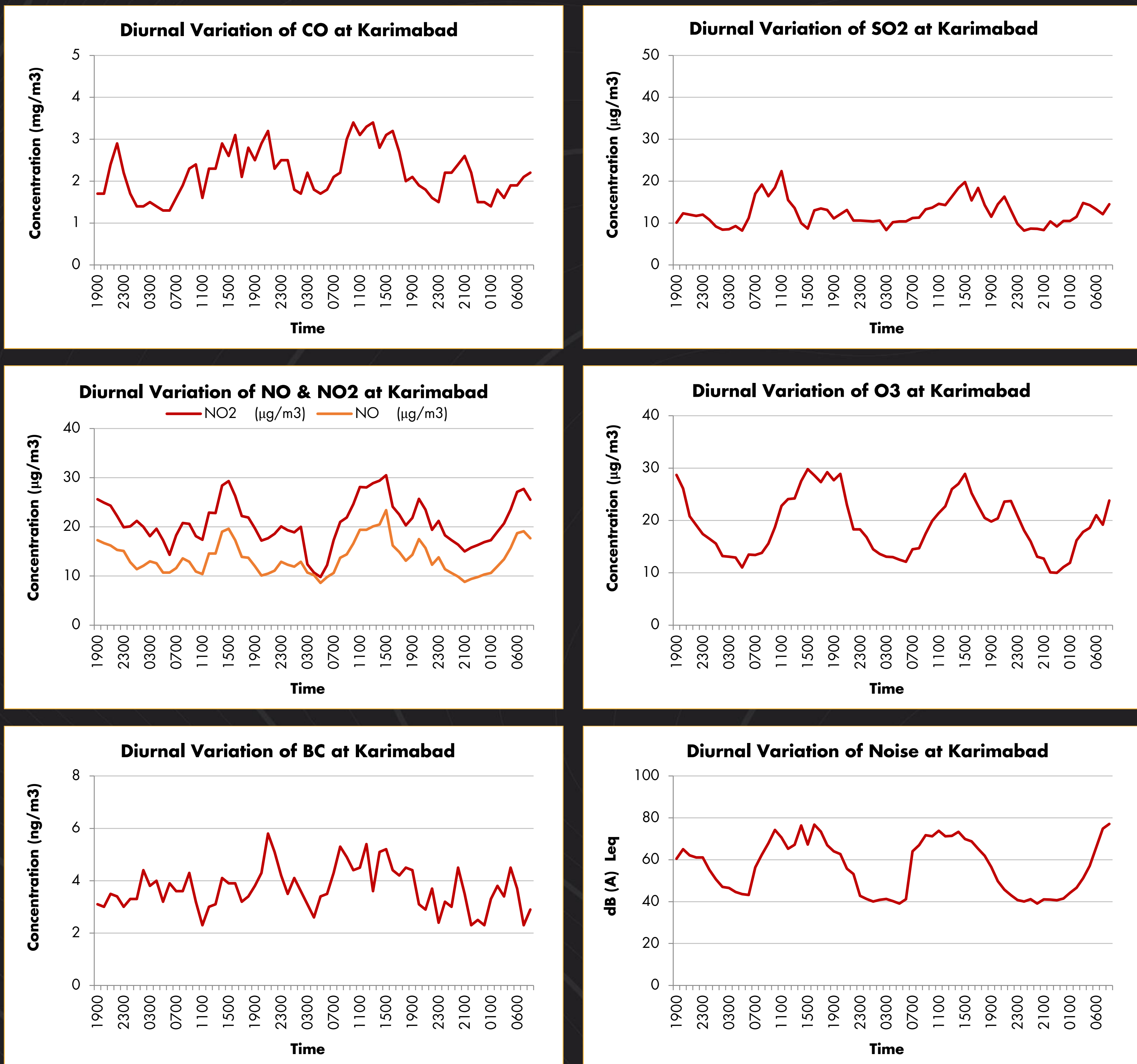


FIGURE 5: HUNZA (Aliabad – H2)

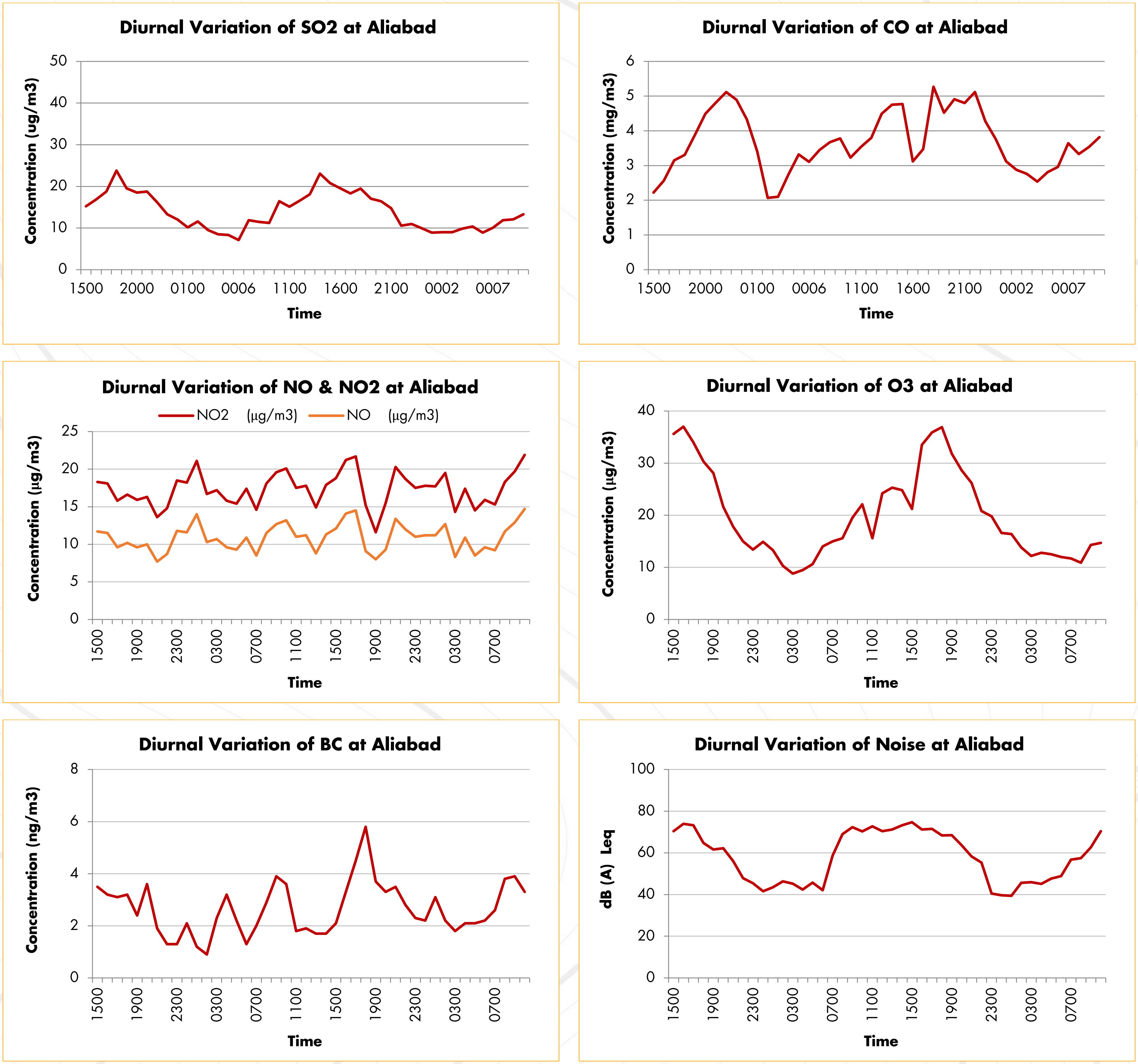
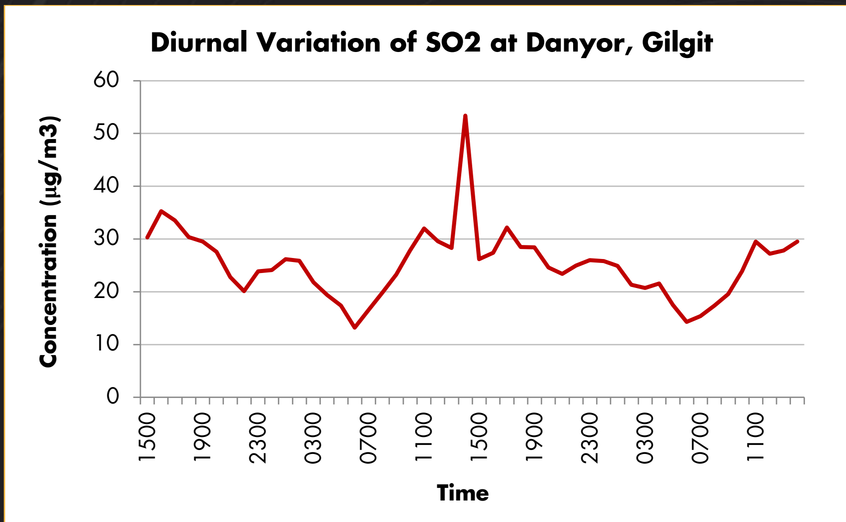
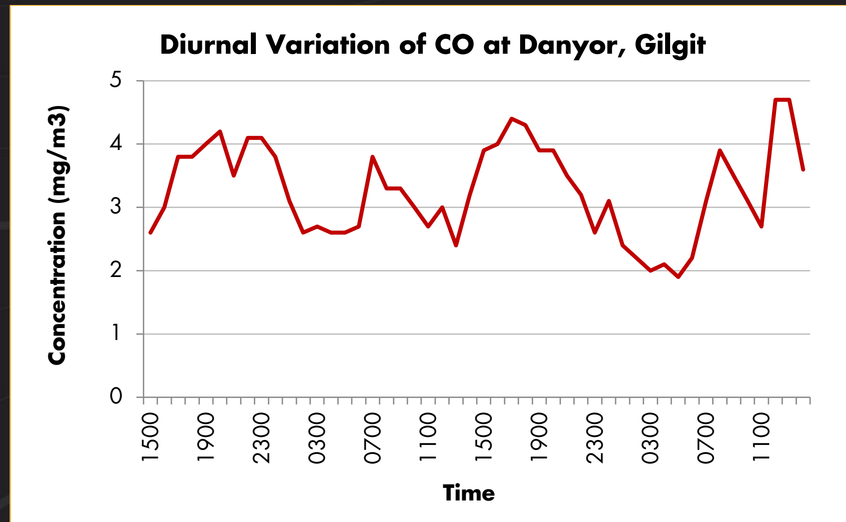
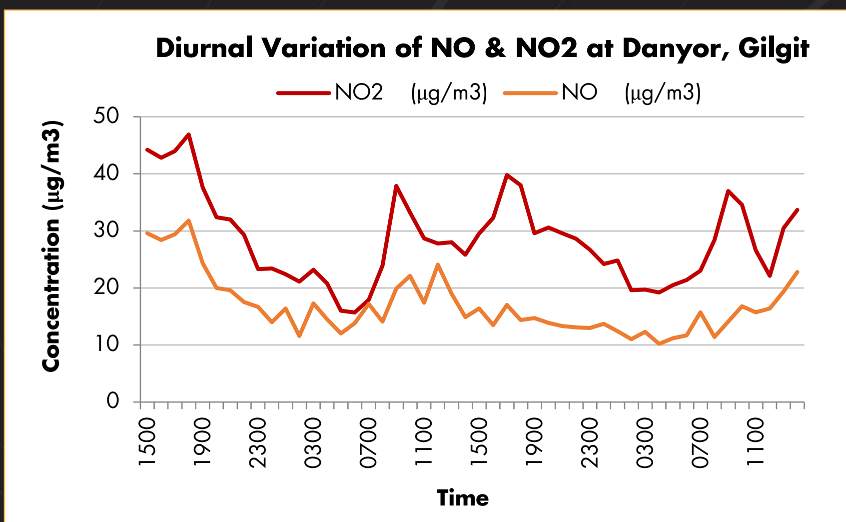
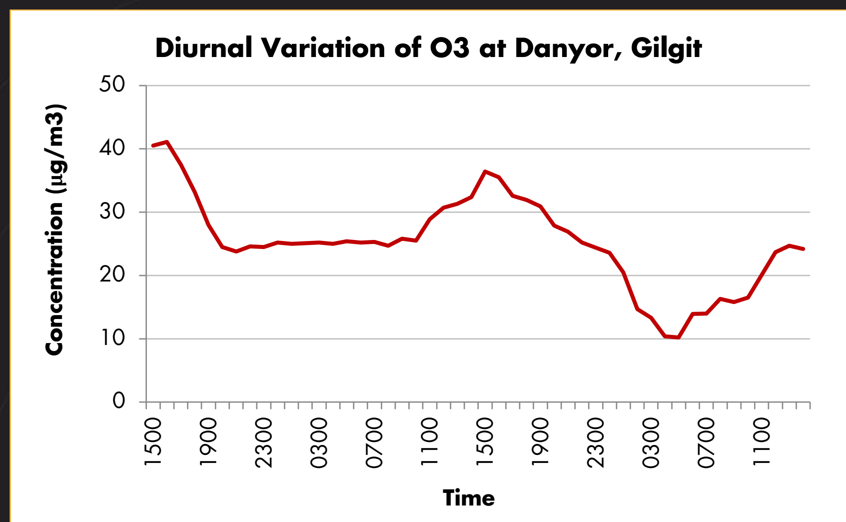


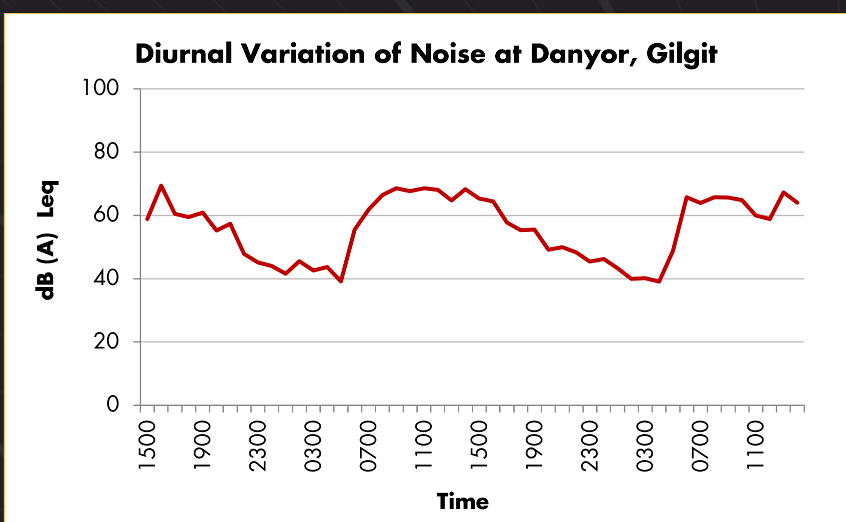
FIGURE 6: GILGIT (Danyor – G1)











