



AGRICULTURE LAND USE STATISTICS OF GILGIT BALTISTAN (2024-25)



STRENGTHENING OF AGRICULTURE SECRETARIAT AND E
AGRICULTURE EXTENSION SERVICES IN GB
DIRECTORATE OF AGRICULTURE (DoA), GILGIT BALTISTAN,
PAKISTAN

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Chapter 1

Introduction

1.1 Background

Agriculture is the backbone of the rural economy in Gilgit-Baltistan (GB), providing livelihoods, food security, and employment for the majority of the population. Despite its predominantly mountainous terrain, agriculture remains one of the most important economic sectors, supporting crop production, horticulture, livestock, and related agro-based activities. The region is characterized by narrow irrigated valleys surrounded by high mountain ranges, where cultivation is only possible through glacier- and snow-fed irrigation systems.

Gilgit-Baltistan covers approximately **72,971 km²** and comprises ten administrative districts grouped into three divisions: **Gilgit, Diamer, and Baltistan**. The province is dominated by the Karakoram, Himalaya, and Hindu Kush mountain ranges, resulting in diverse topography, climatic conditions, and agricultural potential. Owing to low annual precipitation, agriculture depends almost entirely on irrigation channels supplied by melting glaciers and seasonal streams.

Agricultural production in the region varies considerably with altitude, climate, and the length of the growing season. Based on these factors, the province is broadly divided into three cropping zones: **single cropping, marginal double cropping, and double cropping**. Wheat, maize, barley, potato, vegetables, fruits, and fodder crops constitute the major agricultural commodities. In recent decades, traditional cereal-based farming systems have gradually shifted towards high-value horticultural crops, particularly apricot, apple, cherry, walnut, and other temperate fruits.

Rapid population growth, climate change, urban expansion, and changing land-use patterns have increased the need for accurate and up-to-date agricultural information. Reliable spatial data are essential for identifying agricultural resources, monitoring land-use changes, planning irrigation infrastructure, improving productivity, and supporting evidence-based policy formulation.

1.2 Importance of Geospatial Technologies in Agriculture

Recent advances in **Geographic Information Systems (GIS)**, **Remote Sensing (RS)**, and **Earth Observation (EO)** technologies have transformed the way agricultural resources are mapped and monitored. High-resolution satellite imagery, combined with GIS-based spatial analysis, enables the rapid and accurate assessment of agricultural land, crop distribution, orchards, cultivable areas, and other land-use categories over large geographical regions.

Compared with conventional field surveys, geospatial technologies provide several advantages, including:

- Rapid assessment of large and inaccessible mountainous areas.

- Consistent and standardized mapping across administrative boundaries.
- Periodic monitoring of agricultural land-use changes.
- Reduced survey costs and time.
- Improved accuracy through integration of satellite imagery and field verification.
- Development of digital spatial databases for planning and decision-making.

The integration of GIS and Remote Sensing within the Department of Agriculture represents an important step towards modernizing agricultural statistics and supporting data-driven governance in Gilgit-Baltistan.

1.3 Rationale of the Study

The last comprehensive agricultural land-use survey conducted in Gilgit-Baltistan was published in **2014**. Since then, significant changes have occurred in agricultural practices, settlement expansion, infrastructure development, and land utilization patterns. The absence of updated spatial information has limited the Department's ability to formulate effective agricultural policies, prioritize development projects, and allocate resources efficiently.

To address this information gap, the Directorate of Agriculture, under the development project **“Strengthening of Agriculture Secretariat and E-Agriculture Extension Services in Gilgit-Baltistan (Phase II),”** initiated a province-wide GIS-based agricultural land-use assessment. The study provides standardized and spatially referenced agricultural statistics for all revenue villages of Gilgit-Baltistan using modern geospatial techniques.

The resulting database establishes a reliable baseline for future agricultural planning, climate adaptation strategies, irrigation development, food security assessments, and sustainable land management.

1.4 Aim of the Study

The primary aim of this study is to develop an accurate and comprehensive geospatial database of agricultural land use in Gilgit-Baltistan using satellite imagery, GIS, and Remote Sensing technologies to support evidence-based planning and sustainable agricultural development.

1.5 Objectives

The specific objectives of the study are to:

1. Delineate agricultural land below irrigation channels for all revenue villages of Gilgit-Baltistan.
2. Map major agricultural land-use categories using satellite imagery and GIS techniques.
3. Estimate village-wise agricultural land statistics.

4. Generate district-wise agricultural land-use statistics.
 5. Prepare division-wise summaries for Gilgit, Diamer, and Baltistan Divisions.
 6. Estimate the total cultivated and cultivable land available in Gilgit-Baltistan.
 7. Develop a standardized geospatial database for future monitoring and planning.
 8. Produce thematic maps and statistical reports to support policy formulation and agricultural investment.
-

1.6 Scope of the Study

This study covers all ten districts of Gilgit-Baltistan, including **Gilgit, Ghizer, Hunza, Nagar, Diamer, Astore, Skardu, Shigar, Kharmang, and Ghanche**. The analysis focuses exclusively on agricultural land located **below the irrigation water channels**, where cultivation is currently practiced or has the potential for future agricultural development.

The assessment classifies agricultural land into five major categories:

- Cropland
- Orchards and Plantations
- Cultivable Land
- Marginal Land
- Built-up Land

The generated statistics are intended to support agricultural planning, infrastructure development, land resource management, climate resilience, and investment decisions at village, district, divisional, and provincial levels.

1.7 Significance of the Study

This report represents the first comprehensive GIS-based agricultural land-use assessment for Gilgit-Baltistan since the publication of the 2014 agricultural statistics. It establishes a reliable spatial baseline that can be used by government departments, researchers, development partners, and policy makers.

The information generated through this study will support:

- Evidence-based agricultural planning and policy formulation.
- Identification of areas suitable for agricultural expansion.
- Irrigation and water resource development.
- Monitoring of land-use and land-cover changes.
- Climate-smart agriculture and environmental management.
- Investment planning by national and international development organizations.
- Development of a provincial agricultural geospatial information system.

By integrating geospatial technologies with agricultural statistics, the Department of Agriculture strengthens its capacity to manage land resources efficiently and promotes sustainable agricultural development throughout Gilgit-Baltistan.

Chapter 2

Materials and Methods

2.1 Study Area

Gilgit-Baltistan (GB) is located in the northernmost part of Pakistan between approximately **35°–37° North latitude** and **72°–77° East longitude**. It shares international borders with China to the northeast, Afghanistan to the northwest, and India to the east, while Khyber Pakhtunkhwa lies to the south.

The region covers an area of approximately **72,971 km²** and consists of ten administrative districts grouped into three divisions: **Gilgit, Diamer, and Baltistan**. The districts include Gilgit, Ghizer, Hunza, Nagar, Diamer, Astore, Skardu, Shigar, Kharmang, and Ghanche.

Gilgit-Baltistan is dominated by the **Karakoram, Himalaya, and Hindu Kush** mountain ranges, with elevations ranging from approximately **1,500 m to more than 8,000 m above sea level**. The terrain is characterized by steep mountains, narrow valleys, glaciers, alpine meadows, and river systems.

Agriculture is primarily confined to valley bottoms and gently sloping alluvial fans where irrigation water is available. Due to the semi-arid climate, annual precipitation is generally low, and crop production depends almost entirely on glacier- and snow-fed irrigation channels. Consequently, agricultural land occupies only a small proportion of the province's total geographical area.

This study covers all revenue villages of Gilgit-Baltistan and focuses on agricultural land located **below the irrigation water channels**, representing areas currently cultivated or having potential for agricultural development.

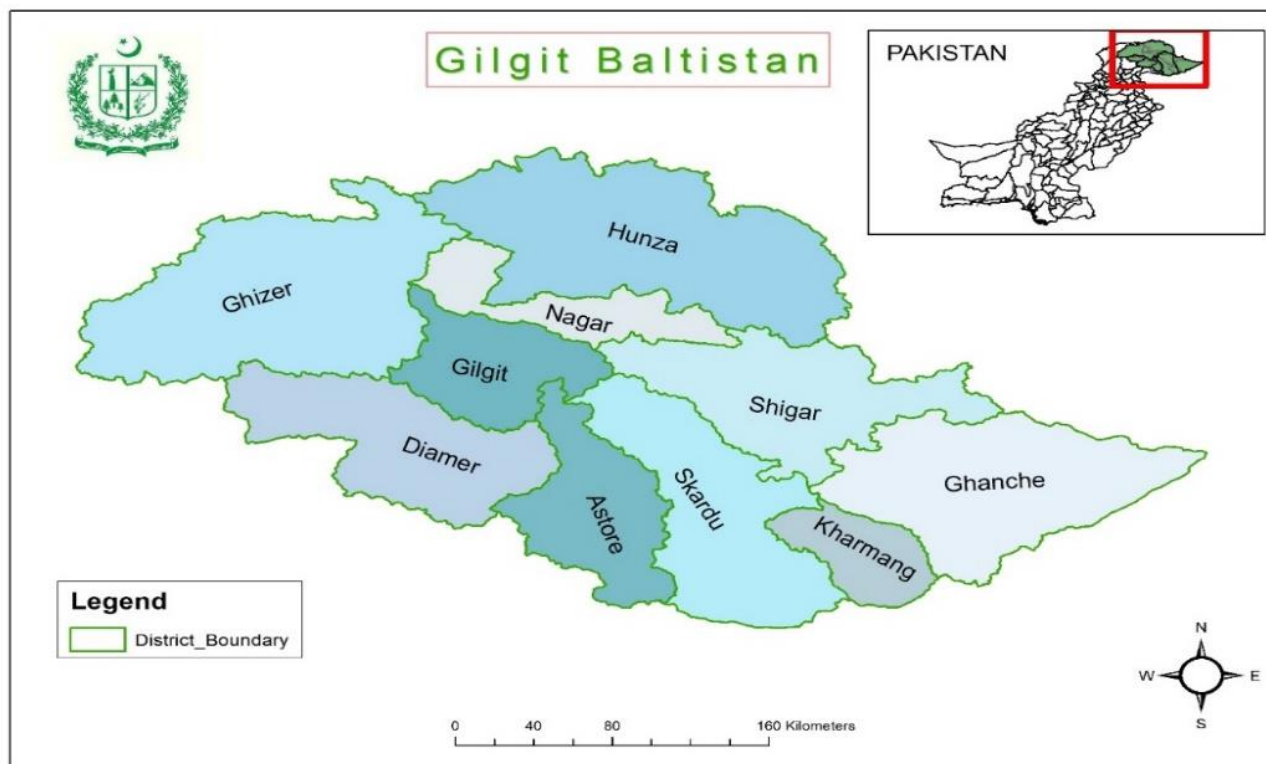


Figure 2.1: Location map of Gilgit-Baltistan.

2.2 Data Sources

Multiple spatial and non-spatial datasets were integrated to generate reliable agricultural land-use statistics.

Primary Data

- Sentinel-2 Multispectral Instrument (MSI) satellite imagery (10 m spatial resolution)
- High-resolution Google Earth imagery
- Village boundary database
- Revenue village records
- Administrative boundary layers
- GPS field observations

Secondary Data

- Department of Agriculture records
- Statistical Cell, Directorate of Agriculture
- Existing village maps
- Topographic reference data
- Previous agricultural statistics and reports

The combination of remotely sensed imagery and field information ensured accurate delineation and classification of agricultural land-use categories.

2.3 Software and Tools

The study utilized industry-standard GIS and Remote Sensing software throughout the project.

Software	Purpose
ArcGIS Pro / ArcMap	GIS analysis, digitization, cartography and area calculation
QGIS	Spatial data processing and visualization
Google Earth Pro	High-resolution image interpretation and validation
ERDAS IMAGINE	Image preprocessing and raster analysis
ENVI	Spectral image analysis and enhancement
Python (ArcPy)	Automation of GIS workflows and data processing
Microsoft Excel	Statistical analysis, tables and charts

These software packages facilitated efficient processing of large datasets and ensured consistency throughout the mapping process.

2.4 Methodological Framework

The agricultural land-use mapping followed a systematic workflow comprising data acquisition, preprocessing, image interpretation, classification, field validation, spatial analysis, and statistical reporting.

The overall methodology consisted of the following stages:

9. Collection of administrative boundary data.
10. Delineation of village boundaries.
11. Acquisition of Sentinel-2 satellite imagery.
12. Image preprocessing.
13. Visual interpretation and image classification.
14. GPS-based field verification.
15. GIS-based digitization.
16. Land-use classification.
17. Area calculation.
18. Preparation of village, district, division, and provincial statistics.

19. Quality assurance and report preparation.

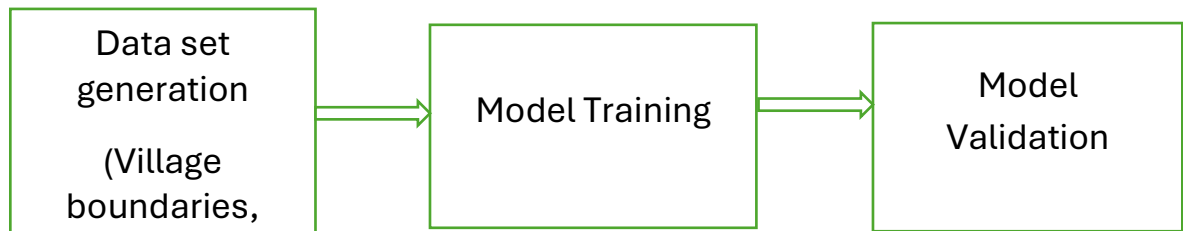


Figure 2.2: Overall methodology flowchart.

2.5 Village Boundary Delineation

Revenue village boundaries were prepared using high-resolution satellite imagery, cadastral information, and local administrative records. Manual on-screen digitization was carried out in GIS to ensure accurate representation of agricultural areas.

Special consideration was given to irrigation channels because agricultural activities in Gilgit-Baltistan are almost exclusively confined to land located below these channels. Consequently, only areas with existing or potential irrigation were included in the assessment.

Each village polygon was assigned a unique identifier to facilitate statistical analysis and integration with departmental databases.

