



**FOREST COVER
ATLAS
AZAD
JAMMU &
KASHMIR**



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AZAD
JAMMU &
KASHMIR**



PAKISTAN

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THE FALLEN PANDAS

AAMIR SAEED KHAN

A passionate environmentalist and loving father

Originally hailing from Kohat, Aamir had over 25 years of experience in conducting forest surveys and implementing community-based conservation projects. Aamir was a technical expert in his field and started his career in WWF working in the Salt Range for a decade. He held two Master's degrees, in organic chemistry and forestry from the Pakistan Forest Institute, and was passionate about the protection of natural resources. Known to all for his kind heart and charitable nature, Aamir was a committed disaster relief volunteer, having spent hours in the field to help communities recover and rebuild after the earthquake of 2005 and the floods of 2010. He leaves behind a wife, and three sons, aged 8, 15 and 21.



IFTIKHAR HUSSAIN

Nature enthusiast and loyal friend

Iftikhar had been a part of the Panda family since his internship days at the Chitral field office. A true nature enthusiast, Iftikhar held a Bachelor of Science degree in environmental sciences and had helped the organization with many challenging projects, including work on snow leopards, Ibex, and Markhors. He worked with the staff in WWF-Sweden who remembered him fondly and are shocked at his passing. His dedication towards his work, charismatic personality and humble nature made everyone warm up to him instantly, be it his colleagues, project partners, or the community members he worked with. Iftikhar leaves behind a young, grieving widow and his beloved mother.



RAFIULLAH SWATI

Budding professional and

conservationist from early years

With a degree in forestry, Rafiullah joined WWF-Pakistan as an intern, like many of his team members. His passion for forestry was unlike others as he had grown up watching his father working in the same field and protecting forests. Already the team leader of the Hazara team of the National Forest Inventory under the REDD+ project, Rafiullah was highly ambitious by nature and aspired to become an expert in his field.



ATIF ALI KHAN

Future leader, beloved father and son

Anyone who knew Atif knew he had a bright future ahead of him. Well-organized, talented, and professional, Atif was a gold medalist with an MPhil degree in forestry and range-land management and was towards the end of completing his PhD degree. He joined the Panda family as an intern and quickly gained confidence and respect within the teams, exhibiting a level of intellect and wisdom unparalleled by his peers. He leaves behind grieving parents, siblings, and a young widow with a four-month-old son.



FARHAN ULLAH AFRIDI

Dedicated, diligent and expectant father

Farhan demonstrated maturity and seriousness towards his duty as a driver. He was also fond of nature and so enjoyed working on WWF assignments as they gave him a chance to explore new areas and be close to nature. Coming from an extremely marginalized background, he could not complete his education. However, he worked hard to provide support to his family and despite his young age, was revered for his professionalism and work ethic. He is survived by aged parents and a young, pregnant wife.



PAKISTAN

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The Ministry also commends the support provided by the Provincial REDD+ Working Groups representing forestry officials, civil society, INGOs (IUCN and WWF Pakistan), during field data collection and consultation workshops. The coordination and technical supervision provided by Syed Ghulam Qadir Shah, Inspector General Forests / National REDD+ Coordinator and the staff of National REDD+ Office, especially Muhammad Afrasiyab, GIS / MRV Expert and Pervez Manan, NFI Expert is also appreciated.

Last but not the least the Ministry of Climate Change highly appreciates the work of WWF-Pakistan's GIS Lab and Forest Inventory teams in developing the National and Sub-national Forest Cover Atlases under the National REDD+ Office. Moreover, the ministry recognizes and honors the sacrifice of the five WWF-Pakistan's field team members Aamir Saeed Khan, Iftikhar Hussain, Atif Ali Khan, Rafiullah Swati and Farhan Ullah Afridi who lost their lives in a fatal car accident during the course of their duty regarding Forest Inventory and Field Surveys.

Disclaimer:

The data regarding administrative boundaries are based on UNOCHA data compiled by WWF-Pakistan and do not necessarily match with the national map published by SoP. The international boundary in Jammu and Kashmir region do not whatsoever represent the actual boundary. The accession of Jammu and Kashmir remains to be decided.



GENERAL FOREST SITUATION IN PAKISTAN

Pakistan is mainly a dry land country with 80 percent of its land in arid and semiarid areas. Land Use Change Assessment plays important role in understanding and resolving various environment related issues especially related to the drivers of deforestation and forest degradation. The data generated from satellite images are good source in studying economic impacts of periodic land use changes and productivity, as well as habitat and biodiversity loss, climate variability and other environmental factors. Time Series Analysis from satellite images are therefore considered a more reliable and accurate mean of monitoring and measurements forests and changes to other land uses as compared to traditional methods. The Forest Cover Atlas gives an overall picture of existing forest cover on national and sub-national level. It shows the information on forest cover changes over a period of four years (2016-2020). The information is supported with tables, maps, graphs and charts of forest cover and other land use / land cover classes.

The study revealed that the area of Forest Cover of the country increased from 4,005,180 (4.56%) of the total area (87,910,600 ha) of Pakistan including AJ&K and GB to 4,113,657 (4.68%) hectares from the year 2016 to 2020. This increase of 1,08,477 hectares in the country's forest cover is the result of extensive tree plantation initiatives at the federal and provincial levels to reduce deforestation and enhance national tree cover such as the Ten Billion Tree Tsunami Programme – Phase – I Up-scaling of Green Pakistan Programme (Revised), and the large-scale mangrove restoration along the coast by the Sindh Province. According to this study, the overall deforestation in Pakistan for the reference period of 2016–2020 was found as 44,028.5 hectares, with an average annual rate of 11,007.1 hectares.

Overall Emissions and Removals from Forests (2016-2020)					
Forest type	Emissions from deforestation (Mt CO ₂ e)	Emissions from forest degradation (Mt CO ₂ e)	Removals from enhancement (Mt CO ₂ e)	Removals from improvement in forest cover density (Mt CO ₂ e)	Net balance (Mt CO ₂ e)
Sub-Alpine	0.11	1.71	0.05	0.41	1.35
Dry Temperate	0.69	19.98	0.16	18.25	2.25
Dry Temperate Juniper And Chilgoza	0.04	3.49	0	0.56	2.96
Moist Temperate	0.23	12.31	0.07	5.32	7.15
Sub-Tropical Chir Pine	0.33	6.79	0.05	2.17	4.89
Subtropical Broadleaved (Scrub)	0.16	4.33	0.05	3.14	1.32
Riverine	0.36	0.12	0.18	0.07	0.24
Tropical Thorn	0.08	0.32	0.04	0.4	-0.04
Mangrove	0.04	0.07	0.96	0.41	-1.26
Total	2.03	49.12	1.57	30.73	18.86

Forest Area and Carbon Stock (2016-2020)				
Forest Type	2016	2020		
	Area (ha)	Area (ha)	C Density (tC/ha)	Carbon Stock (Mt C)
Sub-Alpine	97,945	102,320	66.22	6.78
Dry Temperate	1,031,503	1,057,651	101.57	107.42
Dry Temperate Juniper and Chilgoza	225,996	228,193	65.87	15.03
Moist Temperate	550,303	556,525	120.92	67.29
Sub-Tropical Chir Pine	633,983	639,786	89.15	57.03
Subtropical Broadleaved (Scrub)	999,776	1,025,130	57.01	58.44
Riverine	117,872	112,878	42.2	4.77
Tropical Thorn	103,333	116,017	35.24	4.09
Mangrove	133,816	157,357	238.85	37.59
Irrigated Plantation	60,672	66,774	69.05	4.61
Farm Plantation (GB Only)	49,981	51,026	56.35	2.88
Total	4,005,180	4,113,657	942.43	365.93

Emissions from Deforestation and Removals from Afforestation/Reforestation (2016-2020)					
Forest type	Deforestation (ha)	Emissions (Mt CO ₂ e)	Enhancement (ha)	Removals (Mt CO ₂ e)	Net balance emissions/removals (Mt CO ₂ e)
Sub-Alpine	744.66	0.1	4,872.06	0.05	0.05
Dry Temperate	3,674.47	0.69	18,138.96	0.16	0.53
Dry Temperate Juniper and Chilgoza	294.84	0.04	281.52	0	0.03
Moist Temperate	959.94	0.24	4,462.77	0.07	0.17
Sub-Tropical Chir Pine	2,332.61	0.33	4,572.78	0.05	0.27
Subtropical Broadleaved (Scrub)	5,398.51	0.16	6,981.35	0.05	0.11
Riverine	25,989.00	0.36	27,945.00	0.18	0.18
Tropical Thorn	3,914.53	0.08	18,783.03	0.04	0.04
Mangrove	719.97	0.04	30,193.22	0.96	-0.92
Total	44,028.53	2.02	116,230.69	1.56	0.46