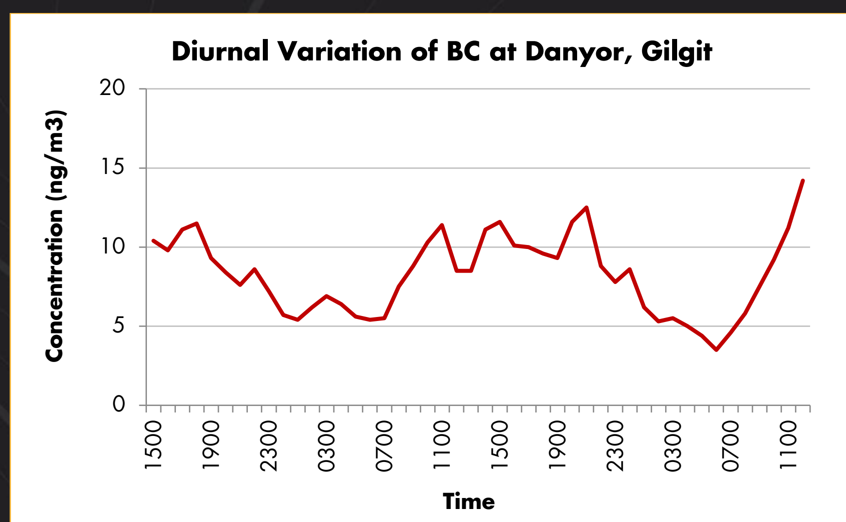


FIGURE 7: GILGIT (City Park near Gilgit Airport – G2)

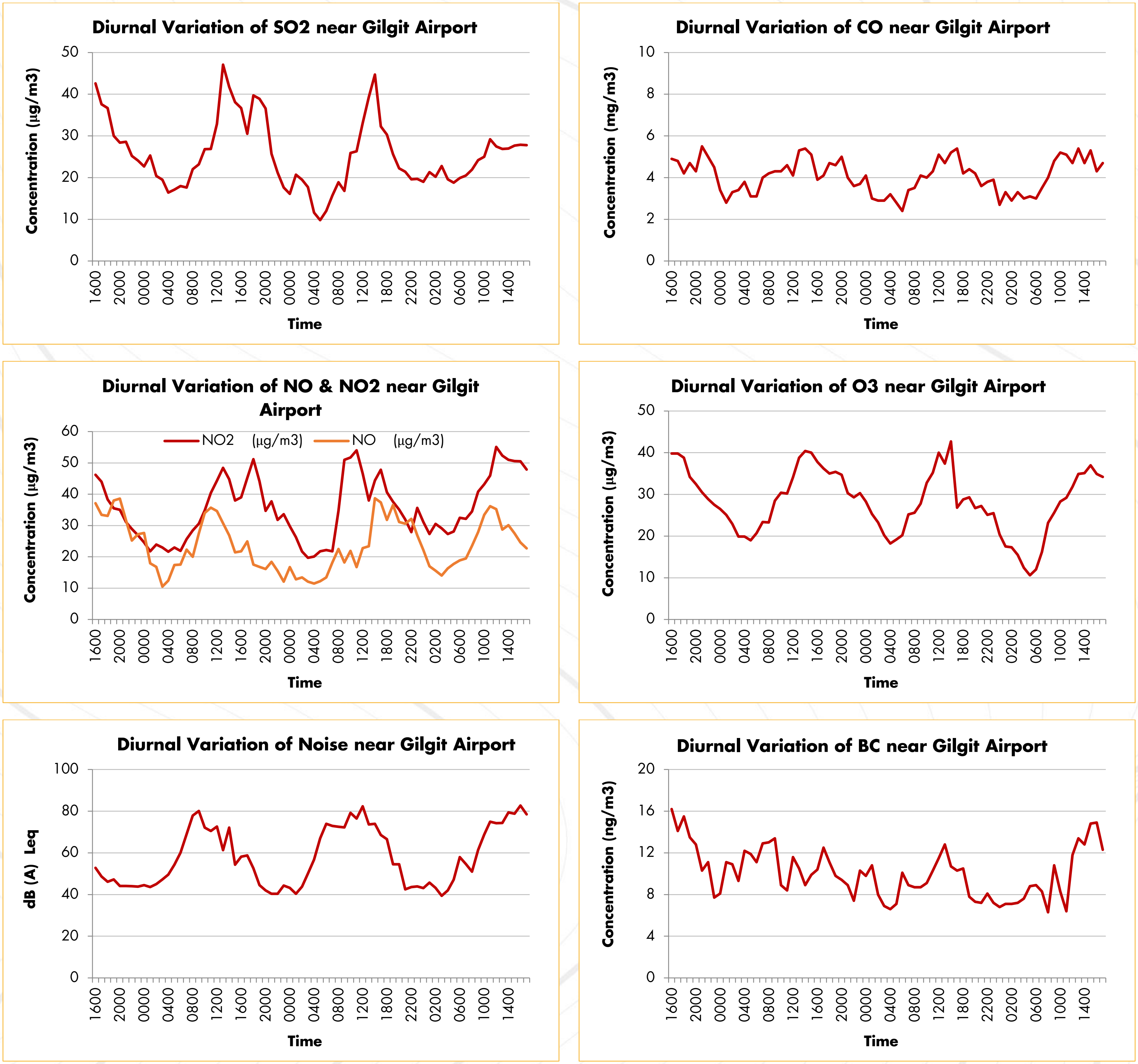


FIGURE 8: JAGLOT (J1)

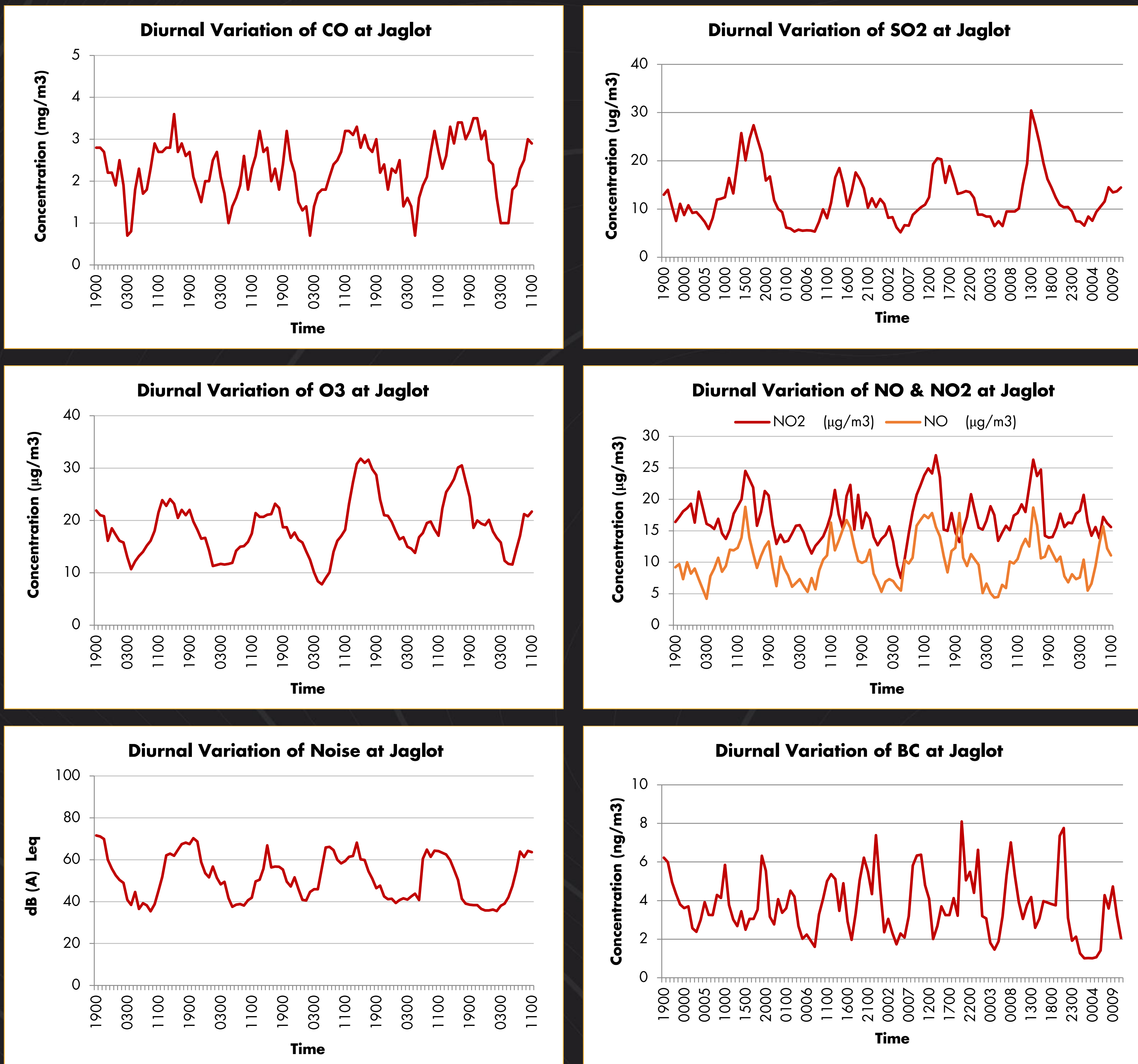
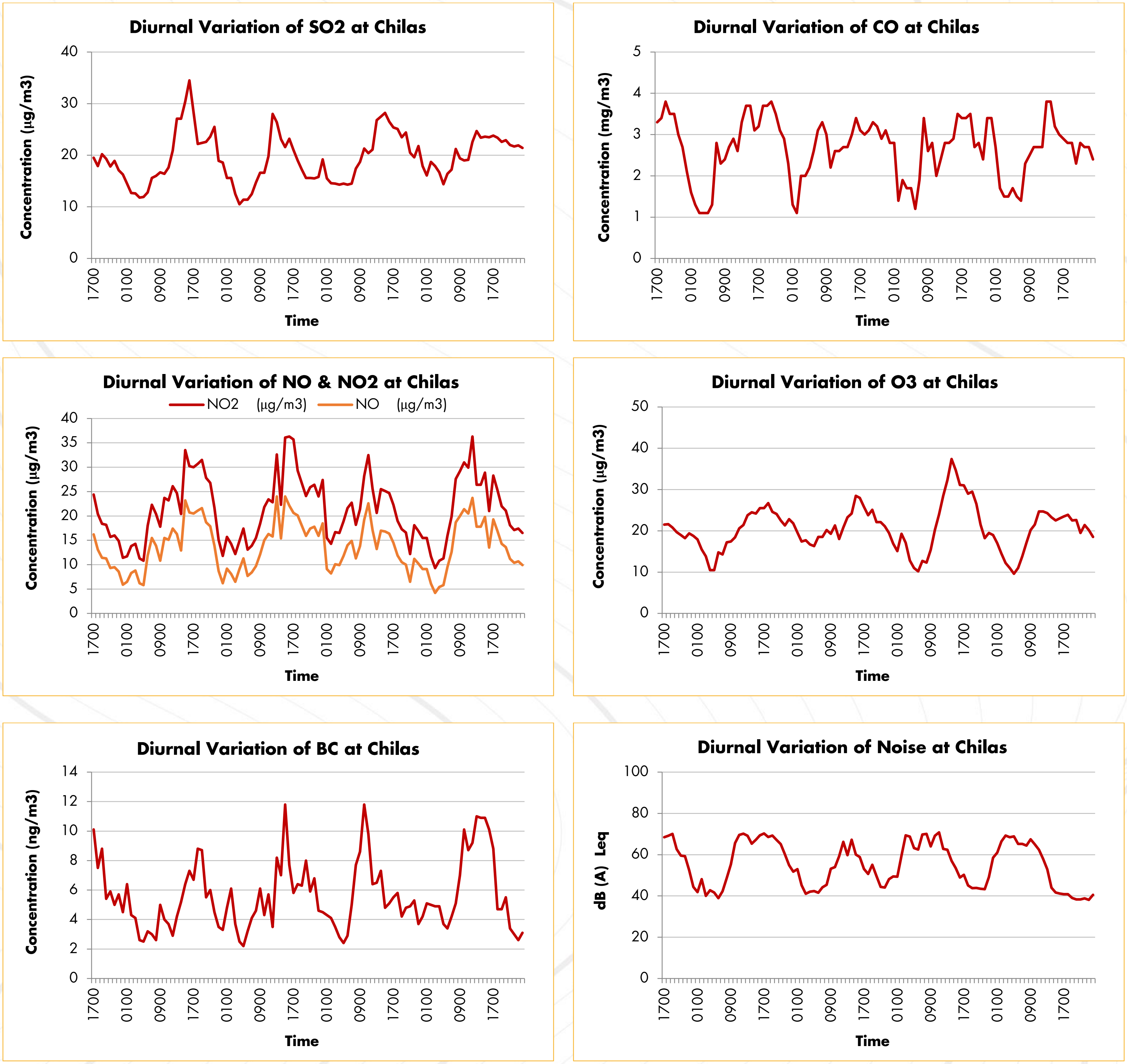


FIGURE 9: Chilas (C1)



Annex-III

Hourly Data of Air Pollutants and Noise Levels in GB during Summer

TABLE 1		SITE NAME: SOST CHECK POST (S1) COORDINATES: 36°41'28.48"N, 74°49'14.87"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
1	08/16/2020	1700	2.8	14.2	18.2	14.9	29.2	2.5	56.9
2	08/16/2020	1800	2.7	13	17	10.2	27.9	3.38	77.5
3	08/16/2020	1900	2.8	13.5	17.5	11.8	25.9	3.4	58.6
4	08/16/2020	2000	2.9	15.1	19.1	11.4	26.5	3.04	57.5
5	08/16/2020	2100	2.3	13.8	17.8	12.1	25.3	1.76	58.4
6	08/16/2020	2200	3.1	17.4	21.4	11.2	25.4	2.12	51.2
7	08/17/2020	2300	3.2	13.9	17.9	11.3	25.5	2	53.4
8	08/17/2020	0000	2.2	10.4	14.4	10.5	24.4	0.94	53.0
9	08/17/2020	0100	2.1	11.5	15.5	9.8	24.3	0.93	45.0
10	08/17/2020	0200	2.0	12.9	16.9	8.3	24.8	0.91	45.0
11	08/17/2020	0300	1.9	10.2	14.2	6.2	23.3	0.91	47.6
12	08/17/2020	0400	1.8	11.6	15.6	5.9	23.2	0.71	47.6
13	08/17/2020	0500	2.1	14.9	18.9	7.1	22.4	0.84	52.7
14	08/17/2020	0600	2.5	16.8	20.8	10.3	26.7	1.18	57.0
15	08/17/2020	0700	2.6	19.5	23.5	14.4	28.3	2.12	61.1
16	08/17/2020	0800	2.8	19.1	23.1	16.2	33.4	5.07	67.4
17	08/17/2020	0900	3.2	18.8	22.8	14.1	25.2	8.92	63.9
18	08/17/2020	1000	3.0	16.6	20.6	13.2	27.6	12.07	58.4
19	08/17/2020	1100	2.8	12.3	16.3	16.5	27.7	14.22	60.5
20	08/17/2020	1200	2.7	15.5	19.5	16.8	28.1	15.2	69.6
21	08/17/2020	1300	3.1	14.8	18.8	19.0	36.4	10.52	60.6
22	08/17/2020	1400	2.6	14.2	18.2	15.7	45.2	6.13	70.0
Max			3.2	19.5	23.5	19.0	45.2	15.2	77.5
Min			1.8	10.2	14.2	5.9	22.4	0.7	45.0
Avg			**2.6**	**14.5**	**18.5**	**12.1**	**27.6**	**4.5**	**58.3**