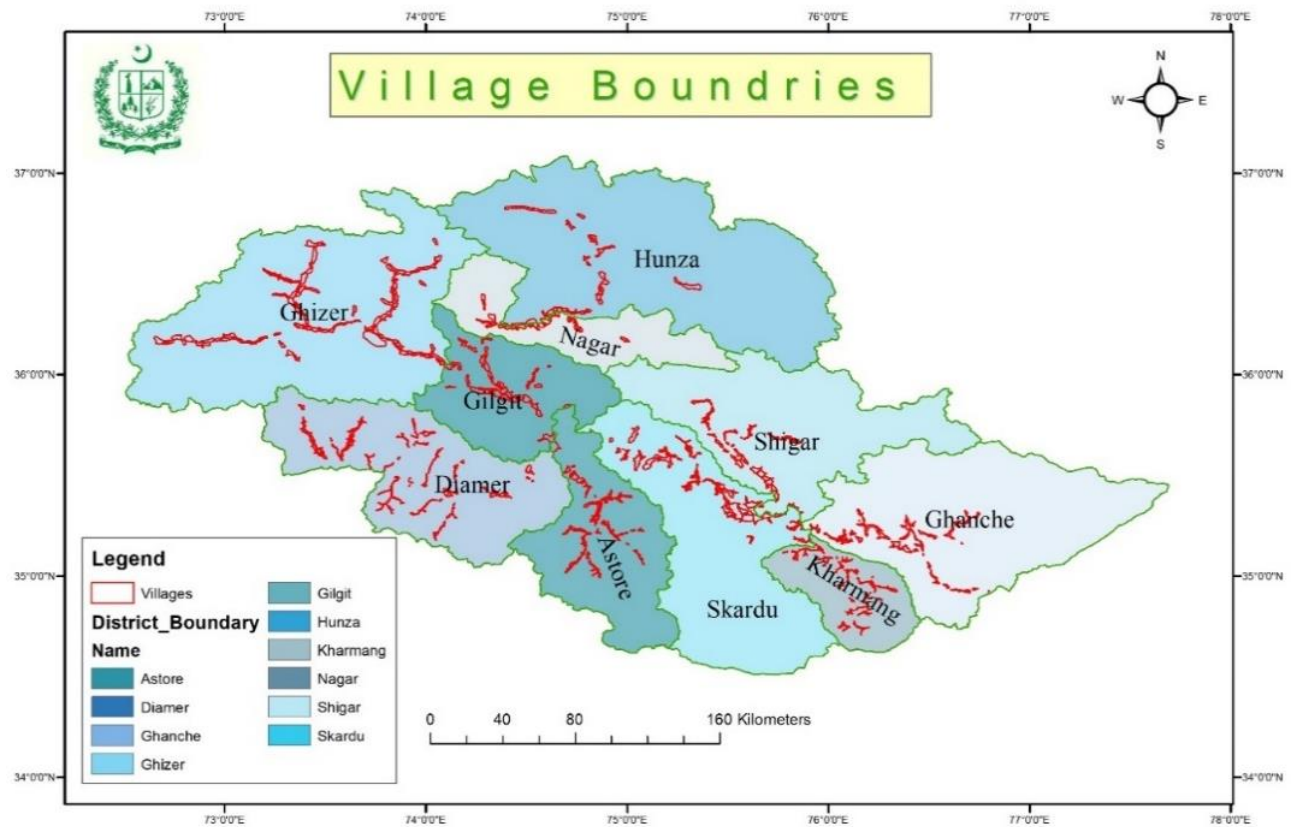


Figure 2.3: Village boundary delineation.

2.6 Satellite Data Acquisition

Sentinel-2 multispectral imagery provided by the European Space Agency (ESA) was used as the primary source of Earth observation data.

Sentinel-2 imagery offers:

- 10 m spatial resolution for visible and near-infrared bands.
- Frequent revisit period.
- High radiometric quality.
- Free and open access.

Multiple images acquired throughout the agricultural season were examined to minimize cloud cover and capture different crop growth stages. Images with minimal cloud contamination and complete coverage of the study area were selected for analysis.

2.7 Image Preprocessing

Prior to interpretation, satellite imagery underwent several preprocessing steps to improve image quality and analytical accuracy.

These included:

- Image mosaicking.
- Layer stacking.
- Radiometric correction.
- Atmospheric correction (where required).
- Clipping to village boundaries.
- Projection standardization.
- Cloud screening and removal.

These procedures ensured consistency among datasets and minimized classification errors.

2.8 Land Use Classification

Agricultural land was classified through detailed visual interpretation supported by GIS analysis, high-resolution imagery, and field observations.

Five major land-use categories were identified:

Land Use Category	Description
Cropland	Actively cultivated agricultural fields under seasonal crops.
Orchards and Plantations	Fruit orchards, tree plantations, nurseries, and perennial horticultural crops.
Cultivable Land	Irrigable land suitable for cultivation but presently uncultivated.
Marginal Land	Land with limited agricultural potential due to slope, shallow soils, gravel, or other constraints.
Built-up Land	Residential areas, farm buildings, roads, and other developed land within agricultural villages.

The classification was performed separately for each revenue village to maximize spatial accuracy.

2.9 Field Verification

Field verification was conducted to validate satellite image interpretation and improve mapping accuracy.

GPS observations, local knowledge, and consultations with Agriculture Department field staff were used to confirm:

- Village boundaries.
- Crop fields.
- Orchard locations.
- Built-up areas.
- Marginal land.
- Cultivable land.

Ground verification significantly enhanced the reliability of the final land-use database.



Figure 2.4: Field verification and GPS survey.

2.10 Spatial Analysis

Following classification, GIS tools were employed to calculate the area occupied by each land-use category within every village.

Village statistics were aggregated to produce:

- Union Council statistics.
- District statistics.
- Division-wise summaries.
- Province-wide agricultural statistics.

Spatial analysis also facilitated comparisons among districts and divisions, enabling identification of areas with high agricultural potential and land available for future development.

2.11 Data Quality Assurance

Quality assurance procedures were implemented throughout the study to maintain consistency and reliability.

These included:

- Cross-checking village boundaries.
- Visual inspection of classified polygons.
- Comparison with high-resolution imagery.
- GPS validation.
- Attribute verification.
- Statistical consistency checks.

These procedures minimized positional and classification errors and ensured the production of a dependable geospatial database.

2.12 Accuracy Assessment

The accuracy of the final agricultural land-use maps was evaluated using field observations, high-resolution imagery, and expert interpretation.

The assessment focused on:

- Correct identification of land-use categories.
- Boundary precision.
- Spatial consistency.
- Logical consistency of area statistics.

The resulting land-use database achieved an **overall mapping accuracy exceeding 95%**, making it suitable for planning, resource allocation, and policy development.

2.13 Limitations of the Study

While every effort was made to ensure high accuracy, certain limitations should be acknowledged:

- Agricultural boundaries may change over time due to land development and natural processes.

- Seasonal variations in crop conditions may influence image interpretation.
- Persistent cloud cover in some locations may reduce image quality.
- Rapid expansion of settlements may alter land-use patterns after the survey period.
- Small agricultural plots in densely populated valleys may present classification challenges despite high-resolution imagery.

These limitations should be considered when interpreting the results and emphasize the need for periodic updates of the agricultural land-use database.

2.14 Chapter Summary

This chapter described the datasets, software, and methodological procedures used to generate agricultural land-use statistics for Gilgit-Baltistan. By integrating satellite imagery, GIS analysis, GPS field verification, and visual interpretation, a comprehensive geospatial database of agricultural land was developed. The standardized methodology ensured reliable, consistent, and scientifically robust statistics at village, district, division, and provincial levels, providing a strong foundation for the analysis presented in the following chapter.

Chapter 3

Results and Discussion

3.1 Introduction

This chapter presents the results of the GIS- and Remote Sensing-based agricultural land-use assessment conducted across Gilgit-Baltistan for the year **2022–23**. The analysis provides a comprehensive overview of the spatial distribution of agricultural land and its major land-use categories at district, divisional, and provincial levels.

Using high-resolution satellite imagery, Geographic Information Systems (GIS), field verification, and spatial analysis, agricultural land was delineated and classified into five major land-use categories:

- **Cropland**
- **Orchards and Plantations**
- **Cultivable Land**
- **Marginal Land**
- **Built-up Land**

The statistics presented in this chapter represent agricultural areas located **below the irrigation water channels**, where cultivation is currently practiced or where land has the potential to be brought under cultivation. These statistics provide an updated and standardized assessment of agricultural resources across Gilgit-Baltistan and establish a reliable baseline for future planning and monitoring.

Gilgit-Baltistan is administratively divided into **three divisions** comprising **ten districts**, all of which were included in this assessment. District-wise statistics were first generated from village-level spatial data and subsequently aggregated to produce divisional and provincial summaries. This hierarchical approach ensures consistency and facilitates comparison across different administrative levels.

Table 3.1 presents the administrative structure of Gilgit-Baltistan used in this study.

Division	Districts
Gilgit Division	Gilgit, Ghizer, Hunza, Nagar
Diamer Division	Diamer, Astore
Baltistan Division	Skardu, Shigar, Kharmang, Ghanche

The chapter begins with detailed district profiles, including the total agricultural land, administrative information, and land-use statistics for each district. This is followed by a comparative analysis of land-use categories, division-wise summaries, and province-wide agricultural statistics. The results highlight spatial variations in agricultural resources, identify areas with significant cultivation potential, and provide insights to support evidence-based planning and sustainable land management.

The analysis reveals considerable variation in the distribution of agricultural land among districts due to differences in topography, elevation, climate, water availability, and settlement patterns. Districts with broad irrigated valleys generally contain larger areas of cultivable and cultivated land, whereas high-altitude and rugged mountainous districts are characterized by relatively smaller agricultural footprints. Similarly, the extent of orchards, cropland, marginal land, and built-up areas reflects local environmental conditions, irrigation infrastructure, and socio-economic activities.

The findings presented in this chapter provide a valuable evidence base for agricultural development planning, irrigation management, climate resilience initiatives, land resource management, and future investment decisions. They also contribute to the establishment of a comprehensive provincial geospatial database that can support periodic monitoring of agricultural land-use dynamics and guide sustainable development across Gilgit-Baltistan.

3.2 District Profile – Hunza

3.2.1 District Overview

Hunza District is located in the northern part of Gilgit-Baltistan and is renowned for its spectacular mountain landscapes, glaciers, and fertile irrigated valleys. The district shares an international border with China and occupies a strategic position along the Karakoram Highway (KKH). Agriculture is concentrated in narrow valleys where glacier-fed irrigation systems support crop cultivation, orchards, and vegetable production.

The district has a geographical area of **11,598.4 km²** and comprises **46 revenue villages**, **one sub-division**, and **eight Union Councils**. Although only a small proportion of the total geographical area is suitable for agriculture, the district possesses significant potential for high-value horticulture due to its favorable climate for temperate fruit production.

The total agricultural land mapped in Hunza during the 2022–23 assessment was **12,596.1 hectares**, representing land located below irrigation channels and classified into five major land-use categories.

Administrative Information

Parameter	Value
Total Area	11,598.4 km²
Total Agricultural Land	12,596.1 ha
Revenue Villages	46
Sub-Divisions	1
Union Councils	8

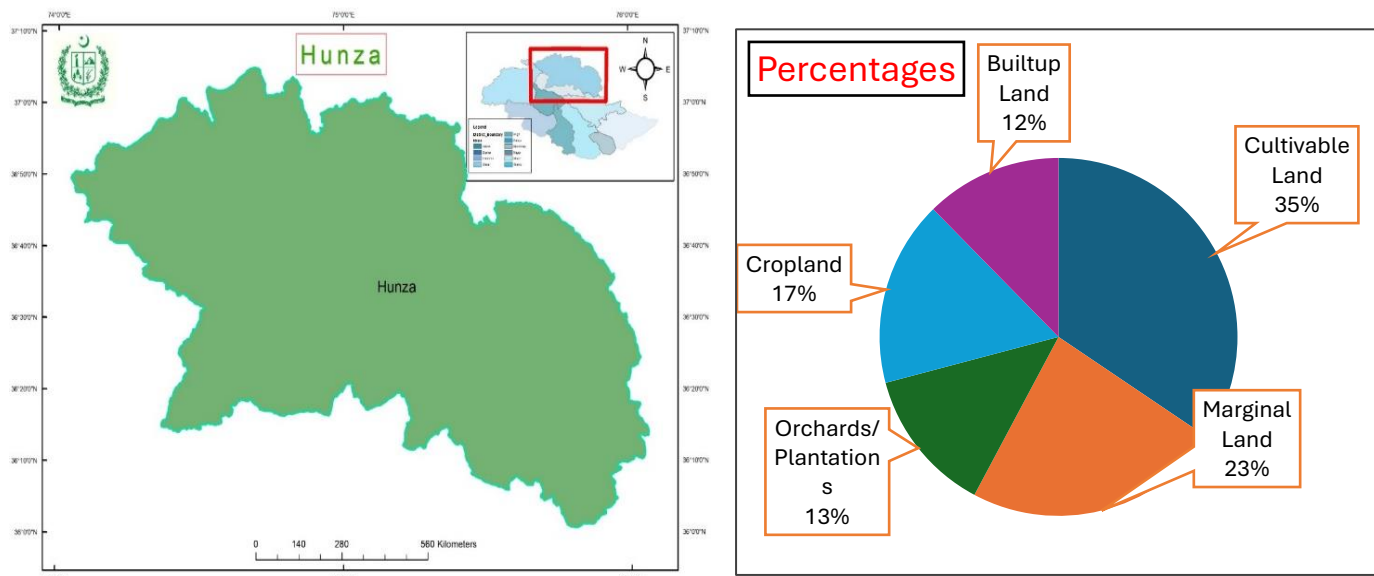


Figure 3.1: Location and agricultural land-use map of Hunza District.

3.2.2 Land Use Statistics

The agricultural landscape of Hunza District consists of cropland, orchards and plantations, cultivable land, marginal land, and built-up land. Among these categories, **cultivable land** occupies the largest share, indicating considerable potential for future agricultural expansion through improved irrigation and land development.