Emissions from Forest Degradation and Removals from Enhancement within existing Forest (2016-2020)					
Forest type	Degradation (ha)	Emissions (Mt CO ₂ e)	Enhancement (ha)	Removals (Mt CO ₂ e)	Net Emissions/Removals (Mt CO ₂ e)
Sub-Alpine	18,706	1.74	4,351.70	0.41	1.28
Dry Temperate	182,691	19.94	133,673.30	18.25	1.74
Dry Temperate Juniper And Chilgoza	55,884	3.48	7,996.90	0.56	2.93
Moist Temperate	107,928	12.3	35,928.90	5.32	6.99
Sub-Tropical Chir Pine	117,516	6.82	40,674.40	2.17	4.62
Subtropical Broadleaved (Scrub)	119,662	4.29	125,237	3.13	1.2
Riverine	12,276	0.12	11,243	0.07	0.05
Tropical Thorn	11,898	0.32	16,111.70	0.4	-0.09
Mangrove	4,270	0.06	34,539	0.41	-0.34
Total	630,831	49.07	409,755.90	30.72	18.38

STANDARDS & METHODOLOGY

Province wise Satellite based Land / Use Land cover, mainly focused on forests, of Pakistan was developed using Mid-resolution Remote Sensing Satellite (Landsat 8) cloud free data for the reference year of 2016 and 2020. Free and Open Source Software (FOSS) including OpenForis Collect Earth and QGIS were utilized to generate activity data (AD). A Non-parametric regression model such as Random Forest was used to classify the satellite imagery into IPCC's six LULC classes. The standard and harmonised definitions of forest, deforestation, forest degradation, and other IPCC land use categories (cropland, grassland, settlement, wetland and other land) used in creating the Activity Data (AD) are as follows.

Forest:

"A minimum area of land of 0.5 ha with a tree crown cover of more than 10 % comprising trees with the potential to reach a minimum height of 2 meters. This will also include existing irrigated plantations as well as areas that have already been defined as Forests in respective legal documents and expected to meet the required thresholds as defined in the national Forest definition of Pakistan."

Cropland:

This category includes arable and tillage land, and agro-Forestry systems where vegetation falls below the thresholds used for the Forest Land category, consistent with the selection of national definitions.

Grassland:

This category includes rangelands and pastureland that is not considered as Cropland. It also includes systems with vegetation that fall below the threshold used in the Forest Land category and which are not expected to exceed, without human intervention, the threshold used in the Forest Land category. The category also includes all Grassland from wild lands to recreational areas as well as agricultural and silvo-pastoral systems, subdivided into managed and unmanaged consistent with national definitions.

Settlement:

This category includes all developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other categories. This should be consistent with the selection of national definitions.

Other Land:

This category includes bare soil, rock, ice, and all unmanaged land areas that do not fall into any of the other five categories. It allows the total of identified land areas to match the national area, where data is available. This atlas describes the techniques and methodology to develop digital database of different LULC classes and prepare LULC maps. The overall methodology comprised of acquisition and processing of satellite images, Systematic Sample generation, Visual interpretation of samples, ROI generation, Classification, Post-processing, Accuracy Assessment and Change Detection.

Forest Degradation:

"Human induced long-term losses within Forest persisting for at least 4 years or more due to change in tree canopy cover i.e., open (11-30%), Sparse (31-50%), Medium (51-70 %) Dense (>70 %) resulting in reduction of Forest carbon stock and not qualifying as deforestation.

Satellite Land Monitoring System (SLMS) supports countries in development of systems to implement REDD+ interventions aligned with the National REDD+ Strategies and Action Plans. SLMS is one of the three functions of Measurement, Reporting and Verification (MRV) to continuously monitoring land by supporting National Forest Monitoring System (NFMS). Land use / land cover and land use change analysis data are the basis for activity Data (AD) which are fundamental input to national Greenhouse gas inventories (GHGi), essential for measuring progress towards climate action goals.

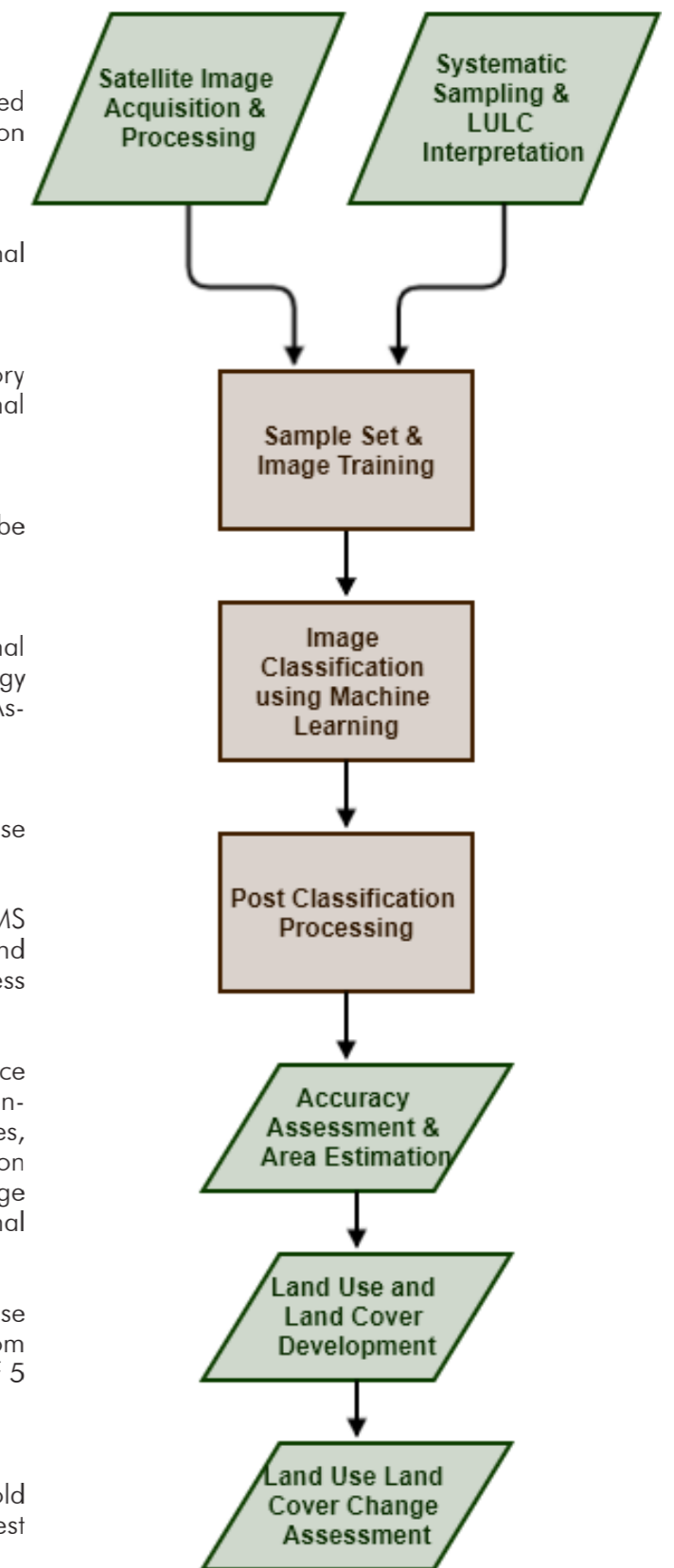
For the development of LULC, Total 130 (65 images for each year) freely available and cloud free (less than 10%) Satellite images of Landsat-8 L2SP (Collection 2 level 2 and Tier 1 Science Product) covering whole Pakistan were downloaded from the USGS Earth Explorer web portal (<https://earthexplorer.usgs.gov>). After image acquisition, FAO's Sample collection tool "Open-Foris Collect Earth" was used for the interpretation of systematically generated 10'x10' or 5'x5' sample grids to generate training and validations samples. In addition to systematic samples, manual training samples were also taken in cases where misclassification or a low number of samples against a particular class were observed. Then, from systematic and manual plots, Region of Interest (ROI) polygons containing spectral signature against each plot as seed for classification were generated. 70% of the generated ROIs were then used as training samples for image classification and remaining 30% for the accuracy assessments. Random Forest classifier algorithm in QGIS environment was applied to classify the imagery into National and sub-national forest cover maps.