TABLE 2		SITE NAME: KHUDABAD (S2) COORDINATES: 36°41'16.12"N, 74°48'58.72"E								
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
1	08/17/2020	17:00	2.5	8	12	10.0	30.2	3.2	57.2
2	08/17/2020	18:00	2.7	11.1	15.1	11.4	31.3	3.3	55.9
3	08/17/2020	19:00	2.3	7.9	11.9	10.0	30.8	3.45	48.9
4	08/17/2020	20:00	2.6	9.7	13.7	10.8	28.2	3.32	49.6
5	08/17/2020	21:00	2.7	7.9	11.9	10.0	25.8	3.14	49.8
6	08/17/2020	22:00	2.7	6.5	10.5	9.4	23	3.05	43.5
7	08/17/2020	23:00	2.3	4.8	8.8	8.7	23	2.04	44.3
8	08/18/2020	0:00	1.9	6.5	10.5	9.4	22.5	2.05	42.7
9	08/18/2020	1:00	1.8	7.8	11.8	9.0	20.5	2.12	39.7
10	08/18/2020	2:00	1.4	9.6	13.6	8.8	28.2	2.58	40.5
11	08/18/2020	3:00	1.3	7.3	11.3	5.8	20.3	1.93	47.6
12	08/18/2020	4:00	1.3	4.8	8.8	8.7	20.2	2.03	47.3
13	08/18/2020	5:00	1.4	6.9	10.9	9.6	20.7	1.92	47.1
14	08/18/2020	6:00	1.8	9.1	13.1	10.6	21.2	3.88	48.8
15	08/18/2020	7:00	2.1	9.3	13.3	10.6	22.3	6.99	56.3
16	08/18/2020	8:00	2.8	12	16	11.9	22.2	12.87	55.4
17	08/18/2020	9:00	3.1	13.7	17.7	11.9	25.1	14.48	57.3
18	08/18/2020	10:00	2.7	17.9	21.9	13.4	30.8	16.23	57.2
19	08/18/2020	11:00	2.5	14.9	18.9	11.7	33.2	14.58	58.1
20	08/18/2020	12:00	2.4	16.9	20.9	14.2	35.8	11.43	57.3
21	08/18/2020	13:00	2.2	20.5	24.5	14.3	37	9.29	55.3
22	08/18/2020	14:00	2.7	19.8	23.8	17.4	40	9.36	55.7
23	08/18/2020	15:00	3.1	19.3	23.3	13.0	40.4	8.43	59.8
Max			3.1	20.5	24.5	17.4	40.4	16.2	59.8
Min			1.3	4.8	8.8	5.8	20.2	1.9	39.7
Avg			**2.3**	**11.0**	**15.0**	**10.9**	**27.5**	**6.2**	**51.1**

TABLE 3		SITE NAME: SOST - GIRCHA (S3) COORDINATES: 36°39'41.42"N, 74°50'21.25"E							
S. No	Date	Time	CO (mg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	NO (µg/m³)	O_3 (µg/m³)	BC (µg/m³)	Noise dBA
1	08/18/2020	18:00	2.3	15.7	19.7	14.4	27.7	4.43	58.7
2	08/18/2020	19:00	2.4	13.9	17.9	11.5	29.5	4.71	59.7
3	08/18/2020	20:00	2.5	13.3	17.3	15.5	30.6	3.61	51.8
4	08/18/2020	21:00	2.6	12.7	16.7	12.3	25.2	3.68	48.6
5	08/18/2020	22:00	2.8	13.6	17.6	12.8	25.7	3.3	48.0
6	08/18/2020	23:00	2.5	14.7	18.7	13.7	23.2	3.21	44.3
7	08/19/2020	0:00	2.1	18.2	22.2	15.1	21.7	2.83	44.2
8	08/19/2020	1:00	1.1	15.7	19.7	14.4	19.6	2.53	43.9
9	08/19/2020	2:00	1.5	14.9	18.9	13.5	16.9	2.64	45.5
10	08/19/2020	3:00	1.9	12.4	16.4	13.2	14.8	1.12	43.1
11	08/19/2020	4:00	1.8	11.2	15.2	11.9	13.9	1.53	43.2
12	08/19/2020	5:00	1.3	12.8	16.8	13.0	16.1	0.64	43.7
13	08/19/2020	6:00	0.8	12.4	16.4	13.9	17.4	0.62	45.1
14	08/19/2020	7:00	1.9	12.6	16.6	12.8	18.2	2.11	50.5
15	08/19/2020	8:00	1.9	12.5	16.5	11.4	22.7	4.59	54.2
16	08/19/2020	9:00	2.7	13.4	17.4	10.9	27.9	5.65	57.9
17	08/19/2020	10:00	2.7	15.7	19.7	13.3	29.6	4.24	67.2
18	08/19/2020	11:00	2.8	18.1	22.1	16.0	33.4	5.33	62.7
19	08/19/2020	12:00	2.6	14.7	18.7	11.7	30.5	4.77	66.6
20	08/19/2020	13:00	2.1	14.9	18.9	11.8	27.7	4.51	67.7
21	08/19/2020	14:00	1.9	21.4	25.4	16.3	30.5	5.07	60.9
22	08/19/2020	15:00	2.0	18.7	22.7	15.2	38.1	4.46	54.4
23	08/19/2020	16:00	2.1	17.8	21.8	13.9	36.7	4.22	52.1
24	08/19/2020	17:00	1.9	16.8	20.8	12.2	40.1	3.97	49.7
25	08/19/2020	18:00	2.2	15.1	19.1	13.1	37.2	2.77	49.2
26	08/19/2020	19:00	2.8	15.4	19.4	12.7	35.6	3.06	47.2
27	08/19/2020	20:00	2.7	16.2	20.2	13.3	33.8	2.2	46.0
28	08/19/2020	21:00	3.2	17.3	21.3	13.5	30.3	2.2	46.0
29	08/19/2020	22:00	2.9	15.5	19.5	12.8	30.5	2.24	45.4
30	08/19/2020	23:00	2.7	19	23	12.7	28.4	2.26	43.5

TABLE 3		SITE NAME: SOST - GIRCHA (S3) COORDINATES: 36°39'41.42"N, 74°50'21.25"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
31	08/20/2020	0:00	2.6	15.6	19.6	11.4	25.2	2.42	42.7
32	08/20/2020	1:00	2.2	14	18	10.6	23.1	2.35	42.8
33	08/20/2020	2:00	1.6	14.9	18.9	11.8	21.4	2.45	42.0
34	08/20/2020	3:00	1.0	12.2	16.2	10.7	23.7	1.22	42.8
35	08/20/2020	4:00	1.2	17.1	21.1	15.2	21.5	0.99	42.8
36	08/20/2020	5:00	0.9	13.8	17.8	12.4	18.2	1.15	45.6
37	08/20/2020	6:00	0.8	15.4	19.4	12.6	19	1.31	48.1
38	08/20/2020	7:00	2.0	17.2	21.2	12.4	21.2	2.55	51.3
39	08/20/2020	8:00	1.9	14.8	18.8	14.5	22.9	2.52	53.7
40	08/20/2020	9:00	1.9	14.8	18.8	13.1	24.4	2.84	56.8
41	08/20/2020	10:00	2.7	15.7	19.7	14.6	24.6	2.62	59.1
42	08/20/2020	11:00	3.1	14	18	12.6	25.9	2.98	57.6
43	08/20/2020	12:00	3.2	16.4	20.4	17.1	27.2	2.77	57.5
44	08/20/2020	13:00	3.1	17.1	21.1	17.4	29.2	2.78	57.6
45	08/20/2020	14:00	2.9	16.3	20.3	14.6	29.9	2.56	56.4
46	08/20/2020	15:00	2.7	15.1	19.1	13.2	34.1	2.64	54.3
47	08/20/2020	16:00	2.6	10	14	10.5	32	2.56	52.0
Max			3.2	21.4	25.4	17.4	40.1	5.7	67.7
Min			0.8	10.0	14.0	10.5	13.9	0.6	42.0
Avg			**2.2**	**15.1**	**19.1**	**13.3**	**26.3**	**2.9**	**51.1**

TABLE 4		SITE NAME: HUNZA - KARIMABABD (H1) COORDINATES: 36°18'59.07"N, 74°40'3.41"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
1	08/20/2020	20:00	3.0	15.2	25.2	17.8	29.2	5.5	63.7
2	08/20/2020	21:00	2.9	14.1	23.9	16.9	27.1	5.9	66.8
3	08/20/2020	22:00	2.6	15.5	22.2	15.8	27.3	4.4	63.1
4	08/20/2020	23:00	2.3	10.4	20.1	14.4	26.7	3.3	45.9
5	08/21/2020	0:00	2.4	10.7	27.1	19.0	25	4.7	43.4
6	08/21/2020	1:00	2.3	9.5	20.3	14.5	23.8	3.6	43.1
7	08/21/2020	2:00	2.3	8.9	22.6	12.1	22.4	3.3	43.9
8	08/21/2020	3:00	2.3	8.4	22.7	12.2	21.6	2.5	41.1
9	08/21/2020	4:00	2.5	9.8	21.9	11.8	21.7	3.0	40
10	08/21/2020	5:00	2.3	10.1	20.7	11.3	19.9	2.8	40.2
11	08/21/2020	6:00	2.4	11.4	21.3	11.6	19.3	2.4	40.7
12	08/21/2020	7:00	2.7	12.5	37.9	19.5	20.5	2.8	60.8
13	08/21/2020	8:00	2.8	15.8	33.7	17.6	22.1	3.2	63.9
14	08/21/2020	9:00	3.5	18.8	29.7	15.8	22.3	6.5	64.9
15	08/21/2020	10:00	2.7	22.4	28.3	15.1	22.8	10.4	62.9
16	08/21/2020	11:00	2.7	19.2	20	11.4	24.7	11.9	61.7
17	08/21/2020	12:00	3.4	19.3	28.9	15.4	29.1	5.4	61.7
18	08/21/2020	13:00	3.4	17.9	27	14.5	36.1	9.0	61.1
19	08/21/2020	14:00	3.6	23.8	31.1	16.4	41.2	10.5	63.2
20	08/21/2020	15:00	3.5	24.2	28.4	15.2	44.7	9.7	63.4
21	08/21/2020	16:00	3.4	27.7	23	12.2	44.8	7.9	65
22	08/21/2020	17:00	3.6	24.7	19.8	10.9	46.6	4.9	58.5
23	08/21/2020	18:00	3.3	26.1	22.5	12.0	38.3	7.7	60.1
24	08/21/2020	19:00	3.6	19.9	28.3	14.5	34.7	6.7	57.4
25	08/21/2020	20:00	3.4	15.5	23.3	12.4	31.2	5.5	58.7
26	08/21/2020	21:00	2.9	15.9	19.8	12.2	30.7	4.8	59.4
27	08/21/2020	22:00	2.6	13.6	17.6	13.4	30.9	4.7	66.3
28	08/21/2020	23:00	2.7	15.5	16.2	15.7	29.1	3.6	52.0
29	08/22/2020	0:00	2.7	13.1	15	13.6	27.1	4.2	49.2
30	08/22/2020	1:00	2.4	13.3	12.7	14.4	26.9	3.1	46.6

TABLE 4		SITE NAME: HUNZA - KARIMABABD (H1) COORDINATES: 36°18'59.07"N, 74°40'3.41"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	NO (µg/m^3)	O_3 (µg/m^3)	BC (µg/m^3)	Noise dBA
31	08/22/2020	2:00	2.3	12.3	11.9	14.6	24.9	2.4	45.7
32	08/22/2020	3:00	1.9	11.6	10.9	12.1	21.9	1.8	44.4
33	08/22/2020	4:00	2.1	10.2	11.3	13.3	20.1	2.3	44.3
34	08/22/2020	5:00	2.2	7.2	11.9	13.1	20.2	2.0	43.6
35	08/22/2020	6:00	2.6	12.4	15.3	12.3	20.9	2.6	43.6
36	08/22/2020	7:00	3.2	13.9	21.9	14.1	24.1	3.6	57.2
37	08/22/2020	8:00	3.5	14.2	27.6	18.5	22.6	3.8	56.2
38	08/22/2020	9:00	3.7	14.5	37.2	20.8	28.3	6.9	56.2
39	08/22/2020	10:00	3.2	17.1	29.8	17.1	29.1	5.4	58.5
40	08/22/2020	11:00	3.1	21.8	24	14.6	34.6	5.2	56.9
41	08/22/2020	12:00	3.3	22.8	19.6	12.3	38.6	8.8	58
42	08/22/2020	13:00	2.9	26.6	24.8	15.0	42.3	7.2	59.1
43	08/22/2020	14:00	3.0	23.8	32.1	13.6	47.2	11.2	59.2
44	08/22/2020	15:00	3.4	19.8	29.2	12.0	50.4	10.4	60.4
45	08/22/2020	16:00	2.8	20.6	20	12.5	49.1	9.2	62.3
46	08/22/2020	17:00	2.4	21	24.5	14.9	43.9	11.9	62.4
47	08/22/2020	18:00	2.9	19.2	23.3	14.2	41.2	6.1	65.2
48	08/22/2020	19:00	2.9	18.7	25.2	15.2	42.3	8.2	65.2
49	08/22/2020	20:00	2.9	19.9	18.5	11.7	37.3	6.8	63
50	08/22/2020	21:00	2.8	22	22	14.2	33.9	5.8	63.1
51	08/22/2020	22:00	3.0	13.7	26.6	16.9	27.3	5.2	63.4
52	08/22/2020	23:00	3.0	13.9	23.6	15.1	26	6.4	41.3
53	08/23/2020	0:00	2.9	12.4	21.9	14.2	24.1	4.1	42.5
54	08/23/2020	1:00	2.9	10.9	22.5	14.5	21.4	2.9	44.4
55	08/23/2020	2:00	2.8	10.5	19.9	13.0	21.6	3.0	44.5
56	08/23/2020	3:00	2.6	9.5	17.6	14.0	22.1	2.7	45.3
57	08/23/2020	4:00	2.6	8.3	15.6	16.3	21.5	2.9	44.8
58	08/23/2020	5:00	2.5	9.4	15.4	16.2	22	2.2	45.9
59	08/23/2020	6:00	2.3	13.6	11.9	14.2	20.8	2.8	44.3
60	08/23/2020	7:00	2.3	15.9	15.9	22.2	20.7	3.4	57

TABLE 4		SITE NAME: HUNZA - KARIMABABD (H1) COORDINATES: 36°18'59.07"N, 74°40'3.41"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
61	08/23/2020	8:00	2.8	14.4	19.2	24.1	25.7	3.9	59.2
62	08/23/2020	9:00	3.2	16.2	25.9	22.2	23	4.2	58.4
63	08/23/2020	10:00	3.0	16.8	25.3	21.8	26.9	3.8	62.2
64	08/23/2020	11:00	3.0	17.5	26.6	16.9	32.8	5.0	56.7
65	08/23/2020	12:00	3.3	25.2	27.9	17.6	33.8	9.0	62.6
66	08/23/2020	13:00	3.5	22.6	34.8	21.5	49.1	8.8	64.3
Max			3.7	27.7	37.9	24.1	50.4	11.9	66.8
Min			1.9	7.2	10.9	10.9	19.3	1.8	40.0
Avg			**2.8**	**16.1**	**22.8**	**15.1**	**29.7**	**5.4**	**55.0**