Land Use Category	Area (ha)	Percentage (%)
Cultivable Land	4,339.2	34.4
Marginal Land	2,940.3	23.3
Cropland	2,114.4	16.8
Orchards and Plantations	1,646.8	13.1
Built-up Land	1,555.3	12.3
Total	12,596.1	100.0

Table 3.2: Agricultural land-use statistics of Hunza District.

3.2.3 Results and Interpretation

The analysis indicates that **cultivable land** is the dominant land-use category, accounting for **34.4%** of the total agricultural area. This suggests that a substantial portion of the district has the potential to be brought under cultivation through investments in irrigation infrastructure, land improvement, and agricultural development programs.

Marginal land represents **23.3%** of the agricultural area. These lands are generally constrained by steep slopes, shallow soils, coarse surface materials, or limited access to irrigation. Although not currently suitable for intensive farming, appropriate soil and water conservation measures may improve their productivity in selected locations.

Cropland covers **2,114.4 hectares (16.8%)**, reflecting the area presently used for seasonal crop production. Wheat, barley, potato, vegetables, and fodder crops are among the principal crops cultivated under the district's glacier-fed irrigation system.

Orchards and plantations occupy **1,646.8 hectares (13.1%)**, highlighting the importance of horticulture in the local economy. Hunza is well known for producing high-quality apricot, apple, cherry, walnut, and other temperate fruits that contribute significantly to household incomes and regional markets.

Built-up land accounts for **12.3%** of the mapped agricultural area. This includes residential settlements, roads, public infrastructure, and farm-related facilities located within village boundaries. The proportion of built-up land reflects ongoing urban expansion and population growth in the district.

Overall, the results demonstrate that Hunza possesses strong potential for sustainable agricultural development, particularly through the utilization of cultivable land and the expansion of high-value horticultural production. Improving irrigation efficiency, promoting climate-resilient farming practices, and enhancing orchard management can further strengthen agricultural productivity while ensuring the sustainable use of limited land and water resources.

3.2.4 Key Findings

- Total agricultural land mapped: **12,596.1 ha**.
- Cultivable land is the largest category (**34.4%**), indicating significant scope for future agricultural expansion.
- Marginal land accounts for **23.3%**, reflecting terrain and irrigation constraints.
- Cropland covers **16.8%** of the agricultural area and supports the district's staple crop production.
- Orchards and plantations contribute **13.1%**, emphasizing the economic importance of temperate fruit cultivation.
- Built-up land represents **12.3%**, illustrating the influence of settlement development within agricultural valleys.
- Sustainable management of irrigation water and expansion of horticulture can further enhance agricultural productivity and rural livelihoods in Hunza District.

3.3 District Profile – Nagar

3.3.1 District Overview

Nagar District is situated in the Gilgit Division of Gilgit-Baltistan and is characterized by rugged mountainous terrain, glacier-fed valleys, and productive agricultural landscapes. The district lies along the Karakoram Highway and shares similar geographical and climatic characteristics with the neighboring Hunza District. Agriculture is the primary livelihood for the rural population, with farming activities concentrated in irrigated valley floors and alluvial terraces.

The district covers a geographical area of **3,294.1 km²** and comprises **39 revenue villages**, **one sub-division**, and **seven Union Councils**. Due to its steep topography, only a limited portion of the district is suitable for cultivation. Nevertheless, fertile soils, glacier-fed irrigation, and favorable climatic conditions support the production of cereals, vegetables, and high-value fruit orchards.

The GIS-based assessment estimated the total agricultural land of Nagar District at **7,644.8 hectares**, which was classified into five major land-use categories.

Administrative Information

Parameter	Value
Total Area	3,294.1 km²
Total Agricultural Land	7,644.8 ha
Revenue Villages	39
Sub-Divisions	1
Union Councils	7

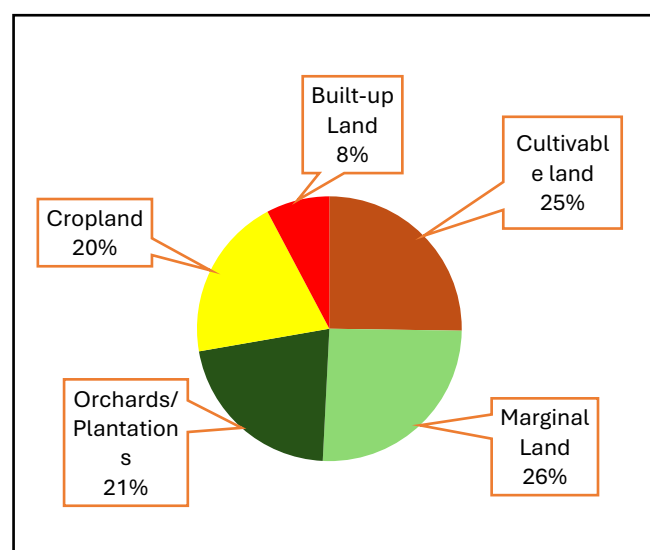
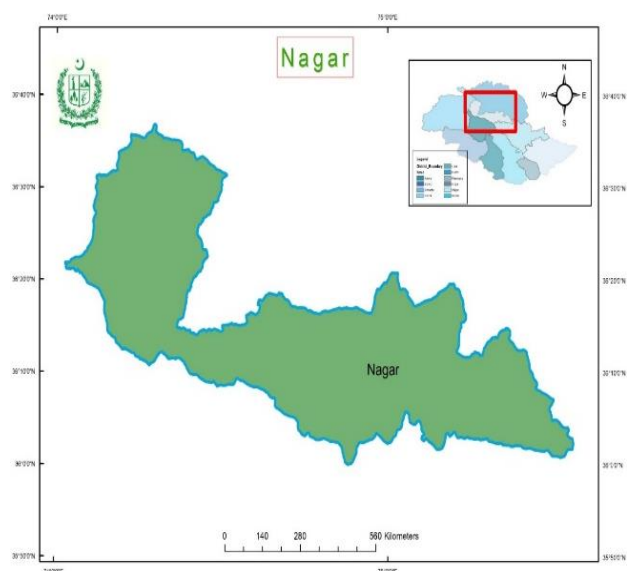


Figure 3.2: Location and agricultural land-use map of Nagar District.

3.3.2 Land Use Statistics

The agricultural landscape of Nagar District comprises cultivable land, marginal land, cropland, orchards and plantations, and built-up land. The results indicate a relatively balanced distribution among the major agricultural land-use categories.

Land Use Category	Area (ha)	Percentage (%)
Cultivable Land	1,929.2	25.2
Marginal Land	1,954.2	25.6
Orchards and Plantations	1,640.9	21.5
Cropland	1,528.7	20.0
Built-up Land	591.7	7.7
Total	7,644.8	100.0

Table 3.3: Agricultural land-use statistics of Nagar District.

3.3.3 Results and Interpretation

The analysis shows that **marginal land** constitutes the largest share of the agricultural landscape, accounting for **25.6%** of the total agricultural area. These lands are generally affected by topographic limitations, shallow soils, rocky surfaces, or restricted irrigation availability, reducing their suitability for intensive agricultural production.

Cultivable land occupies **25.2%** of the agricultural area, indicating considerable opportunities for future agricultural expansion through improved irrigation infrastructure, land leveling, and soil improvement measures. The availability of cultivable land highlights the district's potential to increase agricultural production under appropriate development initiatives.

Orchards and plantations cover **1,640.9 hectares (21.5%)**, reflecting the importance of horticulture within the district. Fruit production, particularly apricot, apple, cherry, walnut, and other temperate fruits, plays a significant role in household income generation and local economic development.

Cropland accounts for **1,528.7 hectares (20.0%)** and supports the cultivation of wheat, barley, potato, maize, vegetables, and fodder crops. Agricultural production is sustained primarily through glacier-fed irrigation systems, which are essential given the region's low annual precipitation.

Built-up land represents only **7.7%** of the agricultural landscape, the lowest among all land-use categories. This indicates that settlement development occupies a relatively small proportion of agricultural land, allowing a greater share of irrigated valleys to remain available for farming activities.

Overall, the findings demonstrate that Nagar District possesses substantial agricultural development potential. The nearly equal proportions of cultivable and marginal land suggest that strategic investments in irrigation, soil conservation, and land reclamation could significantly increase the productive agricultural area. At the same time,

strengthening horticultural practices and improving market access for fruit growers can further enhance rural livelihoods and agricultural sustainability.

3.3.4 Key Findings

- Total agricultural land mapped: **7,644.8 hectares**.
- Marginal land is the largest land-use category (**25.6%**).
- Cultivable land accounts for **25.2%**, indicating strong potential for agricultural expansion.
- Orchards and plantations occupy **21.5%**, highlighting the district's comparative advantage in temperate fruit production.
- Cropland represents **20.0%** of the agricultural area and supports staple food and vegetable production.
- Built-up land covers only **7.7%**, indicating limited conversion of agricultural land to settlements.
- Future agricultural development should prioritize irrigation improvement, orchard expansion, climate-resilient farming practices, and sustainable land management to maximize the productive use of available land resources.

3.4 District Profile – Diamer

3.4.1 District Overview

Diamer District is located in the southern part of Gilgit-Baltistan and serves as the gateway to the region through the Karakoram Highway. The district is characterized by rugged mountains, deep valleys, and the Indus River, which forms the primary source of irrigation for agricultural activities. Agriculture is practiced mainly along valley bottoms and river terraces where fertile soils and irrigation water are available.

The district covers a geographical area of **6,995.2 km²** and comprises **104 revenue villages, two sub-divisions, and eleven Union Councils**. Among all districts of Gilgit-Baltistan, Diamer has one of the largest numbers of revenue villages, reflecting its extensive rural population and agricultural settlements.

The GIS-based land use assessment estimated a total agricultural area of **20,324.5 hectares** in Diamer District. Agricultural land was classified into five major land-use categories: cropland, orchards and plantations, cultivable land, marginal land, and built-up land.

Administrative Information

Parameter	Value
Total Area	6,995.2 km²
Total Agricultural Land	20,324.5 ha
Revenue Villages	104
Sub-Divisions	2
Union Councils	11

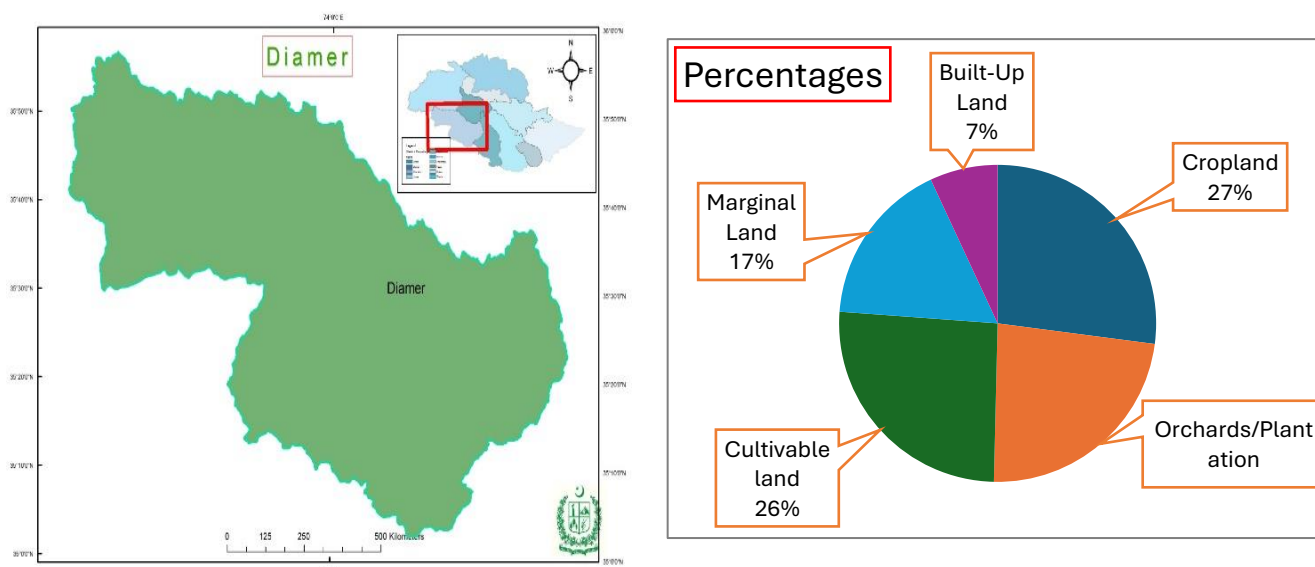


Figure 3.3: Location and agricultural land-use map of Diamer District.

3.4.2 Land Use Statistics

The land use analysis reveals that cropland, cultivable land, and orchards collectively occupy more than three-quarters of the total agricultural area, highlighting the district's strong agricultural base.

Land Use Category	Area (ha)	Percentage (%)
Cropland	5,503.3	27.1
Cultivable Land	5,243.8	25.8
Orchards and Plantations	4,735.5	23.3
Marginal Land	3,434.0	16.9
Built-up Land	1,407.8	6.9
Total	20,324.5	100.0

Table 3.4: Agricultural land-use statistics of Diamer District.

3.4.3 Results and Interpretation

The assessment indicates that **cropland** is the dominant land-use category in Diamer District, covering **5,503.3 hectares (27.1%)** of the total agricultural area. This reflects the district's importance in cereal and vegetable production, supported by irrigated valleys along the Indus River and its tributaries. Wheat, maize, vegetables, and fodder crops constitute the major cultivated crops.

Cultivable land occupies **5,243.8 hectares (25.8%)**, representing land that is suitable for agriculture but is currently uncultivated. This considerable proportion indicates significant opportunities for expanding agricultural production through irrigation development, land leveling, and soil improvement.

Orchards and plantations account for **4,735.5 hectares (23.3%)**, demonstrating the growing importance of horticulture in the district. Fruit trees such as apricot, walnut, apple, mulberry, and other temperate species contribute to household income and diversify agricultural production.

Marginal land covers **3,434.0 hectares (16.9%)**. These areas are constrained by steep slopes, shallow soils, rocky terrain, or limited water availability, making them less suitable for intensive cultivation without substantial investment in land and water management.