In the post-processing phase, a sieve of two pixels was applied to LULC rasters to reduce noise such as 'salt and pepper' effects. Accuracy assessment and area estimation of the Land Use and Land Cover maps were conducted using the sample of reference observations of the study area. The classification results were further improved by utilising historic LULCs, Feedback from provincial forest departments, field data and experts' ground knowledge. Pixel based Change analysis tool in QGIS was used to estimate the deforestation and enhancement. A sieve of 5 pixels was applied to the deforestation/enhancement rasters to extract the rate of deforestation and enhancement at the national as well as sub-national levels.

Deforestation:

Deforestation is defined as the direct human induced conversion of Forest to non-Forest (UNFCCC) or the permanent reduction of the tree canopy cover below the minimum 10% threshold (FAO, 2015). In scope of Pakistan's first FREL submission, deforestation assessment has been based on changes in natural Forests and exclude irrigated plantations, though the notified Forest definition includes irrigated plantations as one of the Forest types.

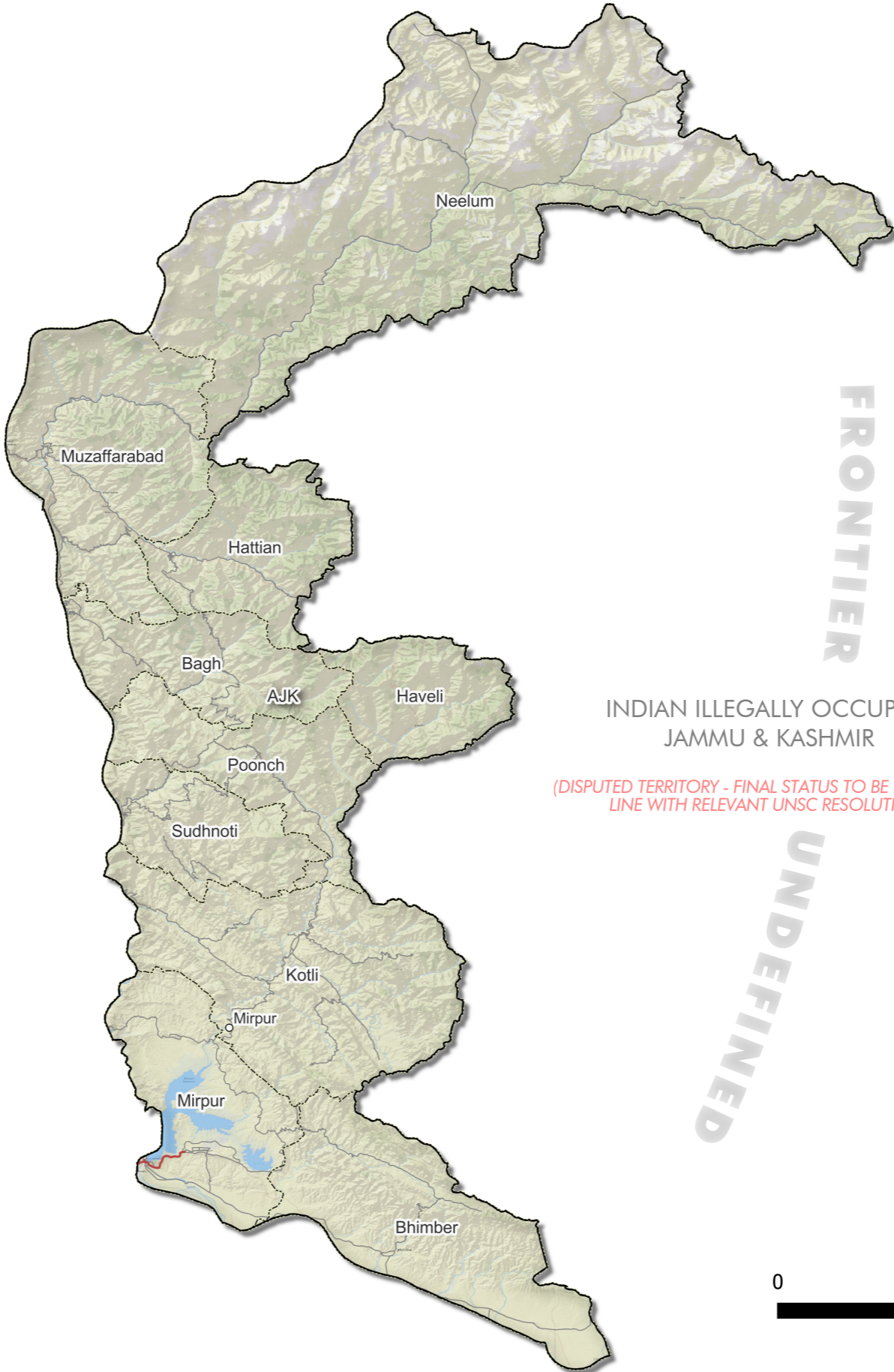
Standard templates were designed in QGIS to develop the national and sub national forest cover maps and change maps. Sub national LULC rasters were utilized to develop National scale Forest cover map. Change detection maps for the deforestation and enhancement in the provinces were generated from the change analysis rasters of the reference year of 2016 and 2020.



TOPOGRAPHIC MAP OF AJ&K

Legend

- Locality
- Province Boundary
- Major Road
- Other Road
- District Boundary



INDIAN ILLEGALLY OCCUPIED
JAMMU & KASHMIR

(DISPUTED TERRITORY - FINAL STATUS TO BE DECIDED IN
LINE WITH RELEVANT UNSC RESOLUTION)

UNDEFINED

0 30 60 90 km

GEOGRAPHY OF AJ&K

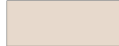





The state of Azad Jammu and Kashmir is situated between longitude $73^{\circ} - 75^{\circ}$ and latitude $33^{\circ} - 36^{\circ}$ having a total area of 13,297 square kilometers. It falls within the Western Himalayan range mainly having hilly and mountainous terrain with altitude ranging from 360 meters in the south to 6325 meters in the north. From climatic point of view AJK has dry sub-tropical climate in the south while moist temperate in the north. Average annual rainfall ranges from 1000 mm to 2000 mm (with 30% to 60% precipitation in the northern parts, mostly snow) (Government of AJK 2014).