TABLE 5		SITE NAME: HUNZA - ALIABAD (H2) COORDINATES: 36°18'21.14"N 74°36'40.72"E							
S. No	Date	Time	CO (mg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	NO (µg/m³)	O_3 (µg/m³)	BC (µg/m³)	Noise dBA
1	08/23/2020	14:00	2.7	15.8	20.1	11.8	43.8	6.9	58.9
2	08/23/2020	15:00	3.0	17.8	20.9	12.1	49.2	6.3	59.4
3	08/23/2020	16:00	3.3	19.1	23.8	13.5	49.7	5.4	60.5
4	08/23/2020	17:00	3.4	15.9	19.2	11.3	45.6	4.2	59.5
5	08/23/2020	18:00	3.7	20.1	18.1	10.8	41.8	5.0	60.4
6	08/23/2020	19:00	3.5	20.5	18.3	10.9	39.1	5.7	53.1
7	08/23/2020	20:00	3.1	22.3	21.9	12.6	36.4	3.8	56
8	08/23/2020	21:00	3.7	18.8	21.5	12.4	30	3.4	55.6
9	08/23/2020	22:00	2.8	18.2	22.2	12.8	28.7	2.7	57.7
10	08/23/2020	23:00	2.5	17.4	18.6	11.0	26.1	2.5	44.7
11	08/24/2020	0:00	2.1	13.2	16.3	9.9	22.7	2.5	47.3
12	08/24/2020	1:00	2.4	10.6	16	10.8	22.6	2.5	47.2
13	08/24/2020	2:00	2.1	9.5	14.8	10.1	22.2	2.5	43.4
14	08/24/2020	3:00	2.0	6.7	14.7	10.0	22.1	2.5	43.4
15	08/24/2020	4:00	1.8	9.2	17.1	11.4	22	2.5	49
16	08/24/2020	5:00	1.6	9.7	16.8	11.2	22.3	2.9	45.3
17	08/24/2020	6:00	1.9	7.5	20.2	13.2	23.2	2.7	40.9
18	08/24/2020	7:00	2.3	8.2	25.9	16.4	23.7	3.7	62.4
19	08/24/2020	8:00	2.4	11.8	28.4	17.8	24.3	3.1	64.4
20	08/24/2020	9:00	2.4	15.3	27.8	17.5	24.8	6.4	73.6
21	08/24/2020	10:00	2.9	20.2	25	15.9	27.4	4.5	64.5
22	08/24/2020	11:00	3.6	19.8	22.8	14.6	26	3.8	74.8
23	08/24/2020	12:00	3.6	20.9	20.8	11.9	31.7	4.0	71.9
24	08/24/2020	13:00	2.7	18.6	20.6	11.8	37.9	3.7	65.5
25	08/24/2020	14:00	2.9	21.9	16.3	9.8	40.3	4.2	62.5
26	08/24/2020	15:00	2.8	26.4	17.2	10.2	44.6	3.1	61.2
27	08/24/2020	16:00	2.7	17.2	19	11.1	40.7	5.1	54.2
28	08/24/2020	17:00	2.7	21.9	19.2	11.1	36.4	4.2	51.7
29	08/24/2020	18:00	2.3	25.6	25.3	14.0	41.2	10.3	51.8
30	08/24/2020	19:00	2.9	23.2	23.3	13.0	34.6	4.5	45.6

TABLE 5		SITE NAME: HUNZA - ALIABAD (H2) COORDINATES: 36°18'21.14"N 74°36'40.72"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
31	08/24/2020	20:00	2.4	24.6	22.5	12.7	30.9	5.8	46.4
32	08/24/2020	21:00	2.7	22.7	22.4	12.6	28.4	4.4	64.7
33	08/24/2020	22:00	2.2	26.9	21.8	12.3	25.7	3.4	61.8
34	08/25/2020	23:00	2.1	21.7	21	12.0	24.6	3.4	44.6
35	08/25/2020	0:00	2.2	17.8	26.5	15.9	23.4	3.4	39.7
36	08/25/2020	1:00	2.0	13.6	23.7	14.4	21.6	3.1	38.3
37	08/25/2020	2:00	2.0	13.3	20.8	12.9	22.2	3.1	44.5
38	08/25/2020	3:00	1.9	12.5	20.4	12.7	20.6	3.2	42.5
39	08/25/2020	4:00	2.0	11.7	19	11.9	20.7	3.2	47.2
40	08/25/2020	5:00	2.5	11.1	17.7	11.3	21.3	3.2	45.1
41	08/25/2020	6:00	2.8	12.8	21.5	13.3	26.1	3.6	49.3
42	08/25/2020	7:00	3.3	14.4	20.1	12.5	25.6	3.8	74.1
43	08/25/2020	8:00	3.6	13.4	25.3	15.3	26.6	4.1	74
44	08/25/2020	9:00	2.9	15.5	20.2	12.6	28.2	4.1	73.2
45	08/25/2020	10:00	3.6	15.9	22.4	13.7	32.3	5.5	68.4
46	08/25/2020	11:00	3.4	19.6	34.9	20.4	33.3	8.2	67.3
47	08/25/2020	12:00	2.7	17.6	38.4	22.2	38	5.3	59.1
Max			3.7	26.9	38.4	22.2	49.7	10.3	74.4
Min			1.6	6.7	14.7	9.8	20.6	2.5	38.3
Avg			**2.6**	**16.8**	**21.5**	**13.0**	**30.4**	**4.2**	**55.8**

TABLE 6		SITE NAME: GILGIT – DANYOR (G1) COORDINATES: 35°54'19.10"N 74°23'35.36"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
1	08/25/2020	16:00	4.5	21.9	32.4	29.8	43.9	6.9	78.2
2	08/25/2020	17:00	4.2	26.6	24.6	26.9	42.4	8.9	76.6
3	08/25/2020	18:00	4.4	25.8	31.7	23.5	42.6	9.5	78.7
4	08/25/2020	19:00	3.8	27.3	42.8	22.2	39.2	11.4	67.4
5	08/25/2020	20:00	3.7	27.8	36.5	20.7	35.5	14.3	64.3
6	08/25/2020	21:00	3.6	31	32.4	18.2	35.8	11.1	59.2
7	08/25/2020	22:00	3.4	28.6	32.9	15.5	33.7	7.9	58.1
8	08/25/2020	23:00	3.0	27.9	27.6	12.8	33.4	8.9	48
9	08/26/2020	0:00	3.4	24.4	21.3	12.2	28	7.8	45.2
10	08/26/2020	1:00	2.8	21.6	21.9	11.5	29.4	6.5	48.6
11	08/26/2020	2:00	2.3	25.3	18.5	11.6	29.5	5.2	52
12	08/26/2020	3:00	2.0	26.4	16.2	10.3	29.2	5.5	51.5
13	08/26/2020	4:00	1.9	26.5	12.6	10.4	30.3	5.5	45.2
14	08/26/2020	5:00	2.1	26.3	13.7	10.8	29.5	6.0	46.2
15	08/26/2020	6:00	2.5	26.9	19.1	13.2	29.4	11.9	47.1
16	08/26/2020	7:00	3.0	29.7	25.9	16.2	30.9	7.8	73.7
17	08/26/2020	8:00	3.9	34.8	30.2	18.0	30.1	7.6	77
18	08/26/2020	9:00	3.1	31.4	29.9	26.6	37.3	7.2	71.7
19	08/26/2020	10:00	4.3	23.1	28.9	17.5	46.1	5.8	69.7
20	08/26/2020	11:00	3.7	19.6	26.1	17.0	49.2	6.8	64.8
21	08/26/2020	12:00	3.6	29.2	33.5	20.5	45.5	7.9	59.5
22	08/26/2020	13:00	3.2	21.9	29	18.4	43.1	9.0	62.3
23	08/26/2020	14:00	3.8	20.6	33.6	20.6	46.9	8.0	64
24	08/26/2020	15:00	3.4	25.5	38.4	22.9	44.5	9.7	57.7
25	08/26/2020	16:00	3.1	25.7	30.8	19.3	40.6	8.5	53.5
26	08/26/2020	17:00	3.5	26.8	38.4	22.9	36.1	12.4	54.6
27	08/26/2020	18:00	4.3	24.7	39.1	27.9	39.2	14.3	60.4
28	08/26/2020	19:00	4.1	26.1	35.5	26.2	33.2	19.9	70.4
29	08/26/2020	20:00	3.9	24.6	39.4	24.3	25.3	18.1	76.7
30	08/26/2020	21:00	3.6	24	32.1	20.6	24	14.2	54.1

TABLE 6		SITE NAME: GILGIT – DANYOR (G1) COORDINATES: 35°54'19.10"N 74°23'35.36"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
31	08/26/2020	22:00	3.4	22.9	33.9	21.5	23	12.9	56.7
32	08/26/2020	23:00	2.8	20.2	31.9	20.5	25.7	10.4	40.9
33	08/27/2020	0:00	2.3	17.4	24.7	16.9	24.1	7.3	46.7
34	08/27/2020	1:00	1.7	19.9	23.9	16.5	20.5	5.7	43.7
35	08/27/2020	2:00	1.6	20.4	19.3	14.2	18.4	5.3	48.9
36	08/27/2020	3:00	1.5	18.2	19.5	14.3	19.5	5.0	41.8
37	08/27/2020	4:00	1.7	18.9	15.6	12.3	18.1	4.8	46.8
38	08/27/2020	5:00	1.8	22.5	15.2	12.1	18.4	4.9	45.3
39	08/27/2020	6:00	2.7	26	17.2	13.1	17.8	12.9	45.5
40	08/27/2020	7:00	2.3	30.9	21.2	15.1	23	9.3	60.9
41	08/27/2020	8:00	2.6	30.5	25.3	17.2	27.4	7.7	57.3
42	08/27/2020	9:00	3.1	31.6	31.5	20.3	21.8	6.5	55.8
43	08/27/2020	10:00	3.5	29.3	29.8	19.5	23	5.4	54.1
44	08/27/2020	11:00	3.6	32.6	30.2	24.7	30.2	4.6	62.3
45	08/27/2020	12:00	3.3	30.1	33.7	23.4	31	5.3	62.1
46	08/27/2020	13:00	3.9	28.3	31.8	23.0	42.2	6.1	58.3
47	08/27/2020	14:00	3.7	29.8	30.4	21.3	51.3	5.2	63.2
48	08/27/2020	15:00	3.3	31.4	31.7	20.4	45.8	5.3	77.1
Max			4.5	34.8	42.8	29.8	51.3	19.9	78.7
Min			1.5	17.4	12.6	10.3	17.8	4.6	40.9
Avg			**3.1**	**25.9**	**28.0**	**18.6**	**32.6**	**8.5**	**58.4**

TABLE 7			SITE NAME: GILGIT – Near Airport(G2) COORDINATES: 35°54'35.90"N 74°20'10.37"E						
S. No	Date	Time	CO (mg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	NO (µg/m^3)	O_3 (µg/m^3)	BC (µg/m^3)	Noise dBA
1	08/27/2020	18:00	3.4	25.7	41.8	17.4	54.4	8.2	65.4
2	08/27/2020	19:00	3.0	24.6	40.8	16.8	52.9	7.8	86.3
3	08/27/2020	20:00	3.1	24.5	35.7	14.1	46.4	7.9	67.4
4	08/27/2020	21:00	2.9	22.4	33.1	16.3	42.1	6.6	66.4
5	08/27/2020	22:00	3.0	21.2	28.1	16.3	38.6	5.4	67.3
6	08/27/2020	23:00	2.6	20.3	24.9	16.2	33.4	5.2	50.0
7	08/28/2020	0:00	2.2	20.1	21.6	15.5	32.8	3.9	52.3
8	08/28/2020	1:00	1.9	19.4	20.8	14.5	31.4	2.4	51.8
9	08/28/2020	2:00	1.6	16.4	22.5	15.3	29.5	1.5	43.9
10	08/28/2020	3:00	1.5	17.3	19.4	15.8	24.4	2.2	43.9
11	08/28/2020	4:00	1.8	14.6	22.3	16.2	34.3	2.2	46.5
12	08/28/2020	5:00	2.0	15.8	23.5	18.8	29.1	1.5	46.4
13	08/28/2020	6:00	2.7	18.8	24	15.3	30.4	4.4	51.6
14	08/28/2020	7:00	3.2	20.6	27.3	16.7	37.2	5.2	67.6
15	08/28/2020	8:00	3.5	21.3	25.7	16.0	45	4.8	72.6
16	08/28/2020	9:00	3.3	21.6	27.2	20.9	54.2	5.8	78.4
17	08/28/2020	10:00	3.6	20.6	28.6	17.2	59.1	5.0	74.8
18	08/28/2020	11:00	4.3	21.8	38.2	21.4	56	4.6	69.4
19	08/28/2020	12:00	4.5	25.7	27.5	17.4	57.7	8.4	71.4
20	08/28/2020	13:00	4.4	29.1	41.1	23.7	49.9	9.3	80.6
21	08/28/2020	14:00	4.2	32.9	48.4	21.5	44.8	10.8	71.5
22	08/28/2020	15:00	4.8	34.4	43.9	19.4	41.7	12.9	80.9
23	08/28/2020	16:00	5.1	43.7	38.8	16.6	44.3	13.3	77.6
24	08/28/2020	17:00	4.6	38.7	38.5	17.2	45.4	14.9	71.2
25	08/28/2020	18:00	4.1	32.3	35.9	20.4	42.7	13.6	68.2
26	08/28/2020	19:00	4.0	16.7	35.2	20.1	37.4	13.6	66.9
27	08/26/2020	20:00	3.9	16.6	41.7	23.0	35.6	10.5	59.9
28	08/26/2020	21:00	3.4	14.3	33.4	19.4	28.2	11.2	47.4

TABLE 7		SITE NAME: GILGIT – Near Airport(G2) COORDINATES: 35°54'35.90"N 74°20'10.37"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
29	08/28/2020	22:00	3.6	13.3	26.6	16.4	24.5	10.9	47.5
30	08/28/2020	23:00	3.6	11.7	20.8	15.4	17.9	8.3	41.3
31	08/29/2020	0:00	2.7	12.8	19.1	14.5	14.1	6.0	42.1
32	08/29/2020	1:00	2.3	10.3	19.5	14.7	14.4	6.4	40.4
33	08/29/2020	2:00	2.3	10.9	18.6	14.2	13.9	6.1	37.5
34	08/29/2020	3:00	2.0	8.8	15.7	12.7	14.3	4.8	38.3
35	08/29/2020	4:00	2.1	9.4	15.5	12.6	12.6	4.6	45.4
36	08/29/2020	5:00	2.1	9.7	22	16.1	13.1	5.3	52.0
37	08/29/2020	6:00	2.6	10.9	24.1	16.1	13.2	6.6	58.2
38	08/29/2020	7:00	3.1	16.3	30.8	19.2	14.2	7.9	71.2
39	08/29/2020	8:00	4.0	20.1	34.3	17.8	16.6	10.1	75.9
40	08/29/2020	9:00	4.2	18.4	28.1	19.9	19	9.2	79.8
41	08/29/2020	10:00	4.0	22.4	29.2	20.5	19.8	8.8	78
42	08/29/2020	11:00	4.4	20.6	37.5	25.2	22.9	9.1	79.8
43	08/29/2020	12:00	4.2	23.5	32	22.1	23.7	10.2	79.7
44	08/29/2020	13:00	4.0	24.6	28.5	20.1	24.8	8.3	78.9
45	08/29/2020	14:00	4.5	30	34.1	23.3	38.7	6.8	74.1
46	08/29/2020	15:00	4.6	34.3	42.9	25.2	42.1	9.6	73
47	08/29/2020	16:00	4.7	27.9	50.5	19.3	41.6	9.9	69.4
48	08/29/2020	17:00	5.0	25.9	42.8	18.5	35.1	8.9	66.1
49	08/29/2020	18:00	4.7	24.7	33.8	20.4	31.2	10.6	60.7
50	08/29/2020	19:00	4.9	24.6	30.9	19.5	30.9	13.6	54
51	08/29/2020	20:00	4.1	26.9	29.4	18.8	28.4	12.9	49.8
52	08/29/2020	21:00	3.3	24.6	24.6	16.4	25	8.5	47.3
53	08/29/2020	22:00	3.1	28.3	19.5	14.0	14.9	7.1	48.4
54	08/29/2020	23:00	3.0	24.5	16.2	12.4	17.6	5.4	35.3
55	08/30/2020	0:00	Monitoring stopped due to rain						
56	08/30/2020	1:00							