Built-up land represents **1,407.8 hectares (6.9%)**, the smallest land-use category within the mapped agricultural area. This indicates that settlement expansion has had relatively limited impact on productive agricultural land compared with other districts.

Overall, the land-use pattern demonstrates that Diamer possesses a strong agricultural resource base, with more than half of the agricultural land either under cultivation or immediately suitable for cultivation. The combination of productive cropland, extensive cultivable land, and well-established orchards provides considerable opportunities for increasing agricultural productivity through improved irrigation systems, modern farming practices, and climate-resilient agricultural technologies.

3.4.4 Key Findings

- Total agricultural land mapped: **20,324.5 hectares**.
- Cropland is the largest land-use category, accounting for **27.1%** of the agricultural area.
- Cultivable land comprises **25.8%**, indicating substantial potential for future agricultural expansion.
- Orchards and plantations occupy **23.3%**, reflecting the district's growing horticultural sector.
- Marginal land represents **16.9%**, highlighting the influence of mountainous terrain on land suitability.
- Built-up land accounts for only **6.9%**, suggesting that most irrigated land remains available for agricultural use.
- Diamer has significant potential for sustainable agricultural development through irrigation improvement, orchard expansion, efficient water management, and the productive utilization of cultivable land.

3.5 District Profile – Kharmang

3.5.1 District Overview

Kharmang District is located in the Baltistan Division of Gilgit-Baltistan and is situated along the upper reaches of the Indus River. The district is characterized by rugged mountainous terrain, narrow valleys, and glacier-fed streams that provide the primary source of irrigation for agriculture. Owing to its high-altitude environment and limited arable land, agricultural activities are concentrated in valley bottoms and settlements located below irrigation channels.

The district covers a geographical area of **2,535.5 km²** and comprises **42 revenue villages**, **one sub-division**, and **eight Union Councils**. Although Kharmang has one of the smallest geographical areas in Baltistan Division, agriculture remains the principal livelihood for the majority of its rural population. Crop cultivation, fruit production, and livestock farming form the backbone of the local economy.

The GIS-based assessment estimated the total agricultural land of Kharmang District at **7,664.8 hectares**. The agricultural landscape was classified into five major land-use categories: cropland, orchards and plantations, cultivable land, marginal land, and built-up land.

Administrative Information

Parameter	Value
Total Area	2,535.5 km²
Total Agricultural Land	7,664.8 ha
Revenue Villages	42
Sub-Divisions	1
Union Councils	8

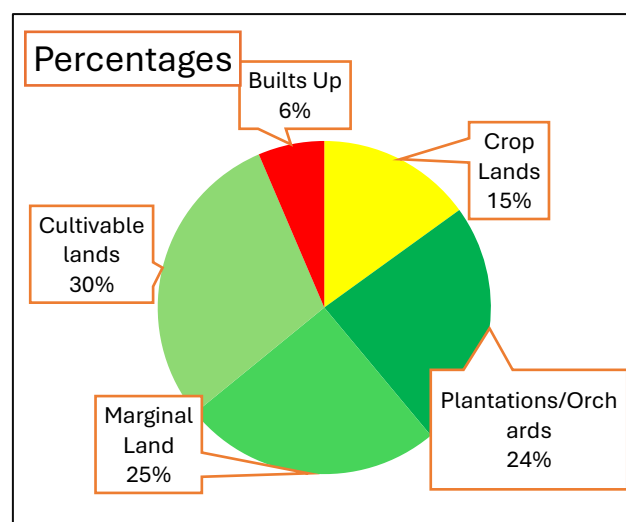
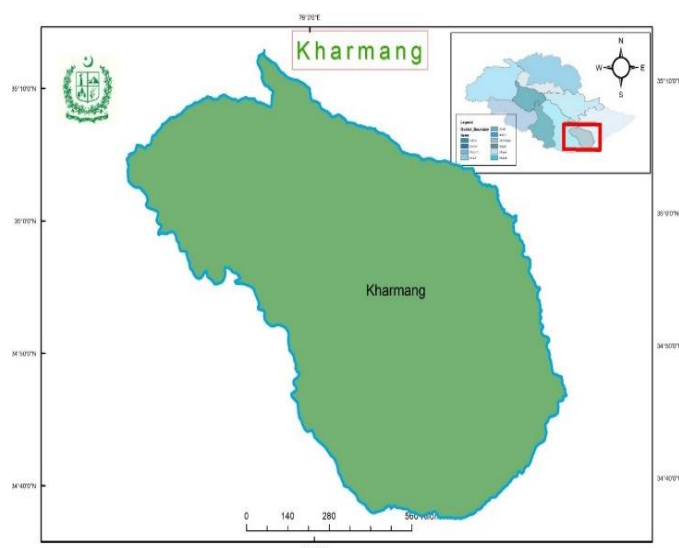


Figure 3.4: Location and agricultural land-use map of Kharmang District.

3.5.2 Land Use Statistics

The agricultural land-use analysis indicates that cultivable land occupies the largest share of the district's agricultural landscape, followed by marginal land and orchards.

Land Use Category	Area (ha)	Percentage (%)
Cultivable Land	2,258.1	29.5
Marginal Land	1,928.6	25.2
Orchards and Plantations	1,832.0	23.9
Cropland	1,153.2	15.0
Built-up Land	492.9	6.4
Total	7,664.8	100.0

Table 3.5: Agricultural land-use statistics of Kharmang District.

3.5.3 Results and Interpretation

The analysis reveals that **cultivable land** is the dominant land-use category in Kharmang District, covering **2,258.1 hectares (29.5%)** of the total agricultural area. This indicates that a significant proportion of the district possesses suitable land resources that could be brought under cultivation through the development of irrigation infrastructure, land reclamation, and improved agricultural management.

Marginal land occupies **1,928.6 hectares (25.2%)**, representing areas affected by steep slopes, rocky surfaces, shallow soils, or limited irrigation access. While these lands currently have limited agricultural productivity, appropriate soil and water conservation measures may improve their suitability for selected agricultural uses.

Orchards and plantations account for **1,832.0 hectares (23.9%)**, highlighting the important role of horticulture in the district's agricultural economy. Fruit crops such as apricot, apple, cherry, walnut, and mulberry are widely cultivated and provide an important source of household income.

Cropland covers **1,153.2 hectares (15.0%)**, the fourth largest land-use category. Wheat, barley, potato, vegetables, and fodder crops are the principal seasonal crops grown under glacier-fed irrigation systems. The relatively smaller proportion of cropland reflects the district's rugged terrain and the limited extent of irrigated agricultural land.

Built-up land occupies **492.9 hectares (6.4%)**, representing the smallest land-use category. Residential settlements, public infrastructure, farm buildings, and transportation networks are generally concentrated within valley settlements and occupy only a limited proportion of the agricultural landscape.

Overall, the results indicate that Kharmang District possesses considerable potential for future agricultural development. The substantial extent of cultivable land, together with the

established horticultural sector, provides opportunities for expanding agricultural production through improved irrigation efficiency, orchard management, and sustainable land development initiatives.

3.5.4 Key Findings

- Total agricultural land mapped: **7,664.8 hectares**.
- Cultivable land is the largest land-use category, accounting for **29.5%** of the agricultural area.
- Marginal land represents **25.2%**, reflecting the influence of mountainous terrain on agricultural suitability.
- Orchards and plantations occupy **23.9%**, demonstrating the significant contribution of horticulture to the district's economy.
- Cropland covers **15.0%**, supporting the production of staple crops and vegetables under irrigated conditions.
- Built-up land accounts for only **6.4%**, indicating limited urban encroachment on agricultural land.
- The district has considerable potential for expanding agricultural production through irrigation development, improved land management, and the productive utilization of currently cultivable land.

3.6 District Profile – Skardu

3.6.1 District Overview

Skardu District is the administrative headquarters of Baltistan Division and one of the most agriculturally significant districts of Gilgit-Baltistan. Located along the Indus River, the district is characterized by broad alluvial plains, fertile valleys, and an extensive glacier-fed irrigation network that supports diverse agricultural activities. Compared with other districts in Baltistan, Skardu possesses relatively larger areas of irrigated land, making it an important center for crop production, horticulture, and livestock farming.

The district covers a geographical area of **7,894.7 km²** and comprises **78 revenue villages**, **two sub-divisions**, and **one municipal area**. Agriculture is concentrated in valley bottoms where fertile soils and reliable irrigation water provide favorable conditions for cultivating cereals, vegetables, and temperate fruits.

The GIS-based agricultural land assessment estimated a total agricultural area of **26,887.6 hectares**, making Skardu one of the largest agricultural districts in Gilgit-Baltistan. Agricultural land was classified into five major land-use categories: cropland, orchards and plantations, cultivable land, marginal land, and built-up land.

Administrative Information

Parameter	Value
Total Area	7,894.7 km²
Total Agricultural Land	26,887.6 ha
Revenue Villages	78
Sub-Divisions	2
Union Councils / Municipal Areas	1 Municipal Area

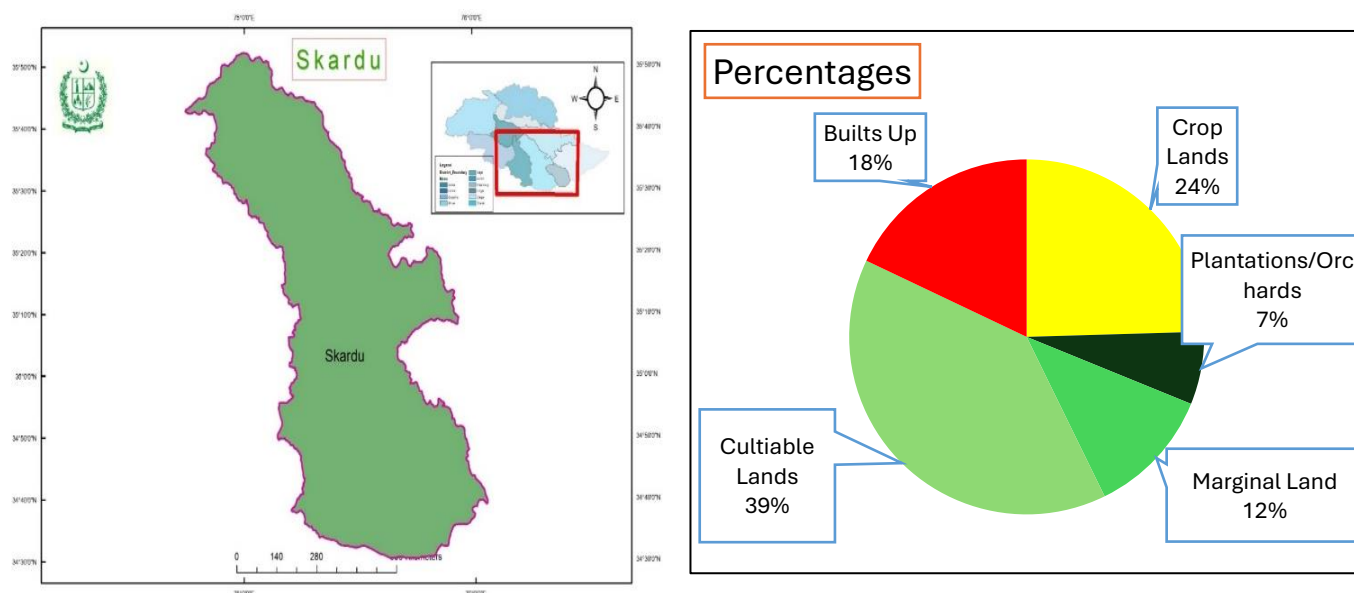


Figure 3.5: Location and agricultural land-use map of Skardu District.

3.6.2 Land Use Statistics

The land-use assessment shows that cultivable land occupies the largest share of the district's agricultural landscape, followed by cropland and built-up land.

Land Use Category	Area (ha)	Percentage (%)
Cultivable Land	10,567.6	39.3
Cropland	6,595.4	24.5
Built-up Land	4,823.9	17.9
Marginal Land	3,118.3	11.6
Orchards and Plantations	1,782.3	6.6
Total	26,887.6	100.0

Table 3.6: Agricultural land-use statistics of Skardu District.

3.6.3 Results and Interpretation

The analysis indicates that **cultivable land** is the dominant land-use category, accounting for **10,567.6 hectares (39.3%)** of the total agricultural area. This is the highest proportion among all land-use categories within the district and reflects the considerable availability of land that can be developed for future agricultural production through improved irrigation systems and land development initiatives.

Cropland occupies **6,595.4 hectares (24.5%)**, representing the second largest land-use category. The district supports the cultivation of wheat, barley, potato, vegetables, and fodder crops, which form the basis of local food production and rural livelihoods. The relatively large area under cultivation highlights Skardu's importance as one of the principal agricultural districts of Baltistan.

Built-up land covers **4,823.9 hectares (17.9%)**, representing a larger proportion than in most other districts of Gilgit-Baltistan. This reflects the concentration of administrative offices, commercial centers, transportation infrastructure, educational institutions, and expanding urban settlements within the district headquarters.

Marginal land accounts for **3,118.3 hectares (11.6%)** of the agricultural landscape. These areas are characterized by limitations such as uneven terrain, coarse soils, or restricted irrigation access, reducing their suitability for intensive cultivation.

Orchards and plantations occupy **1,782.3 hectares (6.6%)**, the smallest land-use category within the district. Although horticulture contributes significantly to household income, the relatively lower proportion of orchard land indicates that agricultural production in Skardu is more strongly oriented toward field crops than perennial fruit cultivation.

Overall, the results demonstrate that Skardu District possesses substantial agricultural resources with considerable opportunities for future expansion. The large extent of cultivable land, together with an extensive irrigated cropland area, provides an excellent

foundation for increasing agricultural productivity through efficient water management, modern farming practices, and sustainable land-use planning.

3.6.4 Key Findings

- Total agricultural land mapped: **26,887.6 hectares**.
- Skardu has one of the largest agricultural areas in Gilgit-Baltistan.
- Cultivable land is the dominant land-use category, accounting for **39.3%** of the agricultural area.
- Cropland occupies **24.5%**, demonstrating the district's importance in agricultural production.
- Built-up land represents **17.9%**, reflecting the concentration of urban development and administrative infrastructure.
- Marginal land covers **11.6%**, indicating moderate terrain-related limitations.
- Orchards and plantations account for **6.6%**, suggesting potential for future horticultural expansion.
- Continued investment in irrigation infrastructure, climate-smart agriculture, mechanization, and efficient land management will further enhance agricultural productivity and strengthen food security within the district.