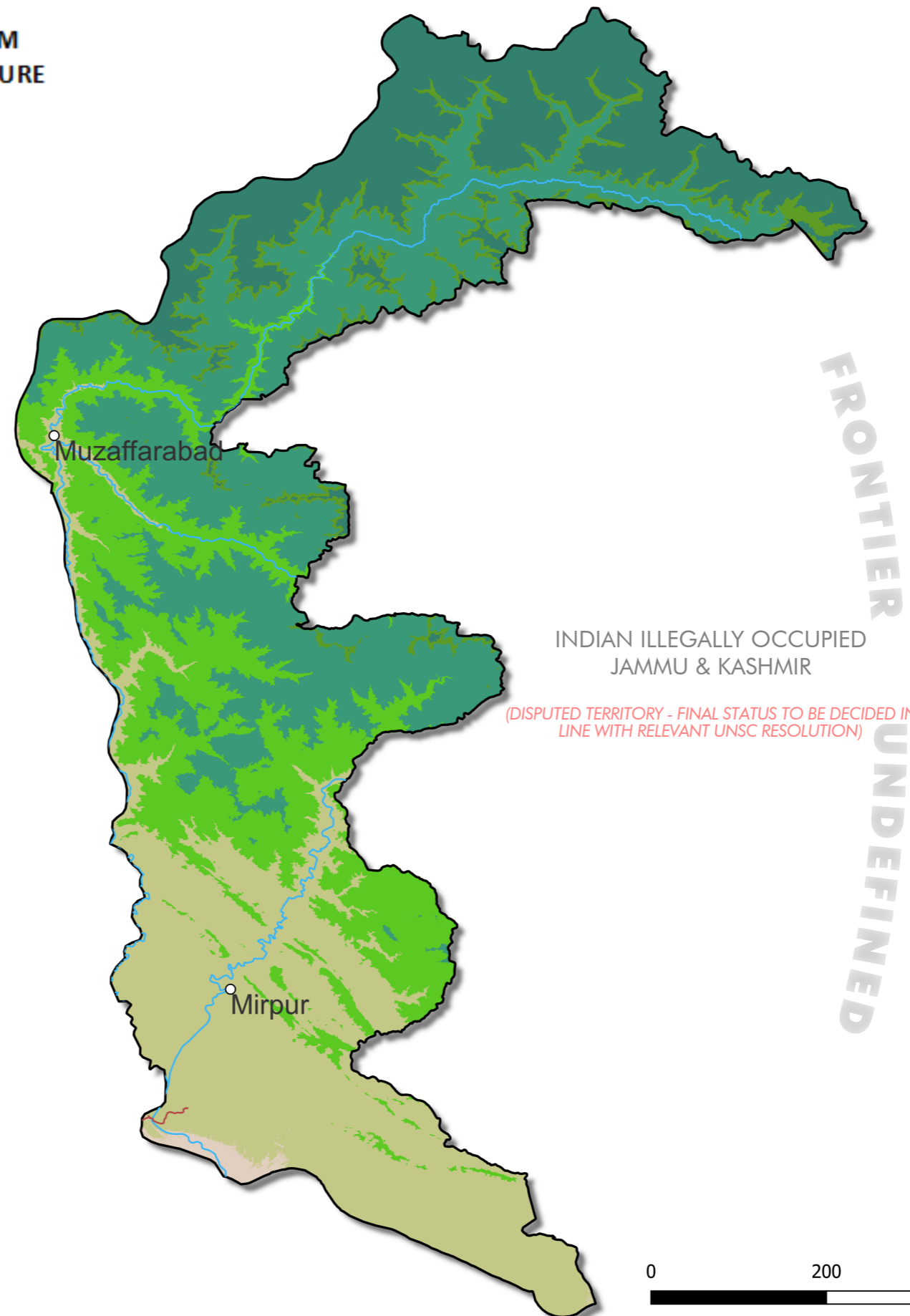
Average maximum temperature ranges from 20°C to 32°C while the average minimum temperature range is 04°C to 07°C (Government of AJK 2014). Administratively the AJK State is divided in to three divisions and ten districts. Total area of AJK is Total population of AJK is 4.361 million (Government of AJK 2014). Major rivers flowing through AJK are Jhelum, Neelum and Poonch Rivers. From forest point of view AJK is divided into five main forest types; Sub-Alpine, Dry Temperate, Moist Temperate, Sub-Tropical Chir Pine, Subtropical Broadleaved (Scrub).

FOREST STRATIFICATION OF AJ&K

FOREST STRATUM	ALTITUDE RANGE (NORTHERN/SOUTHERN ASPECT)	MEAN ANNUAL RAINFALL	MEAN MINIMUM TEMPERATURE
THORN	3-385 m	5-49 cm	10 °C
SCRUB	457-1524 m	12-98 cm	7 °C
PINE	914-1676/2134 m	77-162 cm	13 °C
MOIST TEMPERATE	1524-3048 m	64-152 cm	2 °C
DRY TEMPERATE	1524-3353/3658 m	14-74 cm	-4 °C
SUB-ALPINE	3353-3810/3962 m	< 66 cm	-13 °C

Forest Type Zone

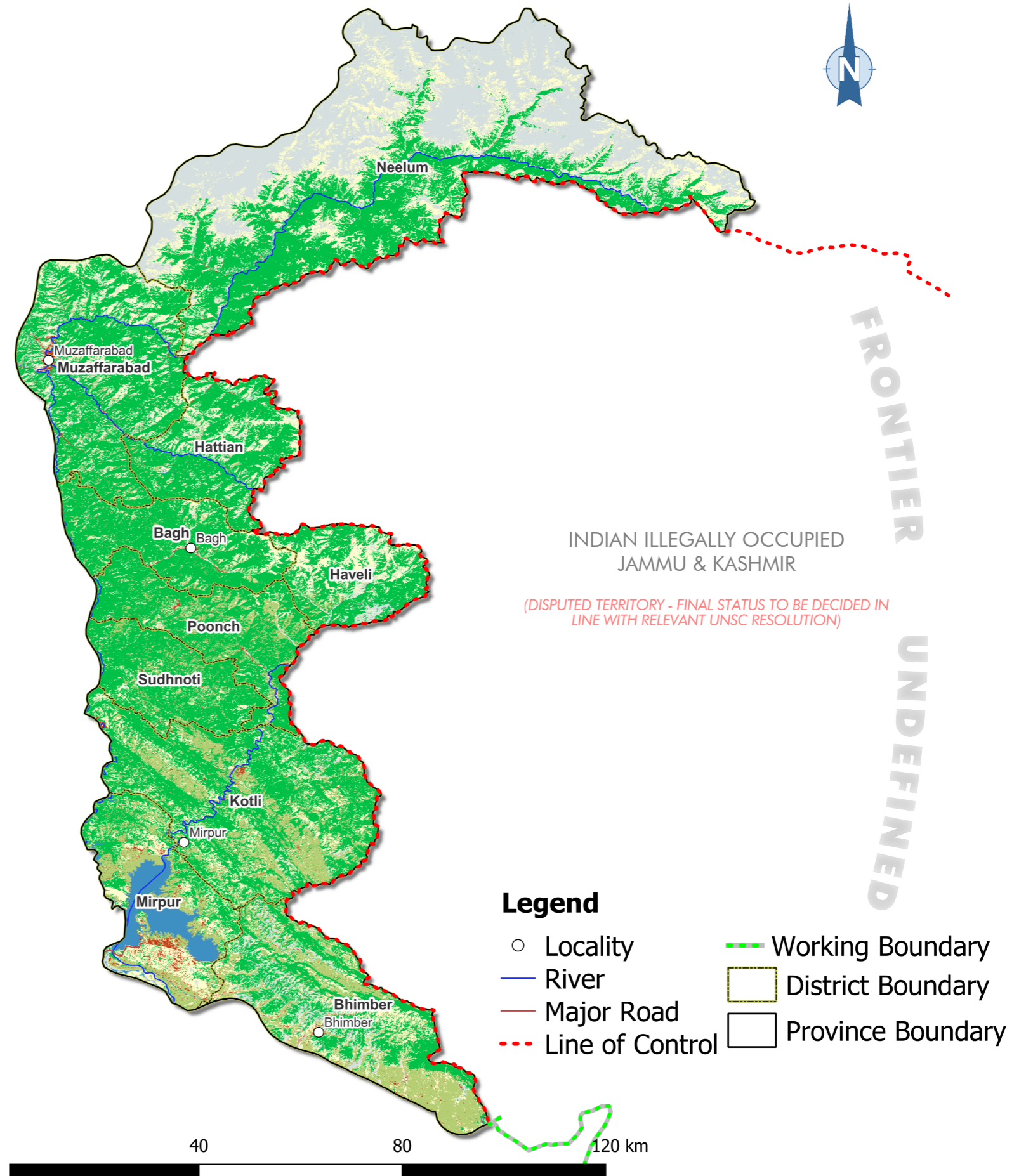
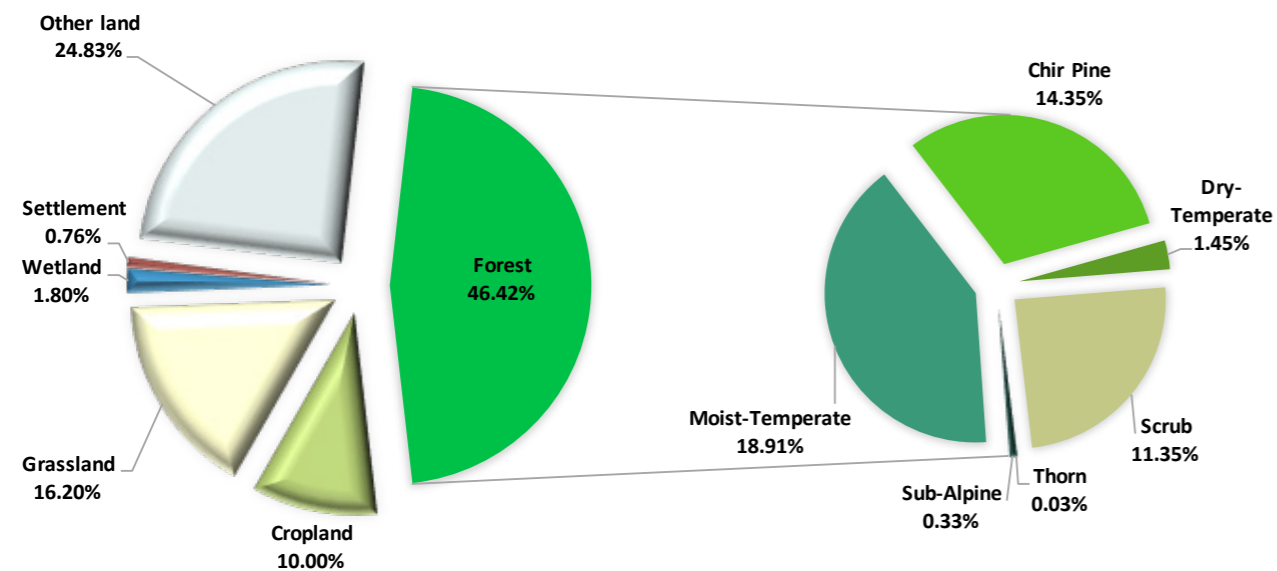
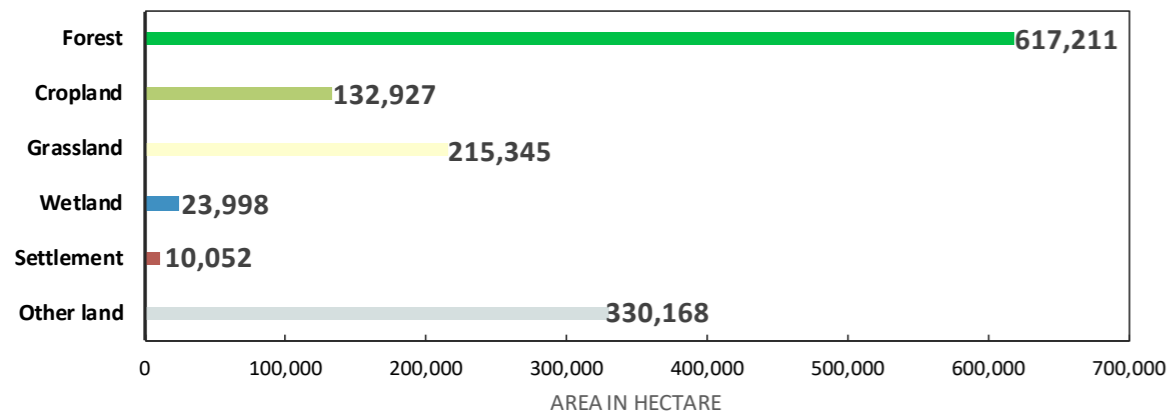
-  Thorn
-  Scrub
-  Moist-Temperate
-  Dry-Temperate
-  Sub-Alpine
-  Pine