TABLE 7		SITE NAME: GILGIT – Near Airport(G2) COORDINATES: 35°54'35.90"N 74°20'10.37"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
57	08/30/2020	2:00	0.5	3.4	6.5	3.1	4.9	0.7	34.9
58	08/30/2020	3:00	0.6	3.5	6.8	3.3	4.3	0.7	35.7
59	08/30/2020	4:00	0.6	2.3	6.9	4.3	5.6	0.7	34.7
60	08/30/2020	5:00	1.0	2.9	8.7	4.2	9.5	0.8	36.2
Max			5.1	43.7	50.5	25.2	59.1	14.9	86.3
Min			0.5	2.3	6.5	3.1	4.3	0.7	34.7
Avg			**3.3**	**20.3**	**28.4**	**16.9**	**30.5**	**7.3**	**59.7**

TABLE 8		SITE NAME: JAGLOT (J1) COORDINATES: 35°41'6.89"N, 74°38'0.47"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	NO (µg/m^3)	O_3 (µg/m^3)	BC (µg/m^3)	Noise dBA
1	08/30/2020	22:00	2.92	14.5	19.9	15.8	30.8	3.5	57.6
2	08/30/2020	23:00	2.72	12.2	18.3	14.8	28.7	3.7	78.1
3	08/31/2020	0:00	2.62	12.1	17.2	12.7	25.5	3.3	59.2
4	08/31/2020	1:00	2.62	11.4	16.1	12.4	21.7	3.4	58.2
5	08/31/2020	2:00	1.82	9.4	15.4	10.7	20.7	2.6	59.1
6	08/31/2020	3:00	1.42	10.3	14.8	8.2	20.4	2.1	51.8
7	08/31/2020	4:00	1.92	7.6	13.3	7.6	19.8	2.1	54.1
8	08/31/2020	5:00	2.32	8.8	11.7	7.8	19.2	1.1	57.2
9	08/31/2020	6:00	2.92	11.8	12.9	10.1	20.7	1.9	52.1
10	08/31/2020	7:00	3.32	13.6	18.6	13.4	19.8	3.8	52.1
11	08/31/2020	8:00	3.72	14.3	22.7	14.1	21.3	4.0	54.7
12	08/31/2020	9:00	3.82	14.6	25.3	15.7	19.6	4.3	54.6
13	08/31/2020	10:00	3.32	13.6	22.8	14.5	20.4	8.0	59.8
14	08/31/2020	11:00	3.42	14.8	19.2	12.9	25.6	7.0	60.3
15	08/31/2020	12:00	3.56	18.7	19.1	12.8	26.5	6.7	64.5
16	08/31/2020	13:00	3.82	18.1	24.2	15.2	27.1	5.1	70.8
17	08/31/2020	14:00	3.73	15.9	29.4	18.2	31.6	6.5	67.2
18	08/31/2020	15:00	3.47	17.4	20.9	14.0	33.2	4.8	61.8
19	08/31/2020	16:00	3.02	16.7	27.7	12.5	33.9	5.3	63.8
20	08/31/2020	17:00	3.32	18.7	30.2	13.1	31.8	4.4	73.0
21	08/31/2020	18:00	3.11	15.3	33.8	20.3	32.1	4.9	63.9
22	08/31/2020	19:00	2.32	15.7	23.2	15.2	31.4	4.6	73.3
23	08/31/2020	20:00	2.4	15.6	20.2	13.7	28.9	3.5	70.0
24	08/31/2020	21:00	1.52	13.3	20.3	13.8	27.8	3.7	63.6
25	08/31/2020	22:00	1.92	12.3	18.4	12.8	27.2	2.0	60.6
26	08/31/2020	23:00	1.32	13.7	21.7	14.4	25.2	2.9	59.3
27	09/01/2020	0:00	1.82	12.8	16.3	11.8	25.6	3.0	52.3
28	09/01/2020	1:00	1.32	11.5	15.1	11.2	25.8	2.3	49.8
29	09/01/2020	2:00	1.52	9.9	14.9	11.1	23.8	1.7	49.9
30	09/01/2020	3:00	1.32	9.6	14.4	10.9	21.3	1.6	43.7

TABLE 8		SITE NAME: JAGLOT (J1) COORDINATES: 35°41'6.89"N, 74°38'0.47"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	NO (µg/m^3)	O_3 (µg/m^3)	BC (µg/m^3)	Noise dBA
31	09/01/2020	4:00	1.42	9.0	13.8	10.6	21.7	1.4	44.5
32	09/01/2020	5:00	1.52	8.5	15	11.2	23.9	1.7	42.8
33	09/01/2020	6:00	1.22	8.9	18.9	13.1	24.4	2.8	39.9
34	09/01/2020	7:00	2.52	8.5	24.2	15.7	24.5	4.6	40.7
35	09/01/2020	8:00	3.02	8.4	34.8	20.8	27.3	5.8	47.8
36	09/01/2020	9:00	3.12	9.1	25.7	16.4	29.6	6.5	54.4
37	09/01/2020	10:00	3.22	11.2	26.1	16.6	37.6	7.6	60.6
38	09/01/2020	11:00	2.82	12.6	21.2	14.2	39.7	4.4	63.6
39	09/01/2020	12:00	1.82	14.9	19.5	13.4	41.2	4.0	68.3
40	09/01/2020	13:00	2.62	16.4	19.5	13.4	41.6	4.5	72.2
41	09/01/2020	14:00	3.32	18.5	18.9	13.1	43.7	4.7	70.4
42	09/01/2020	15:00	3.62	19.2	20.3	13.8	47.5	6.0	72.2
43	09/01/2020	16:00	3.52	16.7	21.4	14.3	45.6	8.9	72.1
44	09/01/2020	17:00	3.32	15.2	19.6	13.4	40.2	10.7	71.3
45	09/01/2020	18:00	3.52	15.6	21.3	14.2	37.9	7.3	66.5
46	09/01/2020	19:00	3.6	13.6	23.6	15.4	38.1	4.8	65.4
47	09/01/2020	20:00	3.12	13.2	19.5	13.4	33.9	5.0	61.8
48	09/01/2020	21:00	3.52	12.6	24.1	15.6	28.1	3.6	58.5
49	09/01/2020	22:00	2.62	13.0	19.7	13.5	26.2	3.9	53.1
50	09/01/2020	23:00	1.92	12.1	18.7	13.0	23.7	3.6	46.4
51	09/02/2020	0:00	1.52	11.8	15.9	11.6	23.5	3.5	42.2
52	09/02/2020	1:00	2.42	11.5	13.4	10.4	21.2	3.6	39.7
53	09/02/2020	2:00	1.72	10.5	14.1	10.7	20.2	2.4	40.8
54	09/02/2020	3:00	1.32	8.6	13.6	10.5	17.1	3.3	37.7
55	09/02/2020	4:00	1.22	9.6	15	11.2	17.4	3.3	37.7
56	09/02/2020	5:00	1.32	9.7	14.7	11.0	17.7	3.4	37.6
57	09/02/2020	6:00	2.72	10.9	16.4	11.8	17.2	3.5	37.3
58	09/02/2020	7:00	3.22	10.4	18.5	12.9	17.6	4.3	38.1
59	09/02/2020	8:00	3.32	13.8	23.2	15.2	22.3	3.7	37.1
60	09/02/2020	9:00	2.82	15.5	22	14.6	24.5	3.8	38.6

TABLE 8		SITE NAME: JAGLOT (J1) COORDINATES: 35°41'6.89"N, 74°38'0.47"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
61	09/02/2020	10:00	2.22	19.0	29.3	18.1	26	4.2	40.8
62	09/02/2020	11:00	2.82	17.7	21.3	14.2	28.3	4.5	43.2
63	09/02/2020	12:00	2.82	15.5	29.3	18.1	30.6	4.5	47.8
64	09/02/2020	13:00	3.22	17.8	19.9	13.6	34.7	4.4	53.7
65	09/02/2020	14:00	2.82	18.3	19.2	13.2	36.9	5.8	62.6
66	09/02/2020	15:00	3.92	18.1	15.8	12.5	36.2	5.0	71.5
67	09/02/2020	16:00	2.92	20.8	21.2	15.6	38.8	5.4	73.7
68	09/02/2020	17:00	2.72	22.1	24.5	17.4	36.8	6.5	57.1
69	09/02/2020	18:00	2.62	21.4	22.8	16.5	30.6	8.9	61.8
70	09/02/2020	19:00	2.02	21.0	31.6	21.5	27.3	8.1	58.3
71	09/02/2020	20:00	1.62	21.8	24.3	17.3	25.6	5.3	69.4
72	09/02/2020	21:00	1.62	17.6	19.2	14.4	22.6	2.7	59.9
73	09/02/2020	22:00	1.82	13.8	19.3	14.5	23.3	2.6	64.5
74	09/02/2020	23:00	1.52	11.1	15.7	12.4	22.3	2.5	52.5
75	09/03/2020	0:00	1.52	11.6	18.1	13.8	19.7	2.5	51.1
76	09/03/2020	1:00	1.42	11.6	12	10.3	19.3	2.5	49.4
77	09/03/2020	2:00	1.82	11.4	15	10.8	20.4	2.4	44.6
78	09/03/2020	3:00	2.02	11.5	12.9	9.9	19.5	2.5	40.3
79	09/03/2020	4:00	1.52	10.7	13.3	10.0	18.3	2.7	37.7
80	09/03/2020	5:00	2.22	11.2	14.8	10.7	19.4	2.5	38.1
81	09/03/2020	6:00	2.52	11.3	16	11.3	21	4.0	39.3
82	09/03/2020	7:00	3.32	12.2	18.7	12.5	28.8	6.3	38.6
83	09/03/2020	8:00	2.92	14.9	18.4	12.4	35.5	5.1	48.2
84	09/03/2020	9:00	2.82	14.3	18.3	13.9	31.9	5.3	59.3
85	09/03/2020	10:00	3.42	15.5	18.8	14.2	35.6	5.5	63.4
86	09/03/2020	11:00	3.62	15.9	22.8	16.5	39.3	5.6	69.6
87	09/03/2020	12:00	3.32	17.7	20.3	15.1	43.3	5.2	61.6
88	09/03/2020	13:00	3.22	18.6	22.8	16.5	39.1	5.2	61.9
89	09/03/2020	14:00	3.02	20.4	22.7	16.4	44.8	5.1	64.6
90	09/03/2020	15:00	3.72	26.0	23.2	16.7	47.2	7.8	69.8

TABLE 8		SITE NAME: JAGLOT (J1) COORDINATES: 35°41'6.89"N, 74°38'0.47"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
91	09/03/2020	16:00	3.92	26.5	22	16.0	47.8	11.3	73.3
92	09/03/2020	17:00	3.92	27.9	22.2	15.1	47.7	5.1	67.5
93	09/03/2020	18:00	3.42	27.6	24.6	16.4	48	5.4	62.3
94	09/03/2020	19:00	3.92	25.4	28.8	18.5	43.1	5.6	57.5
95	09/03/2020	20:00	3.52	23.0	21.5	14.8	34.6	5.2	69.1
96	09/03/2020	21:00	3.42	21.5	18.8	13.4	31.9	3.2	61.8
97	09/03/2020	22:00	2.92	19.4	24.8	16.5	26.5	2.6	64.2
98	09/03/2020	23:00	2.02	18.8	18.3	13.1	24.6	3.6	58.0
99	09/04/2020	0:00	1.52	13.1	25	16.6	24.2	3.4	47.3
100	09/04/2020	1:00	1.32	13.7	19.8	15.4	21.8	2.8	51.8
101	09/04/2020	2:00	1.22	12.5	19.3	15.1	21.2	1.9	46.8
102	09/04/2020	3:00	1.32	12.6	15.7	12.9	20.3	2.2	42.1
103	09/04/2020	4:00	1.42	10.4	15.8	13.0	19.3	1.3	38.7
104	09/04/2020	5:00	1.52	13.1	17.3	13.9	20.5	1.1	37.6
105	09/04/2020	6:00	2.22	12.8	16.2	13.2	24.4	1.6	38.2
106	09/04/2020	7:00	2.92	13.5	17	13.7	25	2.4	39.3
107	09/04/2020	8:00	2.52	12.9	23.8	17.8	26.2	2.6	41.9
108	09/04/2020	9:00	2.82	15.8	24.9	18.5	34.6	4.7	53.0
109	09/04/2020	10:00	3.42	14.2	26.6	19.5	35.5	7.6	60.6
110	09/04/2020	11:00	3.92	16.4	26	19.1	37.6	6.3	70.1
Max			3.9	27.9	34.8	21.5	48.0	11.3	78.1
Min			1.2	7.6	11.7	7.6	17.1	1.1	37.1
Avg			**2.6**	**14.7**	**20.2**	**14.0**	**28.7**	**4.3**	**55.4**

TABLE 9		SITE NAME: CHILAS (C1) COORDINATES: 35°25'30.41"N, 74°5'40.50"E							
S. No	Date	Time	CO (mg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	NO (µg/m³)	O_3 (µg/m³)	BC (µg/m³)	Noise dBA
1	09/04/2020	2000	1.9	19.7	17.7	13.2	29.6	5.6	66.8
2	09/04/2020	2100	1.7	18.4	19.8	14.5	27.1	5.0	65.3
3	09/04/2020	2200	1.4	17.8	18.3	13.6	28	3.4	67.8
4	09/04/2020	2300	1.3	19.3	15.8	12.0	26.8	3.7	67.5
5	09/05/2020	0000	1.4	15.5	13.3	10.5	26.8	3.7	64.4
6	09/05/2020	0100	1.4	13.9	13.2	10.4	27.3	3.7	63.2
7	09/05/2020	0200	1.3	13.3	12.9	10.2	26.8	2.8	55.8
8	09/05/2020	0300	1.1	12.5	11.7	9.5	26.7	2.9	47.7
9	09/05/2020	0400	1.0	12.6	12.7	10.1	25.2	1.2	43.8
10	09/05/2020	0500	1.0	11.5	12.1	9.7	25.2	2.8	49.1
11	09/05/2020	0600	2.0	11.9	12.5	9.9	25.9	4.5	41.0
12	09/05/2020	0700	1.8	12.8	20.9	10.2	26.6	7.7	43.8
13	09/05/2020	0800	1.7	13.8	22.2	10.9	26.6	10.9	42.7
14	09/05/2020	0900	2.6	13.7	25.3	15.6	29.3	10.2	39.9
15	09/05/2020	1000	3.4	14.8	20.8	15.0	27.2	8.0	43.3
16	09/05/2020	1100	2.7	19.8	19.3	12.3	30.4	6.7	49.6
17	09/05/2020	1200	4.1	22.7	21	13.1	33.4	5.6	56.3
18	09/05/2020	1300	3.8	23.3	21.8	13.5	35.9	5.1	66.6
19	09/05/2020	1400	3.9	26.8	26.4	15.6	38.6	9.0	73.4
20	09/05/2020	1500	4.2	27.9	27.8	16.2	42.1	10.9	72.4
21	09/05/2020	1600	4.6	29.3	36.1	19.9	43.8	11.4	70.2
22	09/05/2020	1700	4.3	30.9	42.7	22.9	38.2	8.3	77.0
23	09/05/2020	1800	4.0	27.8	41.2	22.3	33.3	11.0	78.7
24	09/05/2020	1900	3.8	24.5	42.6	22.9	31.4	13.0	76.0
25	09/05/2020	2000	3.5	21.4	45.1	22.2	26.2	8.9	81.8
26	09/05/2020	2100	3.8	17.1	32.2	17.0	24.5	7.0	73.1
27	09/05/2020	2200	2.9	14.9	31.4	16.7	27.4	3.1	73.4
28	09/05/2020	2300	2.6	13.6	24.9	14.0	24.2	2.8	68.1
29	09/06/2020	0000	1.9	13.1	20.9	12.4	22.5	1.7	66.1
30	09/06/2020	0100	2.5	11.8	17.7	11.1	22.3	1.2	61.2