3.7 District Profile – Ghanche

3.7.1 District Overview

Ghanche District is the easternmost district of Gilgit-Baltistan and forms part of the Baltistan Division. The district shares an international border with China and India and is characterized by high mountain ranges, glaciers, and narrow river valleys. Agriculture is concentrated in irrigated valley floors where glacier- and snow-fed streams provide the essential water resources required for crop cultivation and horticulture.

The district covers a geographical area of **9,116.6 km²** and comprises **61 revenue villages** distributed across **three sub-divisions**. Agriculture remains the primary source of livelihood for the majority of the rural population, with farming systems largely based on cereals, vegetables, fruit orchards, and livestock production.

The GIS-based agricultural land assessment estimated a total agricultural area of **15,234.6 hectares** in Ghanche District. Agricultural land was classified into five major land-use categories: cropland, orchards and plantations, cultivable land, marginal land, and built-up land.

Administrative Information

Parameter	Value
Total Area	9,116.6 km ²
Total Agricultural Land	15,234.6 ha
Revenue Villages	61
Sub-Divisions	3

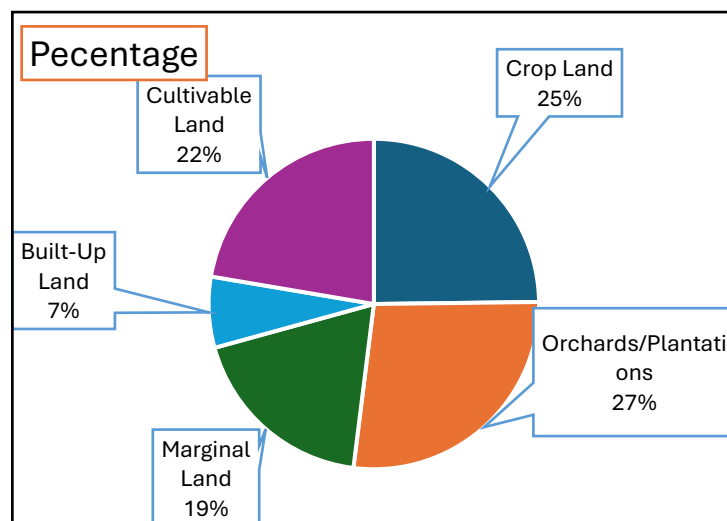
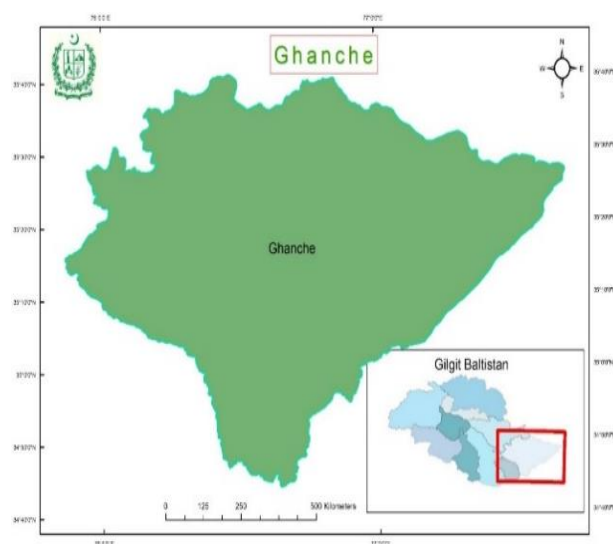


Figure 3.6: Location and agricultural land-use map of Ghanche District.

3.7.2 Land Use Statistics

The land-use analysis indicates that orchards and plantations constitute the largest agricultural land-use category in Ghanche District, highlighting the district's comparative advantage in horticultural production.

Land Use Category	Area (ha)	Percentage (%)
Orchards and Plantations	4,139.7	27.2
Cropland	3,778.6	24.8
Cultivable Land	3,402.4	22.3
Marginal Land	2,857.0	18.8
Built-up Land	1,056.9	6.9
Total	15,234.6	100.0

Table 3.7: Agricultural land-use statistics of Ghanche District.

3.7.3 Results and Interpretation

The assessment reveals that **orchards and plantations** are the dominant land-use category, covering **4,139.7 hectares (27.2%)** of the total agricultural area. This is the highest proportion among all land-use categories within the district and reflects Ghanche's favorable climatic conditions for the cultivation of temperate fruit trees. Apricot, apple, cherry, walnut, and other fruit crops contribute significantly to household income and the local economy.

Cropland occupies **3,778.6 hectares (24.8%)**, representing the second largest land-use category. Wheat, barley, potato, vegetables, and fodder crops are the principal agricultural commodities cultivated under glacier-fed irrigation systems. The extensive cropland demonstrates the district's continued reliance on traditional crop production for food security.

Cultivable land accounts for **3,402.4 hectares (22.3%)**, indicating the presence of substantial land resources that could be brought under cultivation through irrigation expansion, land improvement, and sustainable agricultural development programs.

Marginal land covers **2,857.0 hectares (18.8%)**, representing areas affected by topographic constraints, shallow soils, rocky surfaces, or limited irrigation access. While these lands are currently less productive, targeted soil and water conservation measures may enhance their agricultural potential.

Built-up land occupies **1,056.9 hectares (6.9%)**, representing the smallest proportion of the agricultural landscape. Residential settlements, public infrastructure, and transportation networks remain largely confined to valley settlements, minimizing their impact on productive agricultural land.

Overall, the land-use pattern indicates that Ghanche District possesses a well-balanced agricultural system, with a strong emphasis on horticulture complemented by extensive cropland and significant cultivable land reserves. Continued investment in orchard

management, irrigation efficiency, and climate-resilient agricultural practices will further strengthen agricultural productivity and support sustainable rural development.

3.7.4 Key Findings

- Total agricultural land mapped: **15,234.6 hectares**.
- Orchards and plantations constitute the largest land-use category, accounting for **27.2%** of the agricultural area.
- Cropland occupies **24.8%**, reflecting the district's strong agricultural production base.
- Cultivable land represents **22.3%**, indicating considerable potential for future agricultural expansion.
- Marginal land accounts for **18.8%**, primarily due to mountainous terrain and environmental constraints.
- Built-up land covers only **6.9%**, suggesting limited conversion of agricultural land to settlements.
- The district has excellent potential for expanding high-value horticulture while improving crop productivity through efficient irrigation, modern farming techniques, and sustainable land management practices.

3.8 District Profile – Shigar

3.8.1 District Overview

Shigar District is situated in the Baltistan Division of Gilgit-Baltistan and is internationally recognized for its unique mountainous landscape, fertile valleys, and rich agricultural heritage. The district is traversed by the Shigar River, which originates from the Karakoram glaciers and provides the primary source of irrigation for agricultural activities. Despite the harsh climatic conditions and rugged terrain, agriculture remains one of the most important economic activities, supporting the livelihoods of the majority of the rural population.

The district covers a geographical area of **7,248.8 km²** and consists of **57 revenue villages**, **one sub-division**, and **ten Union Councils**. Agricultural activities are concentrated in irrigated valleys where suitable soils and adequate water availability support the cultivation of cereals, vegetables, and temperate fruit orchards.

The GIS-based land use assessment estimated the total agricultural area of Shigar District at **11,052.3 hectares**. Agricultural land was classified into five major land-use categories: cropland, orchards and plantations, cultivable land, marginal land, and built-up land.

Administrative Information

Parameter	Value
Total Area	7,248.8 km²
Total Agricultural Land	11,052.3 ha
Revenue Villages	57
Sub-Divisions	1
Union Councils	10

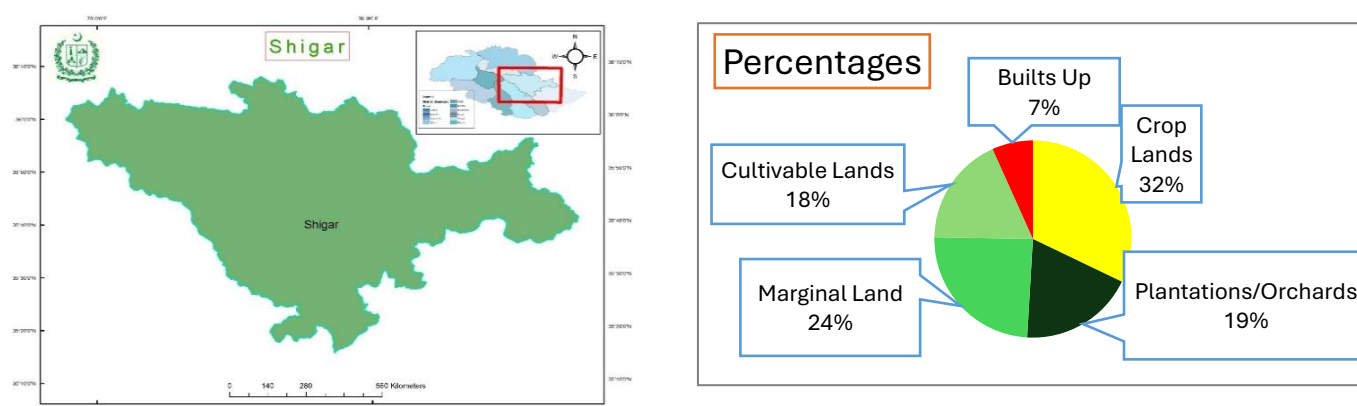


Figure 3.7: Location and agricultural land-use map of Shigar District.

3.8.2 Land Use Statistics

The agricultural land-use analysis indicates that cropland occupies the largest proportion of agricultural land in Shigar District, followed by marginal land and orchards.

Land Use Category	Area (ha)	Percentage (%)
Cropland	3,551.1	32.1
Marginal Land	2,691.0	24.3
Orchards and Plantations	2,080.1	18.8
Cultivable Land	1,988.3	18.0
Built-up Land	741.9	6.7
Total	11,052.3	100.0

Table 3.8: Agricultural land-use statistics of Shigar District.

3.8.3 Results and Interpretation

The analysis shows that **cropland** is the dominant land-use category in Shigar District, accounting for **3,551.1 hectares (32.1%)** of the total agricultural area. This is the highest proportion among all land-use categories within the district, indicating that a significant share of the available agricultural land is actively utilized for crop production. Major crops include wheat, barley, potato, vegetables, and fodder crops, all of which depend on glacier-fed irrigation systems.

Marginal land occupies **2,691.0 hectares (24.3%)**, making it the second largest land-use category. These areas are generally characterized by steep slopes, coarse-textured soils, or limited irrigation access, which restrict their agricultural productivity. However, selected areas may be improved through appropriate soil conservation and irrigation development measures.

Orchards and plantations cover **2,080.1 hectares (18.8%)**, reflecting the district's well-established horticultural sector. Fruit crops such as apricot, apple, cherry, walnut, and mulberry are widely cultivated and contribute significantly to household income and local agricultural markets.

Cultivable land accounts for **1,988.3 hectares (18.0%)**, indicating the availability of additional land resources that could be developed for agricultural production. Investment in irrigation infrastructure, land leveling, and soil improvement could enable these areas to be brought under cultivation in the future.

Built-up land occupies **741.9 hectares (6.7%)**, representing the smallest land-use category. Residential settlements, educational institutions, public facilities, and transportation infrastructure are concentrated within village boundaries and occupy only a limited portion of the agricultural landscape.

Overall, the land-use pattern demonstrates that Shigar District has a strong agricultural foundation with a high proportion of land already under cultivation. The combination of productive cropland, expanding horticultural activities, and available cultivable land

presents considerable opportunities for sustainable agricultural development. Future initiatives should focus on improving irrigation efficiency, promoting climate-smart farming practices, and enhancing the value chain for agricultural and horticultural products.

3.8.4 Key Findings

- Total agricultural land mapped: **11,052.3 hectares**.
- Cropland is the dominant land-use category, accounting for **32.1%** of the agricultural area.
- Marginal land represents **24.3%**, highlighting the influence of mountainous terrain on agricultural suitability.
- Orchards and plantations occupy **18.8%**, emphasizing the importance of horticulture in the district's economy.
- Cultivable land accounts for **18.0%**, indicating opportunities for future agricultural expansion.
- Built-up land covers **6.7%**, demonstrating limited urban encroachment on productive agricultural land.
- Strengthening irrigation systems, promoting sustainable land management, and supporting high-value horticulture will further enhance agricultural productivity and improve rural livelihoods in Shigar District.

3.9 District Profile – Gilgit

3.9.1 District Overview

Gilgit District serves as the administrative capital of Gilgit-Baltistan and is the economic, commercial, and administrative hub of the region. Strategically located along the Karakoram Highway (KKH), the district has well-developed infrastructure, markets, educational institutions, and government offices. Despite rapid urbanization, agriculture continues to play a vital role in the local economy, particularly in rural areas where farming, horticulture, and livestock production remain the primary sources of livelihood.

The district covers a geographical area of **4,123.4 km²** and consists of **55 revenue villages**, **two sub-divisions**, and **eleven Union Councils**. Agricultural activities are concentrated in irrigated valleys along the Gilgit River and its tributaries, where glacier-fed irrigation systems provide water for crop cultivation and fruit production.

The GIS-based agricultural land assessment estimated a total agricultural area of **16,052.6 hectares** in Gilgit District. The agricultural landscape was classified into five major land-use categories: cropland, orchards and plantations, cultivable land, marginal land, and built-up land.