Disclaimer:
Forest Stratification Zones for Pakistan were generated using parameters of altitude, Slope, Aspect, Mean Annual Rainfall and Mean minimum temperature. These zones were also improved as per expert opinions of the local forest authorities.

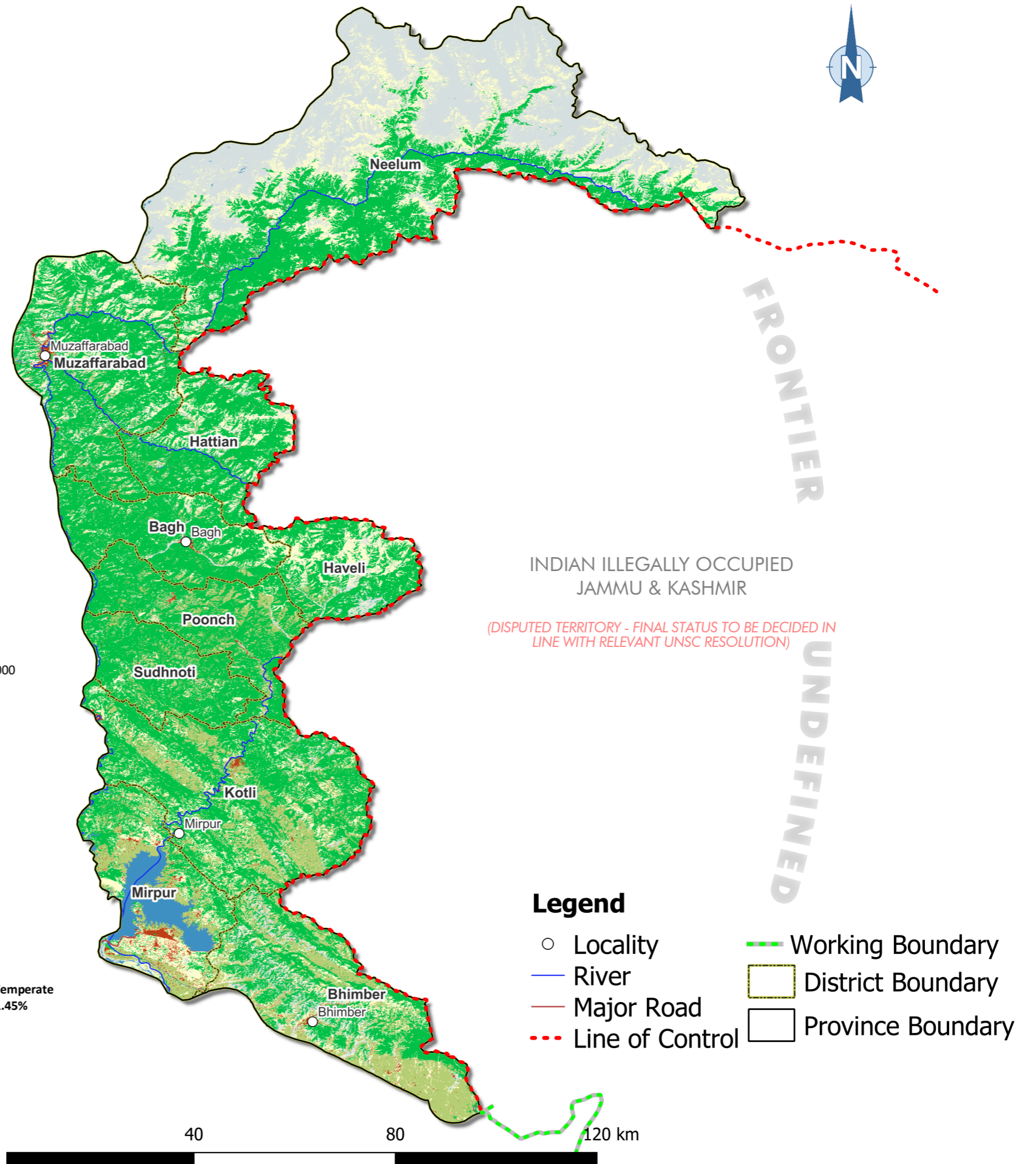
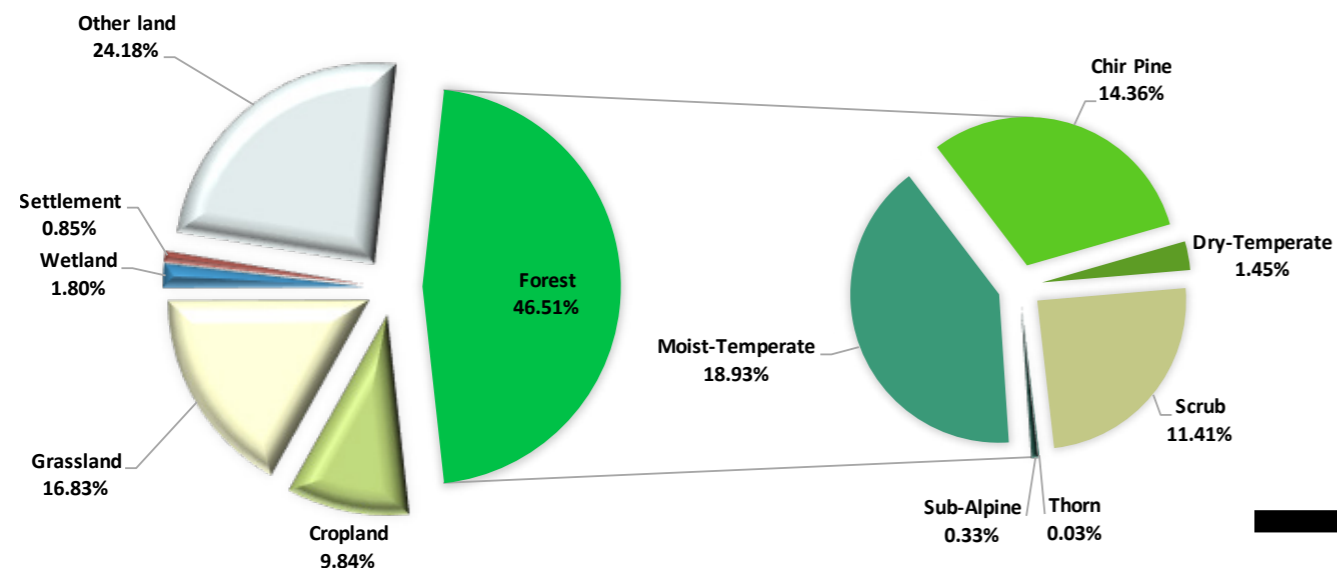
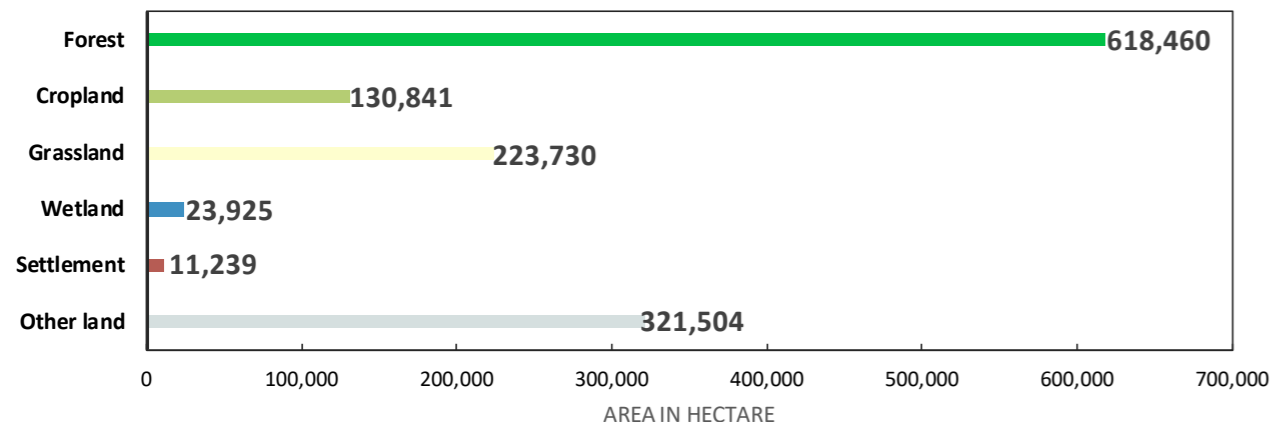
AJ&K LULC MAP - 2016