TABLE 9		SITE NAME: CHILAS (C1) COORDINATES: 35°25'30.41"N, 74°5'40.50"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	NO (µg/m^3)	O_3 (µg/m^3)	BC (µg/m^3)	Noise dBA
31	09/06/2020	0200	2.1	10.5	12.7	9.1	22.3	0.9	55.9
32	09/06/2020	0300	1.6	9	14.7	9.9	24.7	0.9	52.8
33	09/06/2020	0400	1.4	.3	10.9	8.4	25.1	0.9	54.0
34	09/06/2020	0500	1.9	10.4	11	8.4	25.1	2.7	46.2
35	09/06/2020	0600	2.0	11.7	24.8	14.0	28.5	4.2	42.0
36	09/06/2020	0700	4.1	13.4	23.8	13.6	29.9	4.7	43.1
37	09/06/2020	0800	3.8	14.1	21.1	12.5	30.1	9.2	43.4
38	09/06/2020	0900	4.1	17.9	23.4	13.4	28.9	7.6	42.6
39	09/06/2020	1000	4.2	18.3	26	15.8	32.9	5.6	45.2
40	09/06/2020	1100	4.3	19.8	27.2	16.4	34.7	5.8	46.4
41	09/06/2020	1200	4.2	19.2	39.8	22.4	39.7	3.6	54.2
42	09/06/2020	1300	4.3	19.3	19.6	12.8	47.8	3.3	55.0
43	09/06/2020	1400	4.1	21.1	18.4	12.2	41.3	6.1	60.2
44	09/06/2020	1500	4.0	22.1	25.7	15.7	44.3	6.9	72.2
45	09/06/2020	1600	3.6	18.8	23	14.4	45	8.0	68.4
46	09/06/2020	1700	4.0	22.8	17.8	11.9	41.8	12.1	83.7
47	09/06/2020	1800	3.6	23.5	20.2	13.1	37.5	6.9	66.3
48	09/06/2020	1900	3.4	24.7	37.4	21.2	39.4	7.4	65.0
49	09/06/2020	2000	3.4	22.9	30.8	18.1	43.4	4.5	59.3
50	09/06/2020	2100	3.0	20.3	23.7	14.7	40.4	2.4	56.9
51	09/06/2020	2200	2.6	20.4	21.8	13.8	33.9	2.6	61.3
52	09/06/2020	2300	2.8	18.7	16.8	11.4	32	2.8	55.8
53	09/07/2020	0000	2.8	16.7	16.9	11.5	31.9	2.4	50.6
54	09/07/2020	0100	2.2	15.9	13.3	10.0	26.6	1.9	50.3
55	09/07/2020	0200	2.1	15.6	12.9	9.8	24.3	1.5	54.3
56	09/07/2020	0300	1.7	14.4	11.8	9.2	23.6	1.1	55.6
57	09/07/2020	0400	1.6	12.5	14.3	10.5	20.8	1.3	59.0
58	09/07/2020	0500	1.7	11.6	15.6	11.2	21.6	1.8	65.8
59	09/07/2020	0600	1.8	11.2	16.4	11.6	23.3	1.7	75.6
60	09/07/2020	0700	1.9	14.7	19.3	13.1	29.3	3.5	75.9

TABLE 9		SITE NAME: CHILAS (C1) COORDINATES: 35°25'30.41"N, 74°5'40.50"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	BC ($\mu g/m^3$)	Noise dBA
61	09/07/2020	0800	2.0	17.6	28.1	17.6	27.5	6.6	75.3
62	09/07/2020	0900	2.2	16.1	21.8	14.3	31.3	5.6	69.7
63	09/07/2020	1000	2.5	16	16.4	11.6	33.3	3.1	78.0
64	09/07/2020	1100	3.5	17.8	20.2	13.5	31.4	2.4	79.1
65	09/07/2020	1200	4.2	14.7	23.7	15.3	36.6	6.6	71.1
66	09/07/2020	1300	4.5	17.2	26.4	16.7	39.2	6.9	81.5
67	09/07/2020	1400	4.5	15.5	22.3	15.4	39.7	7.8	77.9
68	09/07/2020	1500	4.6	17.8	34.6	22.4	45.6	2.1	69.9
69	09/07/2020	1600	4.4	26.3	40.5	25.8	46.4	9.1	69.6
70	09/07/2020	1700	4.0	19.6	24.7	16.8	54.1	11.8	64.2
71	09/07/2020	1800	3.7	26.1	26.7	17.9	51.7	12.7	60.7
72	09/07/2020	1900	3.3	20	34.1	22.1	47.2	10.2	56.1
73	09/07/2020	2000	3.0	21.2	30	17.6	41.2	6.6	57.4
74	09/07/2020	2100	2.7	19.5	24.1	14.8	43.1	6.6	52.2
75	09/07/2020	2200	2.2	19.5	24.9	15.2	37.8	3.3	50.9
76	09/07/2020	2300	2.6	18.3	20.9	13.3	34.8	2.0	51.1
77	09/08/2020	0000	2.1	16.4	19.7	12.5	32.9	2.3	47.2
78	09/08/2020	0100	1.7	15.5	24.4	14.6	29.1	2.0	50.5
79	09/08/2020	0200	1.7	14.4	18.8	12.1	24.1	1.9	56.3
80	09/08/2020	0300	1.8	13.7	18	11.7	24.2	1.2	65.7
81	09/08/2020	0400	1.7	13.3	20.8	13.0	25.3	1.0	65.3
82	09/08/2020	0500	2.2	13.5	22.7	13.8	26.7	2.0	70.6
83	09/08/2020	0600	2.8	14.1	23.9	14.4	24.7	2.7	73.5
84	09/08/2020	0700	3.0	17.3	32.8	18.4	25.2	2.8	77.3
85	09/08/2020	0800	2.5	17.6	38.7	25.1	26.8	2.8	75.6
86	09/08/2020	0900	2.3	18.2	27	18.3	28.9	2.6	78.2
87	09/08/2020	1000	3.4	21.7	21.3	15.0	31.5	6.0	77.1
88	09/08/2020	1100	4.1	19.3	37.4	24.4	34.9	13.4	74.9
89	09/08/2020	1200	4.4	23.5	43.1	27.7	39.8	13.0	71.7
90	09/08/2020	1300	4.1	22.1	35.9	24.0	34.7	10.3	69.3

TABLE 9		SITE NAME: CHILAS (C1) COORDINATES: 35°25'30.41"N, 74°5'40.50"E							
S. No	Date	Time	CO (mg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	NO (µg/m^3)	O_3 (µg/m^3)	BC (µg/m^3)	Noise dBA
91	09/08/2020	1400	4.0	25.7	27.1	18.7	40.8	8.3	66.6
92	09/08/2020	1500	4.2	25.2	27.1	18.7	43.2	8.3	62.1
93	09/08/2020	1600	4.4	19.6	27.9	19.2	46.2	5.3	57.2
94	09/08/2020	1700	4.1	18.3	37.3	24.8	51.4	6.9	48.2
95	09/08/2020	1800	3.8	19.2	34.3	23.1	49.4	7.1	45.9
96	09/08/2020	1900	3.9	17.3	41.3	27.2	54.5	9.5	45.4
97	09/08/2020	2000	3.5	17.1	42.4	27.9	50.4	8.9	45.1
98	09/08/2020	2100	3.7	16.6	45.2	24.6	44.8	6.7	42.4
99	09/08/2020	2200	3.0	16.4	40.4	22.4	43.1	3.7	43.3
100	09/08/2020	2300	3.0	15.8	33.7	19.2	34.9	2.3	42.6
101	09/09/2020	0000	2.5	14.5	28.2	16.7	32.9	2.1	42.7
102	09/09/2020	0100	2.4	15.8	23.1	14.3	32.9	0.9	43.0
103	09/09/2020	0200	2.2	14.9	17.2	11.5	28.9	1.1	43.0
104	09/09/2020	0300	2.1	14.7	16.9	11.4	24.2	1.6	44.8
105	09/09/2020	0400	1.7	12.4	11.8	9.0	24.6	1.4	45.9
106	09/09/2020	0500	1.7	11.5	14.3	10.2	23.8	1.0	48.9
107	09/09/2020	0600	1.7	13.6	25.6	15.5	27.6	4.6	54.2
108	09/09/2020	0700	2.8	15.4	32	18.5	29.3	2.1	61.4
109	09/09/2020	0800	2.6	16.3	40.5	22.4	28.4	3.5	70.7
110	09/09/2020	0900	3.0	19.6	24.7	15.0	28.1	8.7	78.1
111	09/09/2020	1000	3.4	19.1	26.7	16.0	31.7	10.8	78.8
112	09/09/2020	1100	4.1	18.6	39.8	22.1	35.2	6.1	75.6
113	09/09/2020	1200	4.1	20.4	32.6	18.7	41.5	5.3	79.1
Max			4.6	30.9	45.2	27.9	54.5	13.4	83.7
Min			1.0	9.0	10.9	8.4	20.8	0.9	39.9
Avg			**2.9**	**17.6**	**24.8**	**15.6**	**33.2**	**5.2**	**60.6**

Annex-IV

Diurnal Variation of Air Pollutants & Noise Levels in GB during Summer

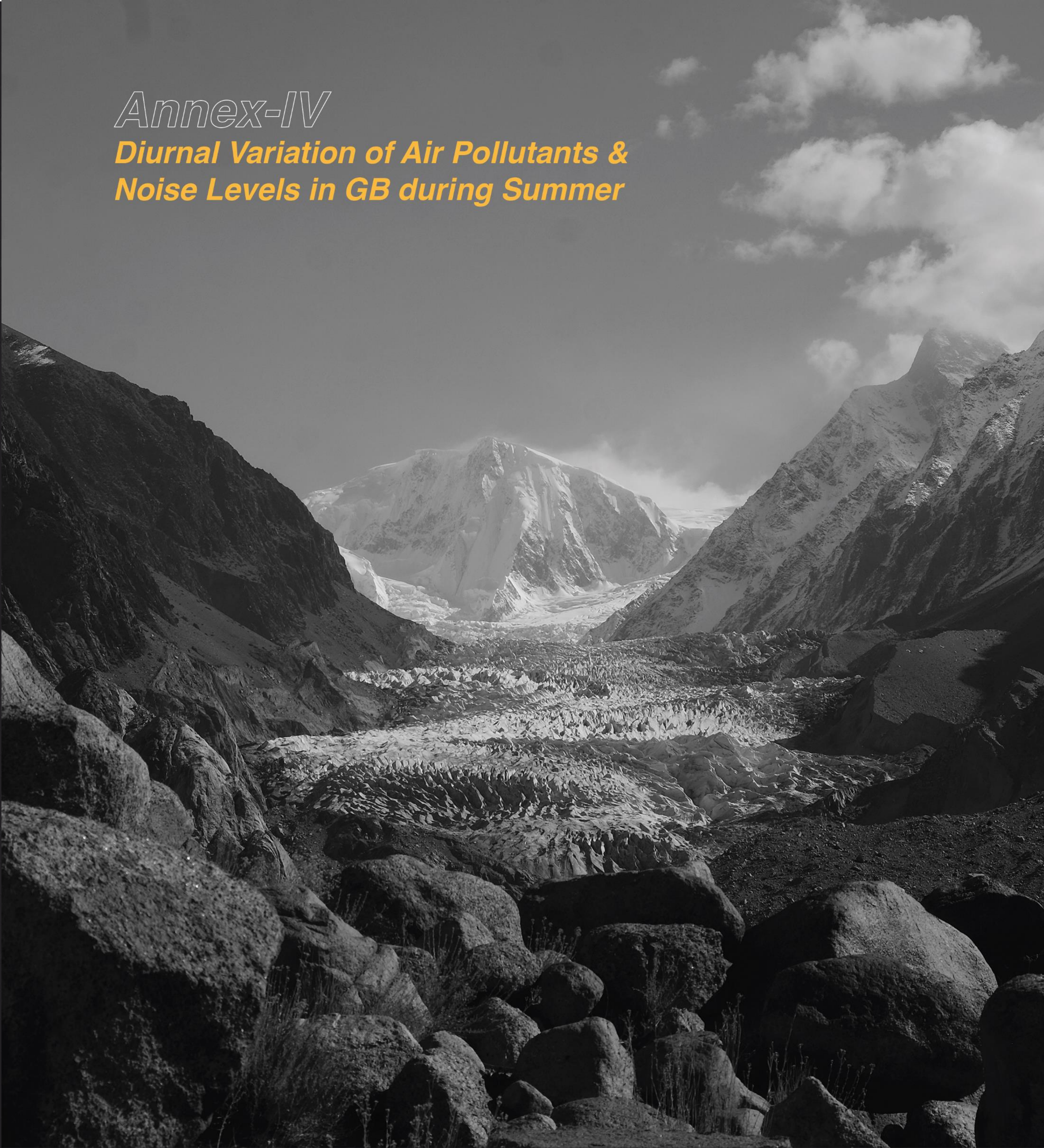


FIGURE 1: SOST (Sost Check Post – S1)

FIGURE 2: SOST (Khudabad – S2)