Administrative Information

Parameter	Value
Total Area	4,123.4 km²
Total Agricultural Land	16,052.6 ha
Revenue Villages	55
Sub-Divisions	2
Union Councils	11

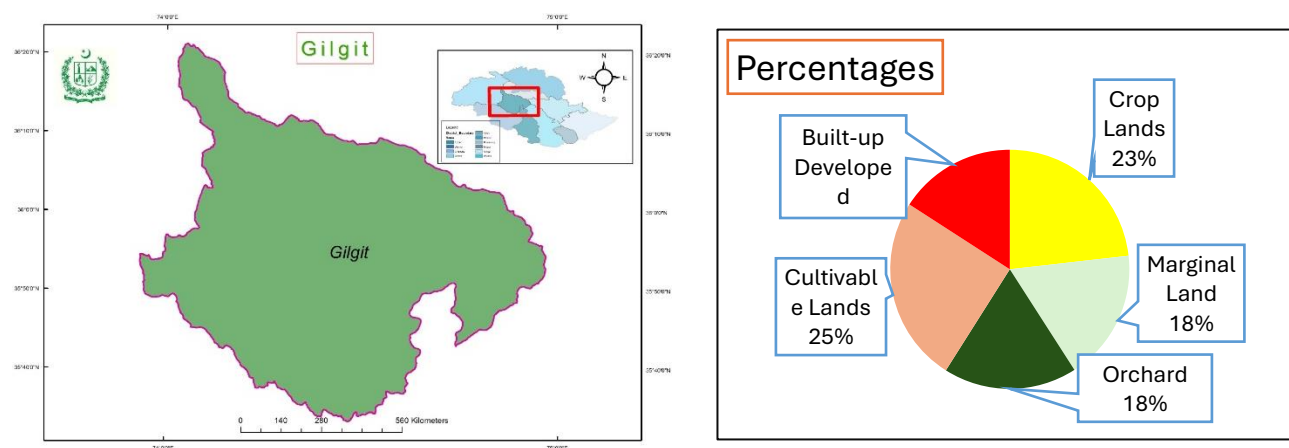


Figure 3.8: Location and agricultural land-use map of Gilgit District.

3.9.2 Land Use Statistics

The agricultural land-use assessment indicates that cultivable land occupies the largest share of agricultural land in Gilgit District, followed by cropland, orchards and plantations, marginal land, and built-up land.

Land Use Category	Area (ha)	Percentage (%)
Cultivable Land	4,037.0	25.1
Cropland	3,721.4	23.2
Orchards and Plantations	2,899.9	18.1
Marginal Land	2,845.9	17.7
Built-up Land	2,548.4	15.9
Total	16,052.6	100.0

Table 3.9: Agricultural land-use statistics of Gilgit District.

3.9.3 Results and Interpretation

The analysis shows that **cultivable land** is the largest land-use category in Gilgit District, covering **4,037.0 hectares (25.1%)** of the total agricultural area. This indicates that a considerable portion of land is suitable for cultivation and offers opportunities for expanding agricultural production through improved irrigation infrastructure, land development, and sustainable farming practices.

Cropland occupies **3,721.4 hectares (23.2%)**, representing the second largest land-use category. The district supports the cultivation of wheat, maize, barley, potato, vegetables, and fodder crops. The relatively large area under cultivation reflects the importance of agriculture in supporting food security and rural livelihoods despite increasing urbanization.

Orchards and plantations account for **2,899.9 hectares (18.1%)**, highlighting the significance of horticulture within the district. Fruit crops including apricot, apple, cherry, pear, walnut, and grape are widely cultivated and contribute substantially to farmers' incomes as well as local and regional markets.

Marginal land covers **2,845.9 hectares (17.7%)**, representing areas with physical limitations such as steep slopes, shallow soils, coarse surface materials, or limited irrigation access. Although these lands currently have lower agricultural productivity, targeted land improvement and soil conservation measures could enhance their future utilization.

Built-up land occupies **2,548.4 hectares (15.9%)**, representing a relatively higher proportion than many rural districts of Gilgit-Baltistan. This reflects the concentration of residential settlements, commercial establishments, public institutions, transportation infrastructure, and urban expansion within the provincial capital. Continued urban growth underscores the need for effective land-use planning to protect valuable agricultural land from unnecessary conversion.

Overall, the results demonstrate that Gilgit District maintains a balanced agricultural landscape, with substantial areas under cultivation, horticulture, and cultivable land. The district is well positioned to enhance agricultural productivity through improved irrigation management, adoption of modern agricultural technologies, and sustainable urban planning that safeguards productive agricultural resources.

3.9.4 Key Findings

- Total agricultural land mapped: **16,052.6 hectares**.
- Cultivable land is the dominant land-use category, accounting for **25.1%** of the agricultural area.
- Cropland occupies **23.2%**, highlighting the district's continued importance in agricultural production.
- Orchards and plantations represent **18.1%**, reflecting the economic significance of horticultural crops.
- Marginal land accounts for **17.7%**, indicating the influence of topography and environmental constraints.
- Built-up land covers **15.9%**, one of the highest proportions among the districts, reflecting rapid urban and infrastructure development.
- Future agricultural planning should focus on protecting productive farmland, improving irrigation efficiency, promoting high-value horticulture, and integrating sustainable land-use planning with urban expansion to ensure long-term agricultural sustainability.

3.10 District Profile – Astore

3.10.1 District Overview

Astore District is located in the Diamer Division of Gilgit-Baltistan and is renowned for its scenic valleys, alpine meadows, forests, and glacier-fed river systems. The district is characterized by diverse topography, ranging from fertile valley floors to high mountain landscapes, where agriculture is concentrated in irrigated areas below water channels. The favorable climatic conditions support the cultivation of cereals, vegetables, and temperate fruit crops, making agriculture one of the principal sources of livelihood for the local population.

The district covers a geographical area of **5,055.7 km²** and comprises **49 revenue villages**, **two sub-divisions**, and **eight Union Councils**. Agricultural activities are predominantly practiced in valley settlements where fertile soils and reliable irrigation water from glaciers and snowmelt provide suitable conditions for crop production.

The GIS-based agricultural land assessment estimated the total agricultural area of Astore District at **16,165.0 hectares**. Agricultural land was classified into five major land-use categories: cropland, orchards and plantations, cultivable land, marginal land, and built-up land.

Administrative Information

Parameter	Value
Total Area	5,055.7 km²
Total Agricultural Land	16,165.0 ha
Revenue Villages	49
Sub-Divisions	2
Union Councils	8

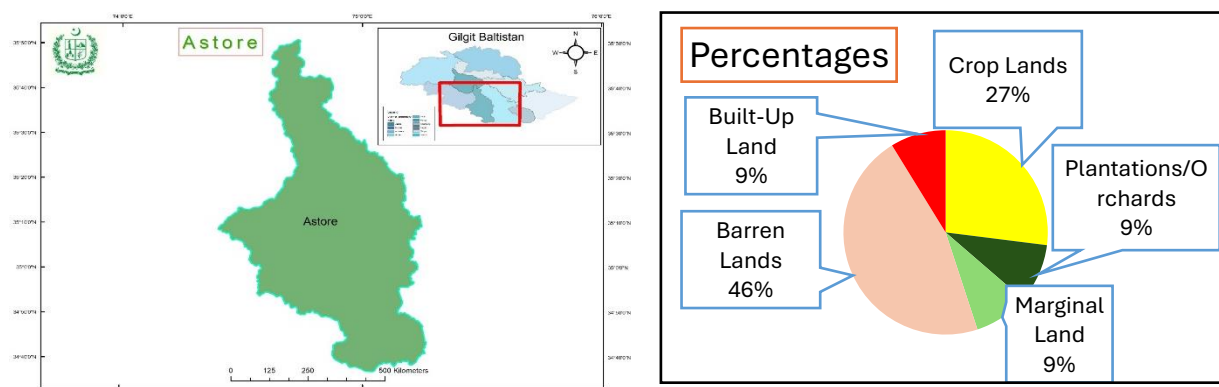


Figure 3.9: Location and agricultural land-use map of Astore District.

3.10.2 Land Use Statistics

The agricultural land-use analysis reveals that cultivable land occupies nearly half of the district's agricultural landscape, making it the dominant land-use category.

Land Use Category	Area (ha)	Percentage (%)
Cultivable Land	7,479.6	46.3
Cropland	4,364.6	27.0
Orchards and Plantations	1,508.2	9.3
Built-up Land	1,420.1	8.8
Marginal Land	1,392.5	8.6
Total	16,165.0	100.0

Table 3.10: Agricultural land-use statistics of Astore District.

3.10.3 Results and Interpretation

The analysis indicates that **cultivable land** is the dominant land-use category, accounting for **7,479.6 hectares (46.3%)** of the total agricultural area. This is the highest proportion of cultivable land among all districts included in the study, demonstrating the district's considerable potential for future agricultural expansion. The availability of suitable land presents significant opportunities for increasing agricultural production through irrigation development, land improvement, and sustainable resource management.

Cropland occupies **4,364.6 hectares (27.0%)**, representing the second largest land-use category. The district supports the cultivation of wheat, barley, potato, maize, vegetables, and fodder crops under glacier-fed irrigation systems. The extensive cropland reflects the importance of agriculture in sustaining local livelihoods and ensuring household food security.

Orchards and plantations account for **1,508.2 hectares (9.3%)**, indicating a developing but comparatively smaller horticultural sector. Fruit crops such as apricot, apple, cherry, walnut, and pear are cultivated in favorable valley locations and provide an additional source of income for farming households.

Built-up land covers **1,420.1 hectares (8.8%)**, including residential settlements, public infrastructure, transportation networks, and farm-related facilities. The relatively modest proportion of built-up land indicates that urban expansion has had limited impact on productive agricultural land.

Marginal land occupies **1,392.5 hectares (8.6%)**, representing the smallest land-use category in the district. These lands are generally affected by steep slopes, shallow soils, rocky terrain, or limited irrigation access, restricting their suitability for intensive cultivation.

Overall, the land-use pattern highlights Astore District as one of the most promising areas for future agricultural development in Gilgit-Baltistan. The extensive cultivable land, combined with productive cropland and favorable agro-climatic conditions, provides

substantial opportunities for expanding agricultural production, promoting high-value crops, and strengthening food security through sustainable land and water management.

3.10.4 Key Findings

- Total agricultural land mapped: **16,165.0 hectares**.
- Cultivable land is the dominant land-use category, accounting for **46.3%** of the agricultural area—the highest proportion among all districts.
- Cropland occupies **27.0%**, highlighting the district’s strong agricultural production base.
- Orchards and plantations represent **9.3%**, indicating potential for further expansion of horticulture.
- Built-up land covers **8.8%**, reflecting relatively limited urban development within agricultural areas.
- Marginal land accounts for **8.6%**, the lowest proportion among the five land-use categories.
- Astore possesses significant opportunities for agricultural expansion through irrigation development, improved land management, and diversification into high-value horticultural crops while ensuring the sustainable use of natural resources.

3.11 District Profile – Ghizer

3.11.1 District Overview

Ghizer District is located in the western part of Gilgit-Baltistan and forms an important component of the Gilgit Division. The district is bordered by Chitral to the west and is characterized by extensive valleys, glacier-fed rivers, fertile plains, and high mountain ranges. The Ghizer River and its tributaries provide a reliable source of irrigation water, enabling agricultural activities across numerous fertile valleys.

The district covers a geographical area of **11,885.8 km²** and comprises **80 revenue villages, two sub-divisions, and sixteen Union Councils**. Agriculture is the principal economic activity, supported by favorable valley conditions and relatively larger irrigated areas compared to many other districts of Gilgit-Baltistan. Major agricultural activities include cereal production, vegetable cultivation, fruit orchards, and livestock farming.

The GIS-based agricultural land assessment estimated a total agricultural area of **36,087.1 hectares**, making Ghizer the district with the **largest agricultural land area in Gilgit-Baltistan**. Agricultural land was classified into five major land-use categories: cropland, orchards and plantations, cultivable land, marginal land, and built-up land.

Administrative Information

Parameter	Value
Total Area	11,885.8 km²
Total Agricultural Land	36,087.1 ha
Revenue Villages	80
Sub-Divisions	2
Union Councils	16

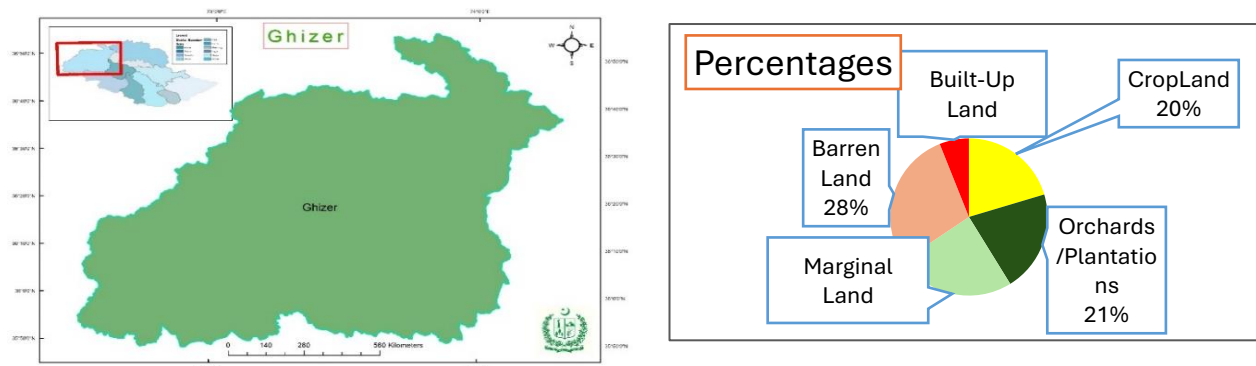


Figure 3.10: Location and agricultural land-use map of Ghizer District.

3.11.2 Land Use Statistics

The agricultural land-use assessment indicates that cultivable land occupies the largest share of the district’s agricultural landscape, followed by marginal land, orchards, cropland, and built-up land.

Land Use Category	Area (ha)	Percentage (%)
Cultivable Land	10,226.7	28.3
Marginal Land	8,812.1	24.4
Orchards and Plantations	7,509.5	20.8
Cropland	7,354.9	20.4
Built-up Land	2,183.9	6.1
Total	36,087.1	100.0

Table 3.11: Agricultural land-use statistics of Ghizer District.

3.11.3 Results and Interpretation

The analysis reveals that **cultivable land** is the dominant land-use category in Ghizer District, covering **10,226.7 hectares (28.3%)** of the total agricultural area. This extensive area indicates considerable potential for future agricultural expansion through irrigation improvement, land development, and sustainable farming practices. The availability of cultivable land provides significant opportunities for increasing agricultural production and enhancing food security across the district.