Land cover Type	Area (ha)	Forest Type	Area (ha)
Forest	617,211	Sub-Alpine	4,330
Cropland	132,927	Moist-Temperate	251,467
Grassland	215,345	Chir Pine	190,833
Wetland	23,998	Dry-Temperate	19,292
Settlement	10,052	Scrub	150,865
Other land	330,168	Thorn	423

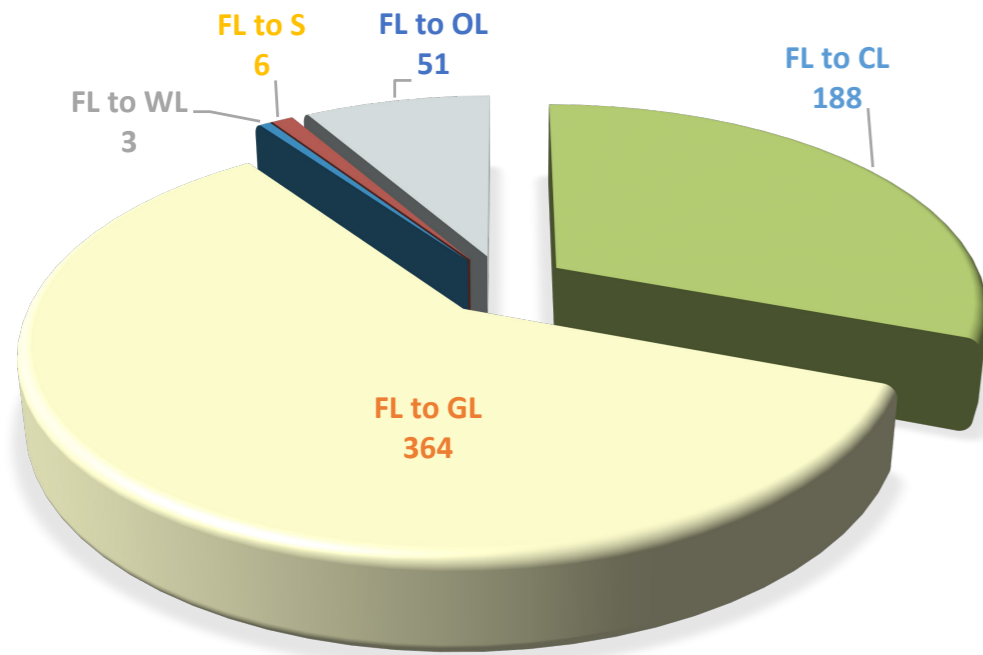


AJ&K LULC MAP - 2020

Land cover Type	Area (ha)	Forest Type	Area (ha)
Forest	618,460	Sub-Alpine	4,355
Cropland	130,841	Moist-Temperate	251,692
Grassland	223,730	Chir Pine	190,944
Wetland	23,925	Dry-Temperate	19,323
Settlement	11,239	Scrub	151,694
Other land	321,504	Thorn	451



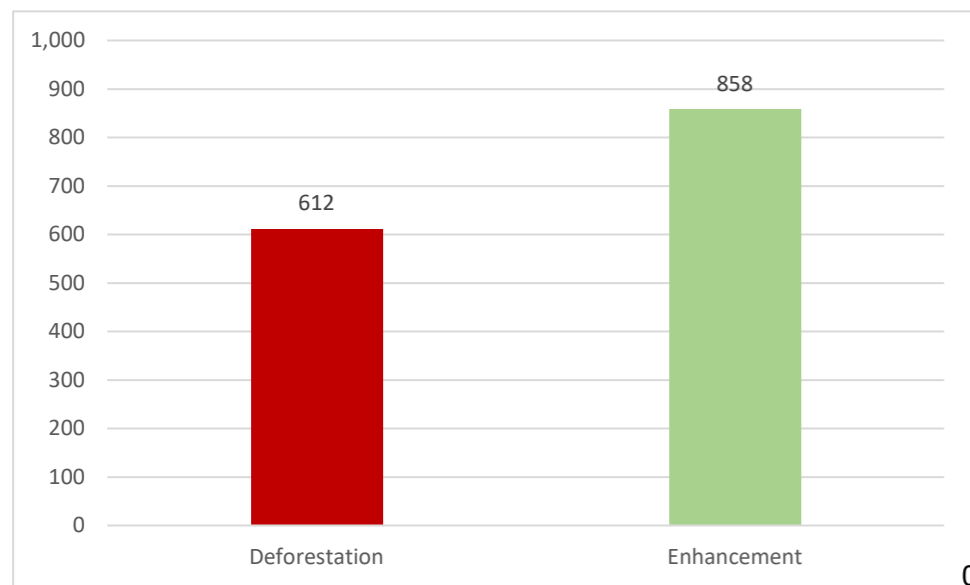
CHANGE DETECTION MAP OF AJ&K (2016-2020)