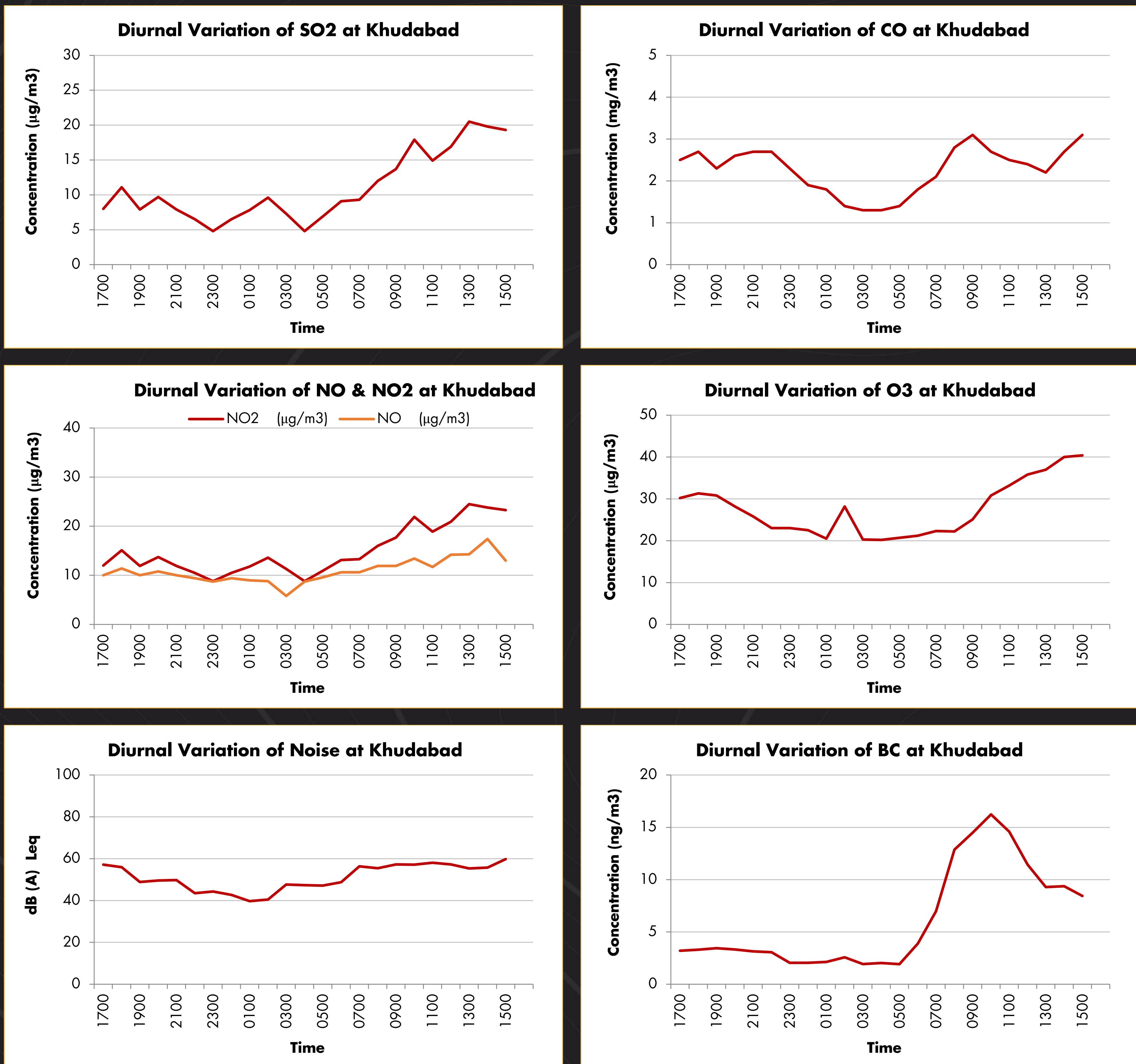
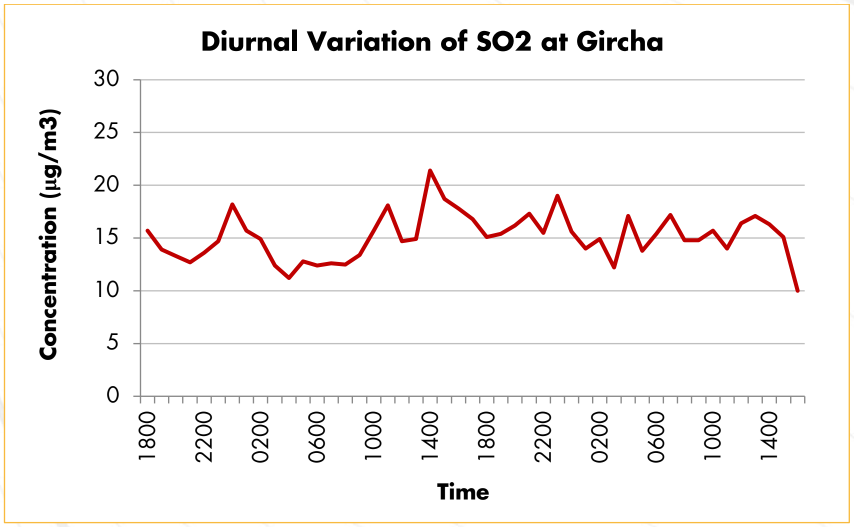
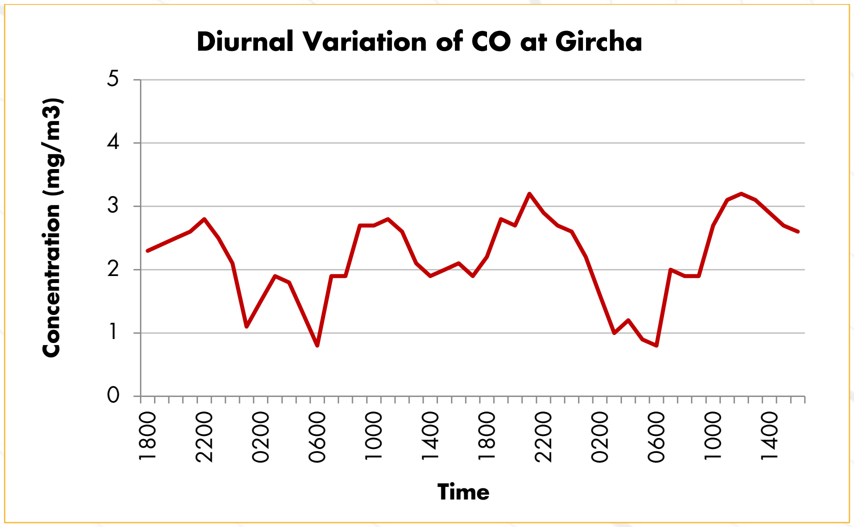
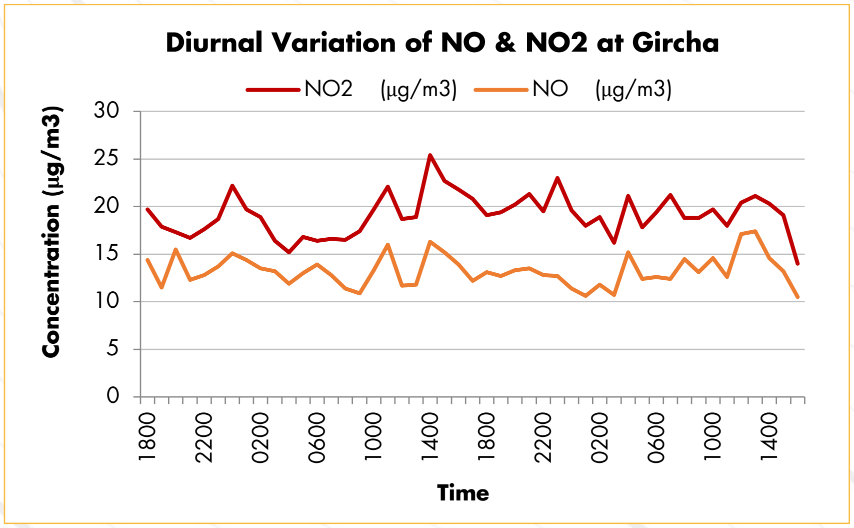
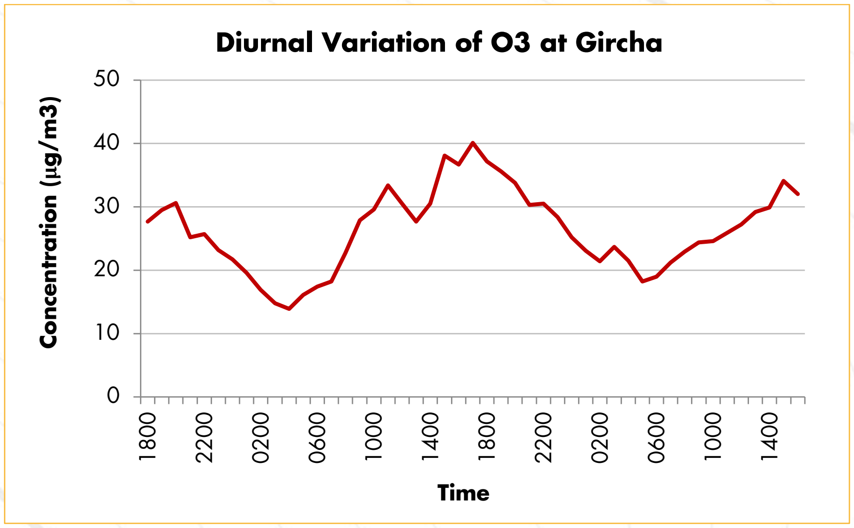


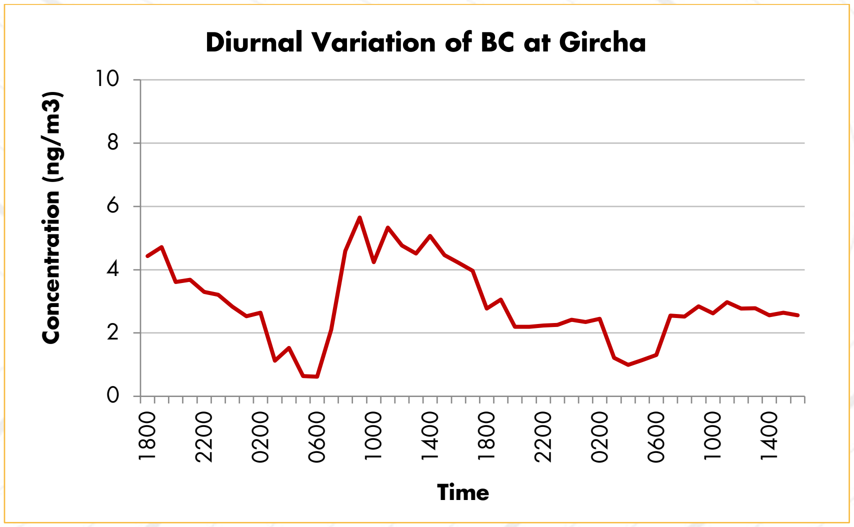
FIGURE 3: SOST (Gircha – S3)











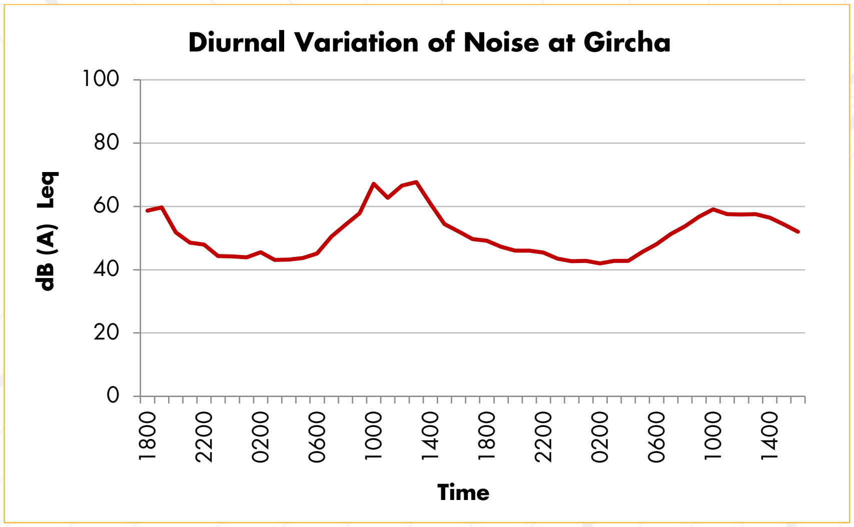


FIGURE 4: HUNZA (Karimabad – H1)

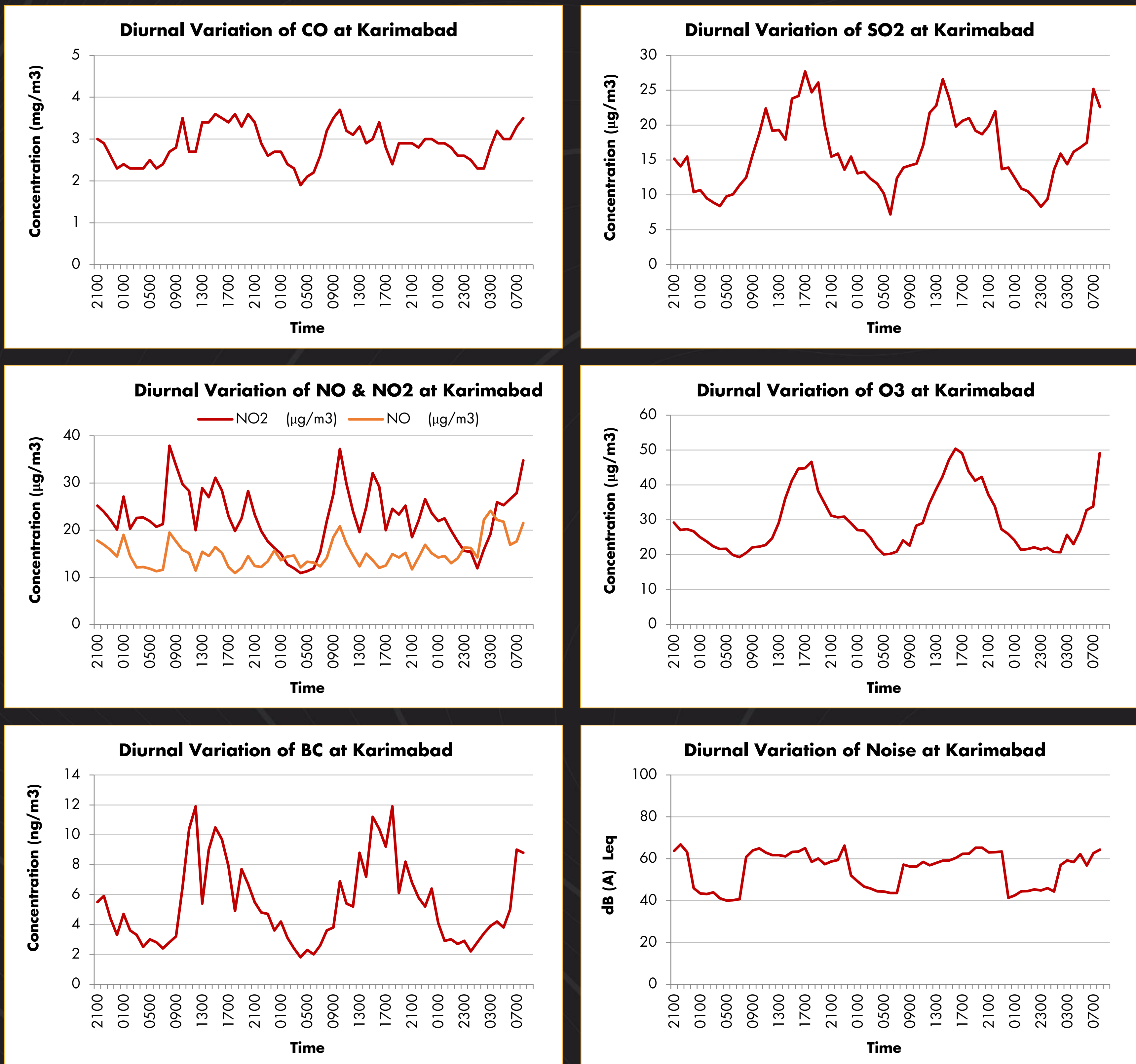


FIGURE 5: HUNZA (Aliabad – H2)