Marginal land occupies **8,812.1 hectares (24.4%)**, making it the second largest land-use category. These areas are generally constrained by rugged topography, shallow soils, gravel deposits, or limited irrigation access. Appropriate soil conservation measures and efficient water management could improve the productivity of selected marginal lands.

Orchards and plantations account for **7,509.5 hectares (20.8%)**, reflecting the district’s strong horticultural potential. Ghizer is well known for producing high-quality apricots, apples, cherries, walnuts, and other temperate fruits, which contribute substantially to household incomes and regional agricultural markets.

Cropland covers **7,354.9 hectares (20.4%)**, supporting the cultivation of wheat, barley, maize, potato, vegetables, and fodder crops. The extensive cropland demonstrates the district’s significant contribution to agricultural production within Gilgit-Baltistan.

Built-up land occupies **2,183.9 hectares (6.1%)**, representing the smallest land-use category. Residential settlements, transportation networks, educational institutions, and public infrastructure are primarily concentrated in valley settlements, resulting in relatively limited conversion of agricultural land to built-up uses.

Overall, the results demonstrate that Ghizer District possesses the largest agricultural resource base in Gilgit-Baltistan. The combination of extensive cultivable land, productive cropland, well-developed orchards, and favorable natural conditions provides exceptional opportunities for sustainable agricultural development. Continued investment in irrigation

infrastructure, climate-smart agriculture, orchard management, and value-added agricultural enterprises will further strengthen the district’s contribution to regional food security and economic growth.

3.11.4 Key Findings

- Total agricultural land mapped: **36,087.1 hectares**, the largest among all districts of Gilgit-Baltistan.
- Cultivable land is the dominant land-use category, accounting for **28.3%** of the agricultural area.
- Marginal land represents **24.4%**, reflecting the influence of mountainous terrain on land capability.
- Orchards and plantations occupy **20.8%**, demonstrating the district’s strong comparative advantage in temperate fruit production.
- Cropland covers **20.4%**, supporting substantial cereal, vegetable, and fodder production.
- Built-up land accounts for only **6.1%**, indicating minimal urban encroachment on productive agricultural land.
- Ghizer has outstanding potential for expanding agricultural production through efficient irrigation management, modernization of farming practices, orchard development, and sustainable utilization of its extensive cultivable land resources.

3.12 Distribution of Land Use Categories

3.12.1 Overview

The GIS-based agricultural land assessment provides a comprehensive understanding of the spatial distribution of agricultural land across Gilgit-Baltistan. The classification of agricultural land into five major Land Use/Land Cover (LULC) categories—**Cropland, Orchards and Plantations, Cultivable Land, Marginal Land, and Built-up Land**—offers valuable insights into the current agricultural resource base and future development potential of the region.

The distribution of these land-use categories reflects the influence of topography, climate, soil characteristics, irrigation availability, and settlement patterns across the diverse mountain landscapes of Gilgit-Baltistan. While actively cultivated cropland represents the existing agricultural production area, cultivable land highlights opportunities for future expansion. Similarly, orchards and plantations demonstrate the growing importance of horticulture in the regional economy, whereas marginal lands identify areas with physical constraints requiring targeted land improvement measures.

Figure 3.11 illustrates the overall distribution of agricultural land-use categories across all districts of Gilgit-Baltistan.

Figure 3.11: Distribution of agricultural land-use categories in Gilgit-Baltistan.

3.12.2 Overall Land Use Distribution

The district-wise GIS analysis estimated a total agricultural land area of **173,545 hectares**, distributed among the five land-use categories as presented in Table 3.12.

Land Use Category	Area (ha)	Share of Agricultural Land (%)
Cultivable Land	51,472	29.7
Crop Land	39,666	22.9
Marginal Land	31,974	18.4
Orchards and Plantations	29,775	17.2
Built-up Land	20,659	11.9
Total Agricultural Land	173,545	100.0

Table 3.12: Overall distribution of agricultural land-use categories in Gilgit-Baltistan.

3.12.3 Interpretation of Land Use Distribution

The analysis indicates that **cultivable land** constitutes the largest component of the agricultural landscape, accounting for **51,472 hectares (29.7%)** of the mapped agricultural area. This substantial land resource represents areas that possess suitable characteristics for agricultural development but are not currently under active cultivation. The availability of extensive cultivable land highlights significant opportunities for increasing agricultural production through irrigation development, land reclamation, and sustainable resource management.

Cropland occupies **39,666 hectares (22.9%)**, making it the second largest land-use category. These lands represent the actively cultivated agricultural fields supporting the production of wheat, maize, barley, potato, vegetables, and fodder crops throughout Gilgit-Baltistan. The widespread distribution of cropland demonstrates the critical role of agriculture in ensuring regional food security and sustaining rural livelihoods.

Marginal land covers **31,974 hectares (18.4%)** of the agricultural landscape. These areas are generally constrained by steep slopes, rocky terrain, shallow soils, erosion, or limited irrigation facilities. Although their current agricultural productivity is relatively low, many of these lands could be improved through watershed management, soil conservation, irrigation expansion, and appropriate land management practices.

Orchards and plantations account for **29,775 hectares (17.2%)**, reflecting the increasing importance of horticulture in the economy of Gilgit-Baltistan. Fruit production, particularly apricot, apple, cherry, walnut, grape, and pear, has become an important source of income for farming communities. The expansion of modern orchard management practices and value-added processing has the potential to further strengthen this sector.

Built-up land represents **20,659 hectares (11.9%)** of the mapped agricultural landscape. These areas include residential settlements, transportation infrastructure, commercial establishments, public institutions, and other developed land uses situated within agricultural boundaries. Although built-up land occupies the smallest share among the five

categories, careful land-use planning is necessary to minimize the conversion of productive agricultural land into urban and infrastructure developments.

3.12.4 Overall Assessment

The overall land-use distribution demonstrates that Gilgit-Baltistan possesses a strong agricultural resource base with considerable opportunities for future expansion. Nearly one-third of the agricultural landscape consists of cultivable land, indicating substantial potential for increasing agricultural production through investments in irrigation infrastructure, land development, and climate-resilient farming practices.

The significant proportion of cropland confirms the continued importance of agriculture in supporting rural livelihoods and regional food security, while the extensive area under orchards highlights the growing contribution of horticulture to household income and the regional economy. At the same time, the presence of marginal lands emphasizes the need for integrated watershed management, soil conservation, and sustainable land rehabilitation programs.

Overall, the GIS-based land-use assessment provides a reliable spatial database that can support evidence-based planning, policy formulation, resource allocation, agricultural investment, and long-term monitoring of land-use changes across Gilgit-Baltistan.

3.13 Division-wise Distribution of Agricultural Land Use

3.13.1 Overview

To facilitate regional planning and resource allocation, the district-level agricultural land-use statistics were aggregated into the three administrative divisions of Gilgit-Baltistan, namely **Baltistan Division**, **Diamer Division**, and **Gilgit Division**. Division-wise analysis provides a broader understanding of agricultural resources, land-use patterns, and development opportunities at the regional scale.

The aggregation of district statistics highlights spatial variations in cropland, orchards and plantations, cultivable land, marginal land, and built-up land across the province. These variations are primarily influenced by differences in topography, climate, irrigation infrastructure, population distribution, and agricultural practices.

The division-wise analysis serves as an important tool for prioritizing agricultural investments, designing region-specific development strategies, and supporting evidence-based policy decisions.

3.13.2 Baltistan Division

Baltistan Division comprises the districts of **Skardu, Shigar, Kharmang, and Ghanche**. The division is characterized by high-altitude valleys, glacier-fed irrigation systems, and fertile alluvial plains that support both crop cultivation and horticulture. Agriculture is concentrated along river valleys where water availability and fertile soils create suitable conditions for farming.

The GIS-based assessment estimated the total agricultural land area of **60,839.3 hectares** in Baltistan Division.

Agricultural Land Use Statistics

Land Use Category	Area (ha)
Cropland	15,078.3
Orchards and Plantations	9,834.2
Marginal Land	10,594.9
Cultivable Land	18,216.4
Built-up Land	7,115.6
Total	60,839.3

Table 3.13: Agricultural land-use statistics of Baltistan Division.

Results and Interpretation

The analysis indicates that **cultivable land** constitutes the largest land-use category in Baltistan Division, covering **18,216.4 hectares**, representing nearly one-third of the division’s agricultural landscape. This substantial reserve of cultivable land provides significant opportunities for expanding agricultural production through irrigation development and land improvement initiatives.

Cropland, occupying **15,078.3 hectares**, represents the second largest category and reflects the importance of cereal and vegetable production throughout the division. Wheat, barley, potato, and vegetables remain the dominant field crops cultivated under glacier-fed irrigation systems.

Marginal land covers **10,594.9 hectares**, indicating the influence of mountainous terrain, shallow soils, and limited irrigation on agricultural suitability. Appropriate land management practices and watershed conservation measures can improve the productivity of selected marginal areas.

Orchards and plantations occupy **9,834.2 hectares**, demonstrating the growing importance of temperate fruit production across Baltistan. Apricot, apple, cherry, walnut, and mulberry are among the principal fruit crops cultivated within the division.

Built-up land accounts for **7,115.6 hectares**, representing the smallest land-use category. Urban settlements and infrastructure remain largely confined to valley floors, minimizing their impact on productive agricultural land.

Overall, Baltistan Division possesses considerable agricultural potential, particularly for expanding irrigated agriculture, strengthening horticultural production, and improving the productivity of cultivable land through sustainable resource management.

Key Findings

- Total agricultural land: **60,839.3 hectares**.
- Cultivable land is the largest land-use category.
- Cropland represents the second largest agricultural resource.
- Horticulture contributes significantly to the regional economy.
- Extensive cultivable land offers opportunities for future agricultural expansion.
- Sustainable irrigation management remains essential for improving agricultural productivity throughout the division.

3.13.3 Diamer Division

Diamer Division comprises the districts of **Diamer** and **Astore**. Located in the southern part of Gilgit-Baltistan, the division encompasses diverse landscapes ranging from rugged mountain slopes to fertile river valleys. Agriculture is primarily practiced in irrigated valley bottoms, where glacier- and snow-fed streams provide the water required for crop cultivation and horticulture.

The division possesses considerable agricultural potential due to its extensive cultivable land, favorable climatic conditions, and well-established farming communities. Wheat, maize, barley, potato, vegetables, and temperate fruits constitute the major agricultural products of the division.

The GIS-based land use assessment estimated the total agricultural area of **36,489.5 hectares** within Diamer Division.

Agricultural Land Use Statistics

Land Use Category	Area (ha)
Cropland	9,867.9
Orchards and Plantations	6,243.7
Cultivable Land	12,723.4
Marginal Land	4,826.5
Built-up Land	2,827.9
Total	36,489.5

Table 3.14: Agricultural land-use statistics of Diamer Division.

Results and Interpretation

The analysis indicates that **cultivable land** is the dominant land-use category, covering **12,723.4 hectares**, which represents the largest share of the division's agricultural landscape. The abundance of cultivable land demonstrates substantial opportunities for future agricultural expansion through irrigation development, land leveling, and improved resource management.

Cropland occupies **9,867.9 hectares**, making it the second largest land-use category. The division supports extensive cultivation of wheat, maize, barley, potato, vegetables, and fodder crops, contributing significantly to regional food production and rural livelihoods.

Orchards and plantations account for **6,243.7 hectares**, reflecting the importance of horticulture in the division. Fruit production, particularly apricot, apple, walnut, pear, and cherry, provides an important source of income for farming households.

Marginal land covers **4,826.5 hectares**, representing areas constrained by steep slopes, shallow soils, rocky terrain, or limited irrigation facilities. Although these lands currently exhibit lower agricultural productivity, targeted land improvement and watershed management interventions could enhance their future utilization.

Built-up land occupies **2,827.9 hectares**, representing the smallest land-use category within the division. Residential settlements, transportation infrastructure, and public facilities remain concentrated in valley settlements, thereby preserving much of the productive agricultural land.

Overall, Diamer Division exhibits a balanced agricultural landscape with extensive cultivable resources, productive cropland, and a growing horticultural sector. The division possesses significant potential for increasing agricultural productivity through climate-resilient farming practices, improved irrigation systems, and sustainable land management initiatives.

Key Findings

- Total agricultural land mapped: **36,489.5 hectares**.
- Cultivable land is the dominant land-use category, accounting for the largest proportion of agricultural land.
- Cropland represents the second largest land-use category, reflecting the division's strong agricultural production capacity.
- Orchards and plantations occupy a substantial area, highlighting the importance of horticulture to the local economy.
- Marginal land offers opportunities for rehabilitation through improved irrigation and soil conservation measures.
- Built-up land constitutes the smallest proportion of the agricultural landscape.
- Future agricultural development should prioritize irrigation expansion, sustainable land management, climate-smart agriculture, and value addition to horticultural products to enhance food security and rural incomes.

3.13.4 Gilgit Division

Gilgit Division comprises the districts of **Gilgit, Ghizer, Hunza, and Nagar**. It is the largest administrative division in terms of agricultural land and includes a wide range of agro-ecological zones extending from high-altitude valleys to relatively broad irrigated plains. The division serves as the administrative and economic center of Gilgit-Baltistan and supports diverse agricultural systems based on crop cultivation, horticulture, and livestock production.

Agriculture in Gilgit Division depends primarily on glacier-fed irrigation networks, fertile valley soils, and traditional farming practices that have evolved over centuries. The region is well known for the cultivation of wheat, maize, barley, potato, vegetables, and high-value temperate fruits including apricot, apple, cherry, walnut, grape, and pear.

The GIS-based assessment estimated the total agricultural land area of **71,276.5 hectares**, making Gilgit Division the largest agricultural division in Gilgit-Baltistan.

Agricultural Land Use Statistics

Land Use Category	Area (ha)	Percentage (%)
Cultivable Land	20,409.3	28.6
Marginal Land	16,432.6	23.1
Crop Land	14,556.6	20.4
Orchards and Plantations	13,600.7	19.1
Built-up Land	6,277.3	8.8
Total	71,276.5	100.0

Table 3.15: Agricultural land-use statistics of Gilgit Division.