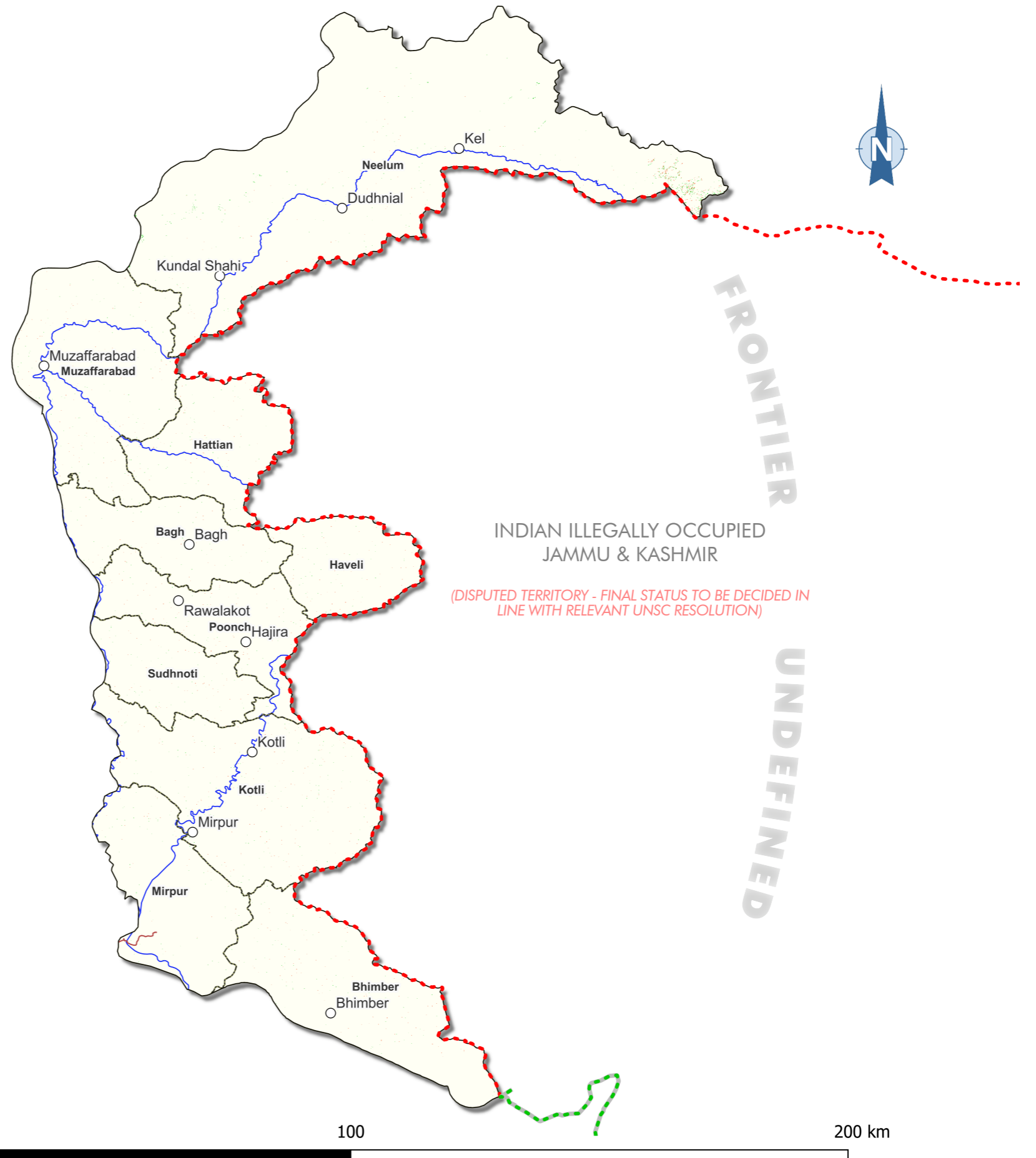
*FL - Forest Land
 *CL - Cropland
 *GL - Grassland
 *WL - Wetland
 *OL - Other Land
 *S - Settlement

Legend

- Locality
- River
- Major Road
- District Boundary
- Province Boundary
- Deforestation
- Enhancement