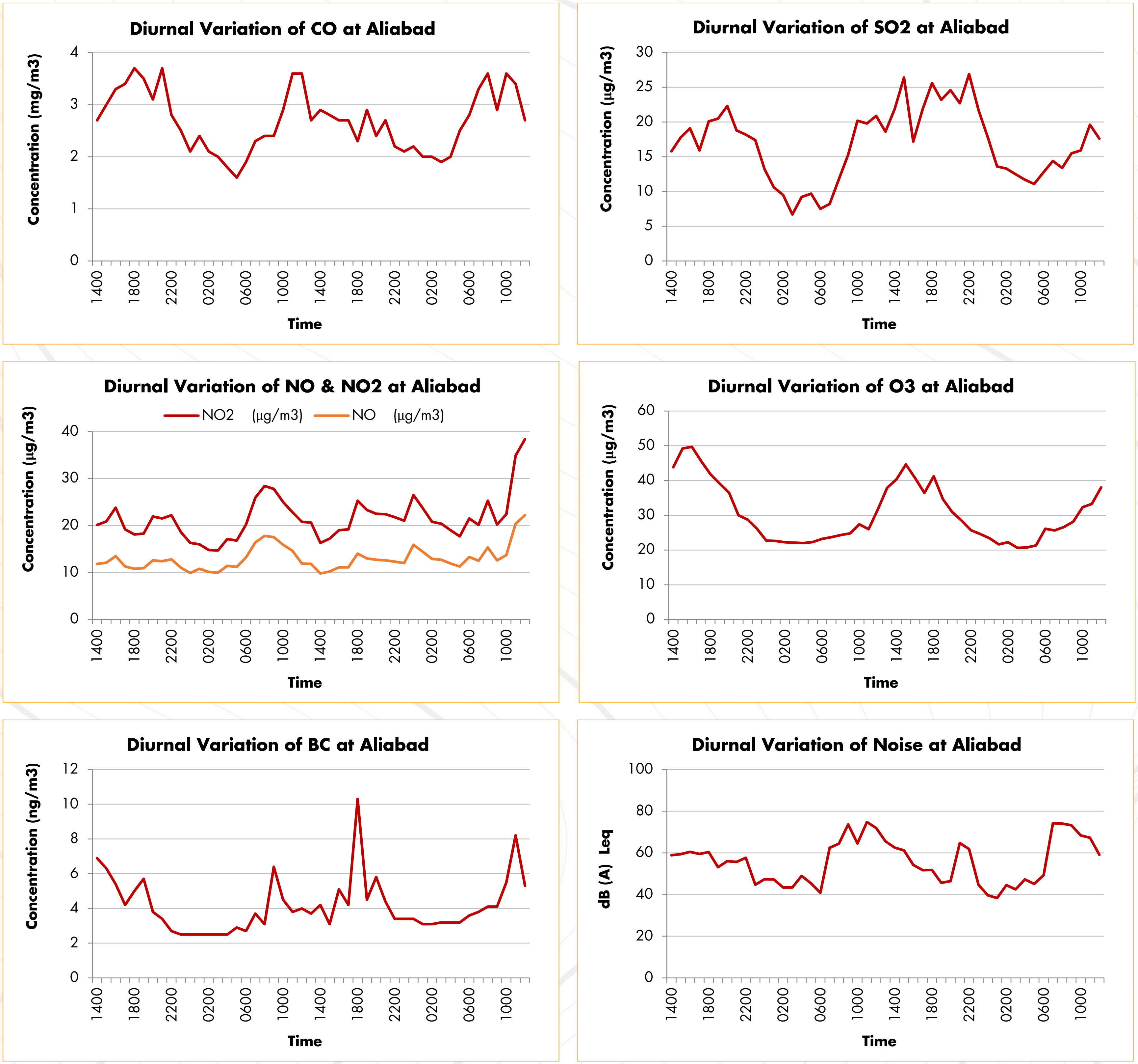


FIGURE 6: GILGIT (Danyor – G1)

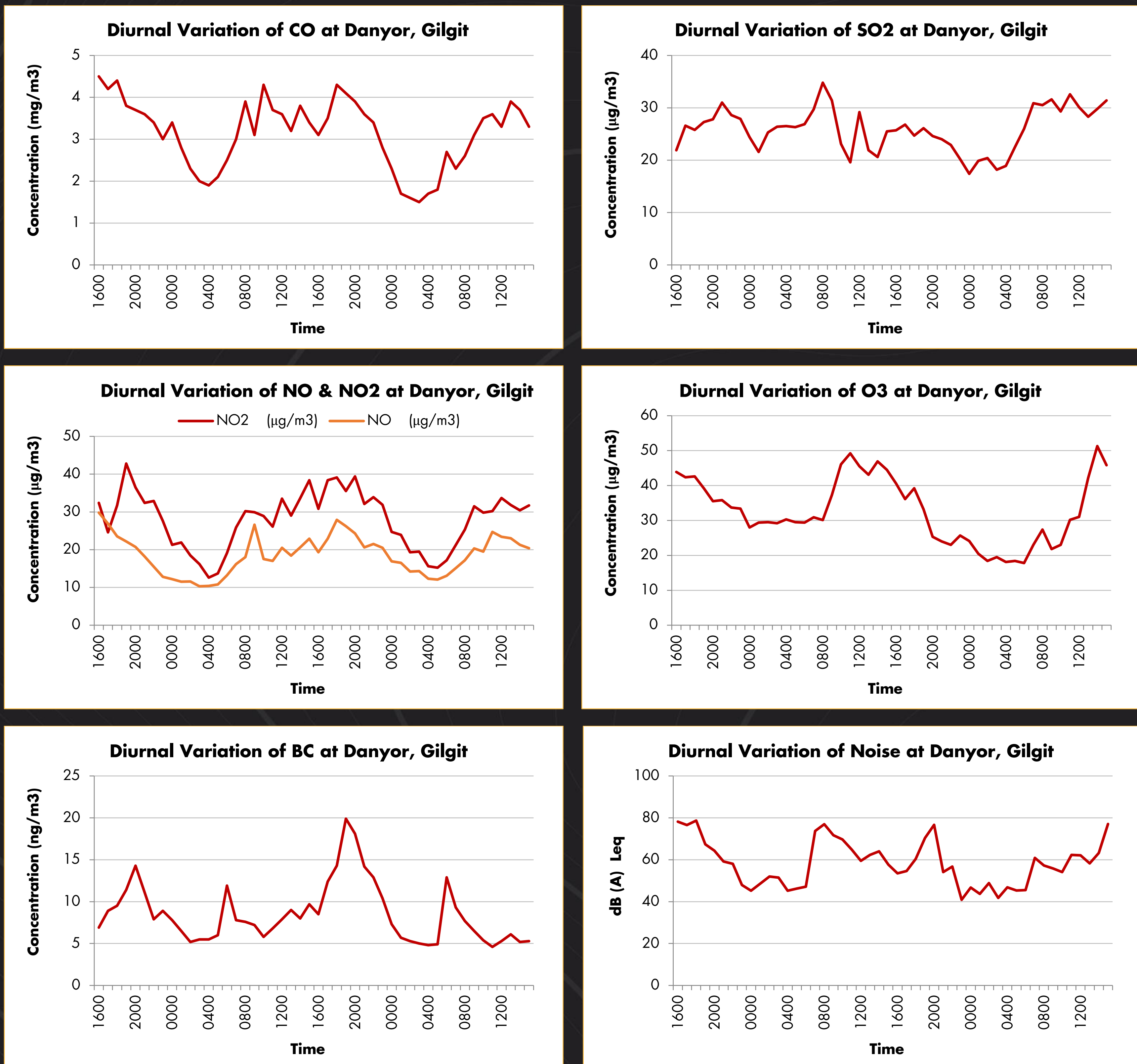


FIGURE 7: GILGIT (Near Gilgit Airport – G2)

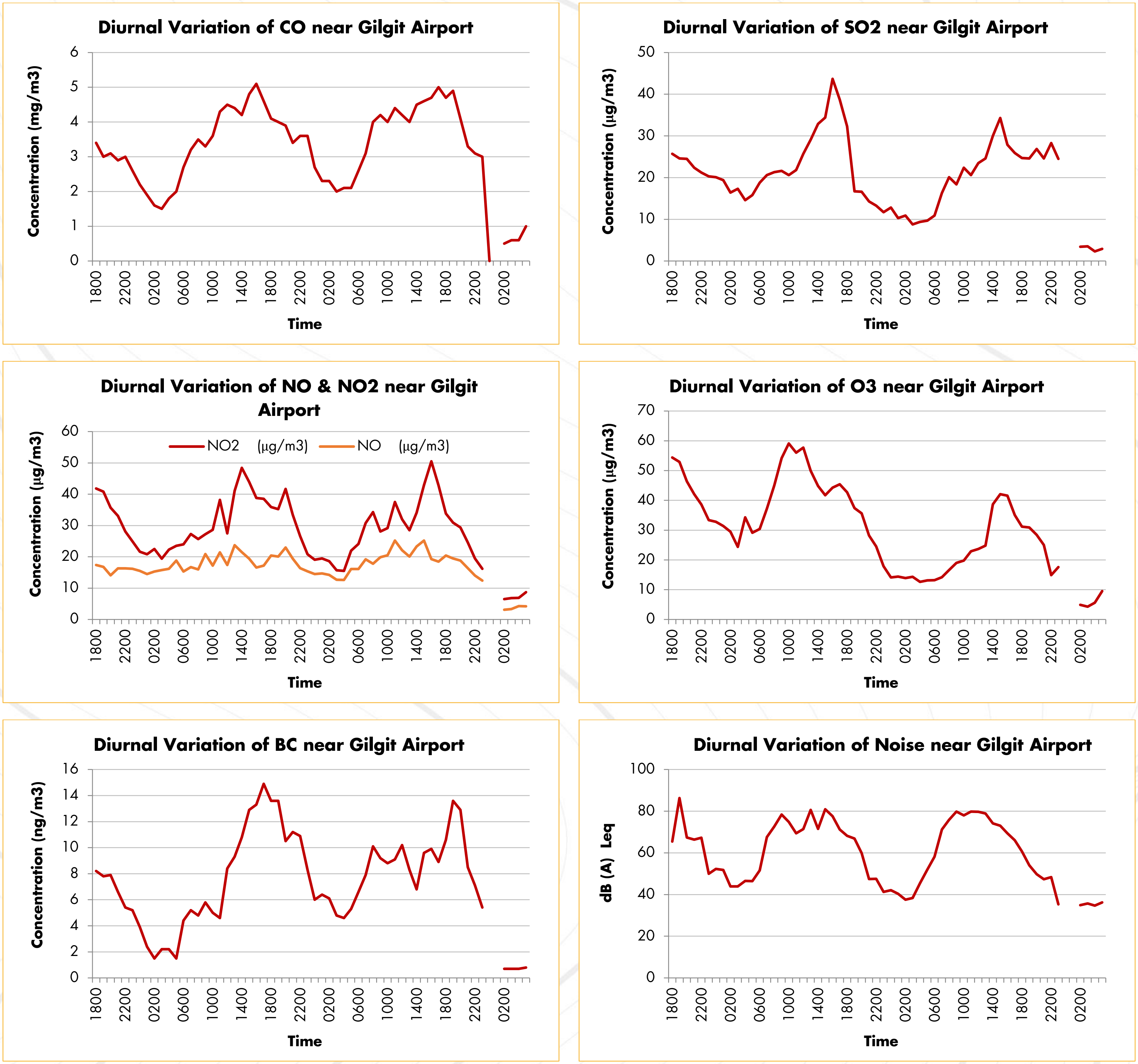


FIGURE 8: JAGLOT (J1)

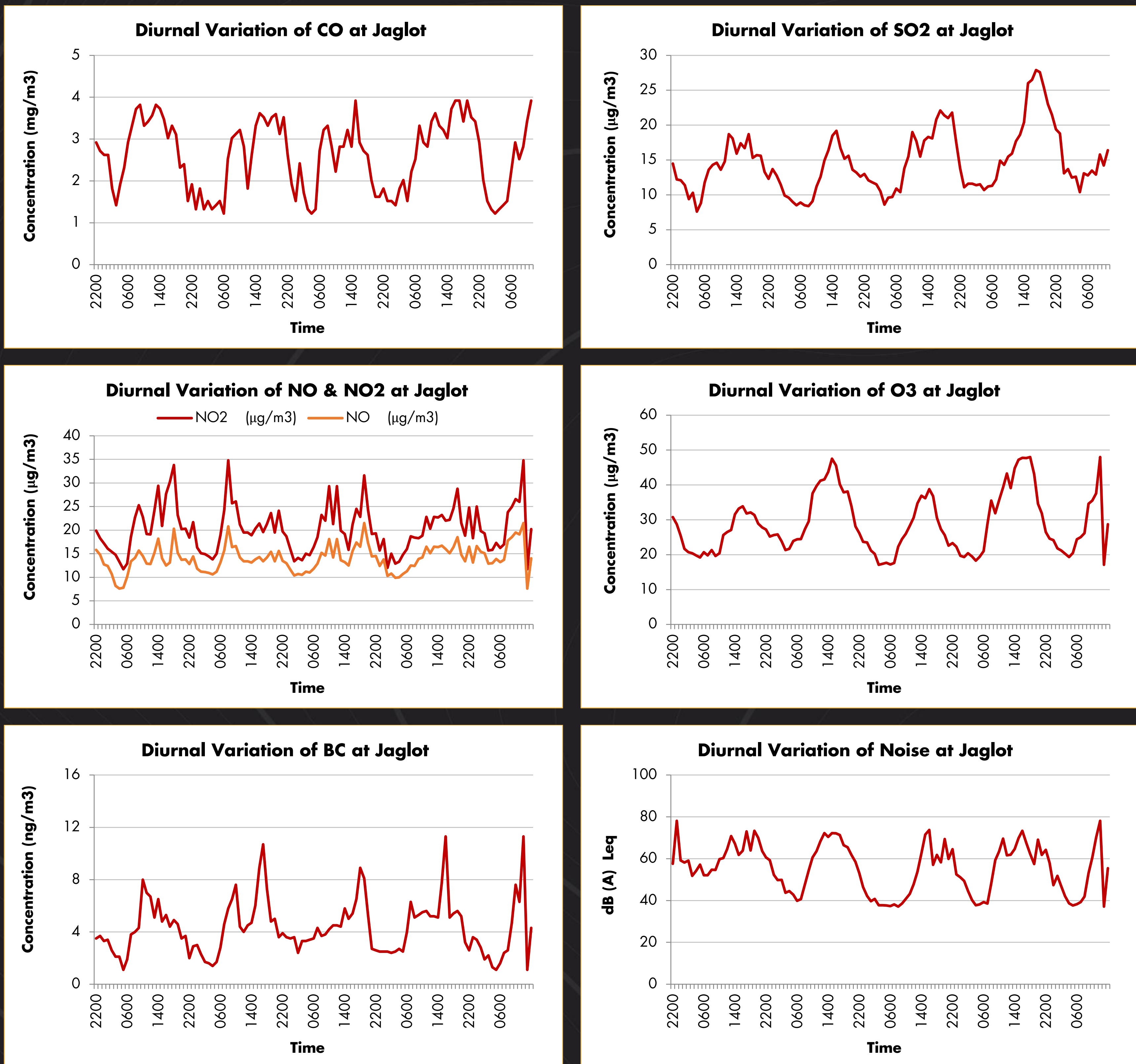


FIGURE 9: CHILAS (C1)