Results and Interpretation

The analysis reveals that **cultivable land** is the dominant land-use category, accounting for **20,409.3 hectares (28.6%)** of the total agricultural area. This extensive land resource highlights the division’s considerable potential for expanding agricultural production through irrigation development, land reclamation, and sustainable land management practices.

Marginal land occupies **16,432.6 hectares (23.1%)**, representing the second largest land-use category. These lands are generally characterized by steep slopes, rocky terrain, shallow soils, or limited access to irrigation water. Although their current productivity is relatively low, selected areas can be improved through watershed management, soil conservation, and irrigation infrastructure development.

Cropland covers **14,556.6 hectares (20.4%)**, reflecting the division’s significant contribution to cereal, vegetable, and fodder production. The extensive cropland area demonstrates the importance of agriculture in supporting rural livelihoods and regional food security.

Orchards and plantations account for **13,600.7 hectares (19.1%)**, indicating the strong role of horticulture within the division. The favorable climatic conditions support the cultivation of a wide range of temperate fruits, which contribute substantially to household incomes and regional agricultural markets.

Built-up land occupies **6,277.3 hectares (8.8%)**, representing the smallest land-use category. The relatively higher proportion of built-up land compared to the other divisions reflects the presence of Gilgit City, expanding urban settlements, commercial centers, educational institutions, and transportation infrastructure. Nevertheless, the majority of agricultural land remains available for productive use.

Overall, Gilgit Division possesses the largest agricultural resource base among the three administrative divisions. The combination of extensive cultivable land, productive cropland, well-developed orchards, and favorable environmental conditions provides exceptional opportunities for sustainable agricultural development. Continued investment in irrigation modernization, climate-smart agriculture, value-added horticulture, and integrated land-use planning will further strengthen agricultural productivity and rural economic development across the division.

Key Findings

- Total agricultural land mapped: **71,276.5 hectares**, the highest among the three administrative divisions.
- Cultivable land is the dominant land-use category, accounting for **28.6%** of the agricultural landscape.
- Marginal land represents **23.1%**, reflecting the mountainous terrain of the division.
- Cropland occupies **20.4%**, highlighting the division's significant contribution to agricultural production.
- Orchards and plantations account for **19.1%**, demonstrating the importance of horticulture in the regional economy.
- Built-up land covers **8.8%**, reflecting the concentration of urban and administrative infrastructure within the provincial capital.
- Gilgit Division offers substantial opportunities for sustainable agricultural expansion through efficient irrigation management, improved land utilization, modern farming technologies, and enhanced horticultural value chains.

3.14 Overall Agricultural Statistics of Gilgit-Baltistan

3.14.1 Overview

The GIS-based assessment provides the first comprehensive and standardized database of agricultural land resources across all ten districts of Gilgit-Baltistan. By integrating satellite imagery, Geographic Information Systems (GIS), Remote Sensing (RS), and field verification, the study quantified the distribution of agricultural land into five major Land Use/Land Cover (LULC) categories. The results establish a reliable spatial database that can support agricultural planning, policy formulation, resource allocation, and sustainable land management throughout the province.

The analysis covered all ten administrative districts and **703 revenue villages**, providing district-level and division-level statistics for agricultural land below irrigation channels.

3.14.2 District-wise Agricultural Statistics

The district-wise distribution of agricultural land demonstrates considerable variation in agricultural resources across Gilgit-Baltistan. Ghizer District possesses the largest agricultural area, while Nagar District has the smallest agricultural land resource.

District	Agricultural Area (ha)
Ghizer	36,087
Skardu	26,888
Diamer	20,325
Astore	16,165
Gilgit	16,053
Ghanche	15,235
Hunza	12,596
Shigar	11,052
Kharmang	7,665
Nagar	7,645
Total	173,545

Table 3.16: District-wise agricultural land distribution in Gilgit-Baltistan.

3.14.3 Overall Land Use Distribution

The agricultural land was classified into five major land-use categories. Cultivable land constitutes the largest share of the agricultural landscape, followed by cropland, marginal land, orchards and plantations, and built-up land.

Land Use Category	Area (ha)	Percentage (%)
Cultivable Land	51,472	29.7
Crop Land	39,666	22.9
Marginal Land	31,974	18.4
Orchards and Plantations	29,775	17.2
Built-up Land	20,659	11.9
Total Agricultural Land	173,545	100.0

Table 3.17: Overall agricultural land-use distribution in Gilgit-Baltistan.

3.14.4 Provincial Analysis

The GIS-based assessment demonstrates that Gilgit-Baltistan possesses substantial agricultural resources despite its predominantly mountainous terrain. Of the total mapped agricultural area, **cultivable land accounts for nearly one-third (29.7%)**, indicating significant opportunities for future agricultural expansion through irrigation development and land improvement programs.

Cropland, covering **39,666 hectares (22.9%)**, forms the backbone of agricultural production in the province. Wheat, barley, maize, potato, vegetables, and fodder crops remain the principal field crops cultivated under glacier-fed irrigation systems. The widespread distribution of cropland reflects the importance of agriculture in ensuring food security and sustaining rural livelihoods.

The province contains **29,775 hectares (17.2%)** of orchards and plantations, demonstrating the growing importance of horticulture as a high-value agricultural enterprise. Fruit crops such as apricot, apple, cherry, walnut, pear, and grape have become major contributors to household income and regional economic development.

Marginal land, occupying **31,974 hectares (18.4%)**, represents areas constrained by topography, shallow soils, rocky surfaces, or inadequate irrigation. Although these lands currently have lower productivity, many areas possess the potential for improvement through watershed management, soil conservation, and irrigation infrastructure.

Built-up land accounts for **20,659 hectares (11.9%)** of the agricultural landscape. These areas include settlements, transportation networks, public institutions, and other infrastructure located within agricultural boundaries. Careful land-use planning will be essential to minimize future conversion of productive agricultural land into non-agricultural uses.

3.14.5 Significance of the Assessment

This study represents one of the most comprehensive GIS-based agricultural land inventories undertaken for Gilgit-Baltistan. The integration of high-resolution satellite imagery, GIS analysis, and field verification has produced a consistent and reliable agricultural database that can serve as a baseline for future planning and monitoring.

The generated spatial database can support:

- Agricultural development planning at provincial and district levels.
- Identification of suitable areas for agricultural expansion.
- Irrigation planning and water resource management.
- Horticulture and orchard development programs.
- Climate change adaptation and resilience planning.
- Agricultural investment and project prioritization.
- Monitoring of land-use change using future satellite observations.
- Sustainable land management and environmental conservation.

3.14.6 Summary

The overall assessment confirms that **Gilgit-Baltistan contains approximately 173,545 hectares of mapped agricultural land**, distributed across ten districts and three administrative divisions. Among the districts, **Ghizer** possesses the largest agricultural area, while **Nagar** has the smallest. **Cultivable land** represents the largest land-use category, highlighting significant opportunities for expanding agricultural production through improved irrigation systems and sustainable land development.

The findings provide a scientifically robust foundation for evidence-based agricultural planning and policy formulation. The GIS database developed under this project will support the Department of Agriculture in monitoring land resources, improving agricultural productivity, optimizing resource allocation, and promoting sustainable agricultural development throughout Gilgit-Baltistan.

Chapter 4

Conclusions and Recommendations

4.1 Conclusions

This study presents a comprehensive GIS- and Remote Sensing-based assessment of agricultural land resources across Gilgit-Baltistan under the development project **“Strengthening of Agriculture Secretariat and E-Agriculture Extension Services in Gilgit-Baltistan (Phase II).”** Using high-resolution satellite imagery, Geographic Information Systems (GIS), field verification, and spatial analysis, agricultural land was mapped and classified into five major Land Use/Land Cover (LULC) categories: **Cropland, Orchards and Plantations, Cultivable Land, Marginal Land, and Built-up Land.**

The assessment covered **703 revenue villages** across **ten districts** and **three administrative divisions**, providing the first province-wide standardized geospatial database of agricultural land resources. The resulting database establishes an accurate baseline for agricultural planning, resource management, policy formulation, and future monitoring of land-use dynamics.

The study estimated a total mapped agricultural area of **173,545 hectares** distributed across the province. Among the identified land-use categories, **cultivable land occupies the largest share (51,472 hectares; 29.7%)**, indicating substantial opportunities for expanding agricultural production through improved irrigation infrastructure and sustainable land development. **Cropland covers 39,666 hectares (22.9%)**, reflecting the strong dependence of rural communities on agriculture for food production and livelihoods.

The assessment also identified **29,775 hectares** under orchards and plantations, demonstrating the increasing economic importance of horticulture in Gilgit-Baltistan. Production of high-value temperate fruits—including apricot, apple, cherry, walnut, grape, and pear—offers significant opportunities for income generation, agro-processing, and export-oriented agriculture.

Approximately **31,974 hectares** were classified as marginal land. Although these areas currently have limited agricultural productivity due to topographic and environmental constraints, many possess considerable potential for improvement through watershed management, irrigation development, soil conservation, and land reclamation programs.

The district-level analysis revealed substantial spatial variation in agricultural resources. **Ghizer District** possesses the largest agricultural land area, while **Nagar District** contains the smallest agricultural resource base. Similarly, **Gilgit Division** accounts for the largest agricultural area among the three administrative divisions, followed by **Baltistan Division** and **Diamer Division**.

The successful application of GIS and Remote Sensing demonstrates the effectiveness of geospatial technologies for generating reliable agricultural statistics. Compared with conventional survey-based approaches, satellite-based mapping provides greater

consistency, efficiency, repeatability, and spatial accuracy while enabling continuous monitoring of agricultural resources.

Overall, the study establishes a scientific and reliable foundation for evidence-based agricultural planning and supports the Department of Agriculture in making informed decisions regarding land utilization, agricultural investment, irrigation development, climate adaptation, and sustainable resource management throughout Gilgit-Baltistan.

4.2 Recommendations

Based on the findings of this assessment, the following recommendations are proposed to strengthen agricultural planning, improve land management, and enhance sustainable agricultural development in Gilgit-Baltistan.

4.2.1 Strengthen the Provincial Agricultural GIS Database

The geospatial database developed under this project should be institutionalized as the official agricultural land information system for Gilgit-Baltistan. The database should be updated periodically using recent satellite imagery and field surveys to ensure that agricultural statistics remain current and reliable.

4.2.2 Regular Monitoring Using Remote Sensing

Annual monitoring of agricultural land should be conducted using freely available satellite data such as Sentinel-2 and Landsat. Regular updates will enable the Department of Agriculture to monitor changes in cultivated land, orchard expansion, urban growth, and land degradation while supporting evidence-based policy decisions.

4.2.3 Develop Additional Irrigation Infrastructure

The large proportion of cultivable land identified in this study demonstrates significant opportunities for expanding agricultural production. Construction of new irrigation channels, rehabilitation of existing watercourses, and improved water-use efficiency should be prioritized to bring suitable land under cultivation.

4.2.4 Promote Climate-Smart Agriculture

Climate variability poses increasing challenges to agricultural productivity in Gilgit-Baltistan. Adoption of climate-smart agricultural practices—including efficient irrigation systems, drought-tolerant crop varieties, conservation agriculture, and improved water management—will enhance resilience to climate change while improving productivity.

4.2.5 Expand Horticultural Development

The substantial area under orchards highlights the importance of horticulture to the regional economy. Future investments should focus on modern orchard management, certified nursery development, disease management, post-harvest handling, cold storage facilities, and value-added processing to increase farmers' incomes and improve market access.

4.2.6 Improve Marginal Land Productivity

Selected marginal lands can be rehabilitated through soil conservation measures, terracing, watershed management, erosion control, and irrigation development. Detailed suitability assessments should be conducted before implementing land improvement projects to ensure environmental sustainability.

4.2.7 Integrate GIS into Agricultural Planning

GIS should be incorporated into all major agricultural planning and decision-making processes. Spatial information can support crop suitability analysis, irrigation planning, fertilizer recommendations, disaster risk assessment, precision agriculture, and agricultural extension services.

4.2.8 Strengthen Capacity Building

Continuous training should be provided to technical staff of the Department of Agriculture in GIS, Remote Sensing, Global Navigation Satellite Systems (GNSS), Unmanned Aerial Vehicles (UAVs), Google Earth Engine (GEE), Artificial Intelligence (AI), and geospatial data analysis. Strengthening institutional capacity will improve the quality and sustainability of future agricultural assessments.

4.2.9 Promote Research and Innovation

Collaboration with universities, research organizations, and national and international development partners should be encouraged to undertake advanced research on precision agriculture, crop monitoring, climate change adaptation, digital agriculture, and AI-assisted geospatial applications.

4.2.10 Establish a Provincial Agricultural Geoportal

A centralized web-based Agricultural Geoportal should be developed to facilitate access to agricultural statistics, land-use maps, satellite imagery, and spatial databases. Such a platform would support planners, researchers, policymakers, development partners, and investors by providing timely and standardized geospatial information.

4.3 Future Scope

The present study provides a strong foundation for future GIS-based agricultural research and monitoring in Gilgit-Baltistan. Future assessments may incorporate higher-resolution satellite imagery, drone-based surveys, machine learning algorithms, and cloud computing platforms such as Google Earth Engine to improve classification accuracy and operational efficiency.

Future editions of this report may include:

- Village-level agricultural land statistics and digital atlases.
- Crop-specific distribution maps for major agricultural commodities.
- Orchard inventory and fruit production assessment.
- Soil fertility and land capability mapping.

- Irrigation infrastructure and water resource mapping.
- Agricultural drought and climate vulnerability assessments.
- Crop disease and pest monitoring using remote sensing.
- Precision agriculture and smart farming applications.
- Carbon stock estimation and ecosystem service assessment.
- Time-series analysis of land-use and land-cover change.

The integration of modern geospatial technologies with field-based agricultural information will enable the Department of Agriculture to establish a dynamic decision-support system that promotes sustainable agricultural development, improves resource management, strengthens climate resilience, and enhances food security across Gilgit-Baltistan.