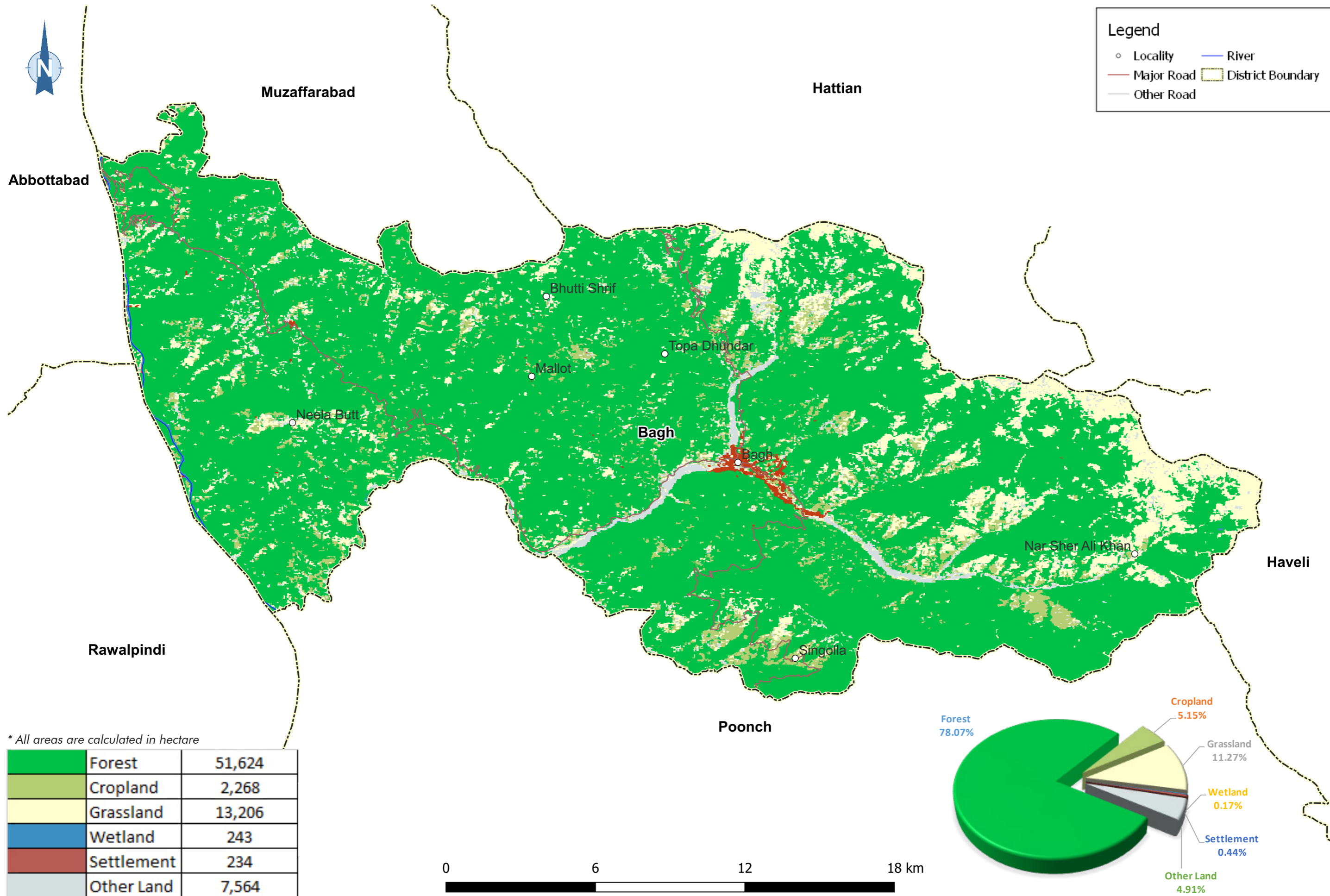


* All areas are calculated in Hectare



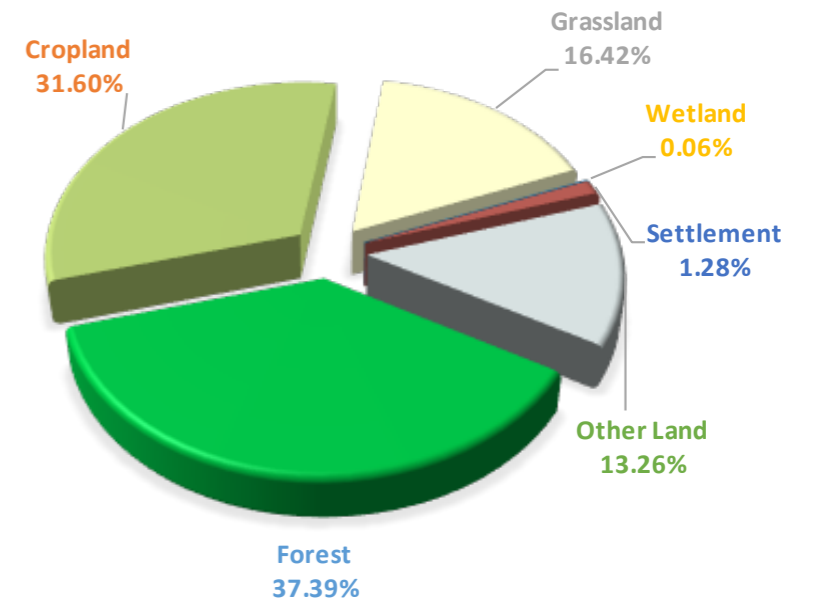
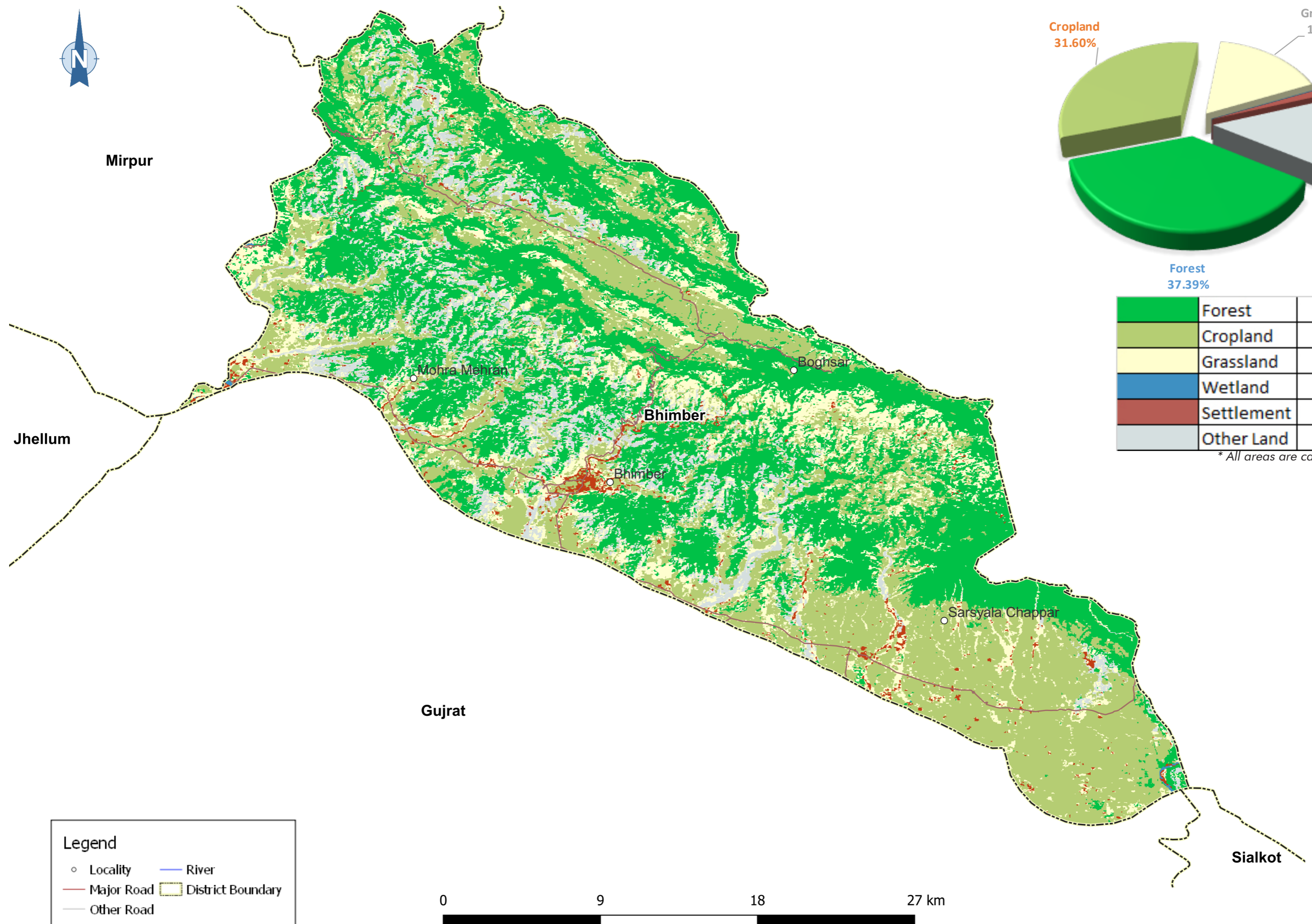


BAGH DISTRICT LULC MAP - 2020



* All areas are calculated in hectare

BHIMBER DISTRICT LULC MAP - 2020

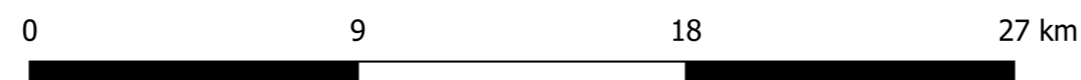


Land Use Type	Area (Hectare)
Forest	47,259
Cropland	39,947
Grassland	20,751
Wetland	70
Settlement	1,614
Other Land	16,766

* All areas are calculated in hectare

Legend

- Locality
- Major Road
- Other Road
- River
- ▭ District Boundary

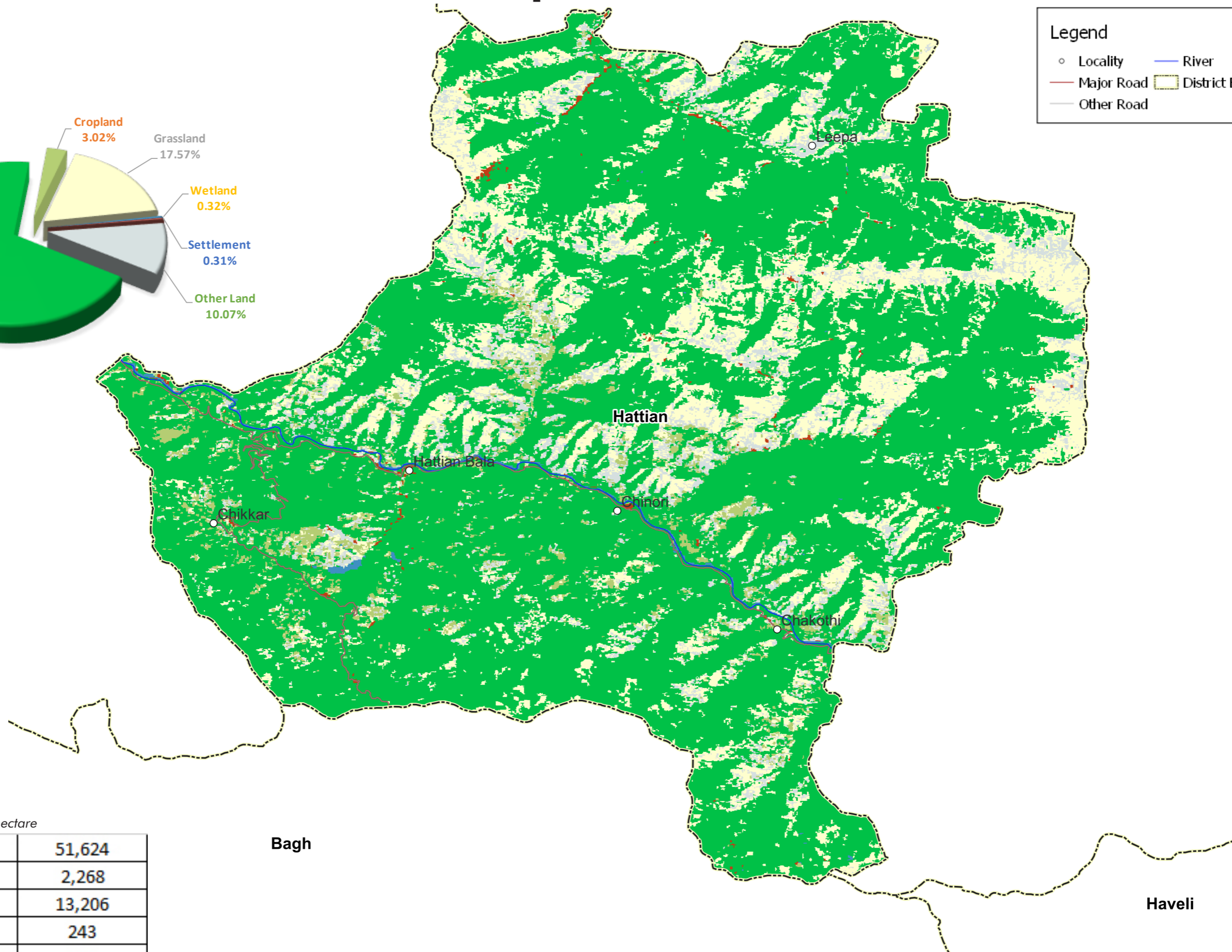
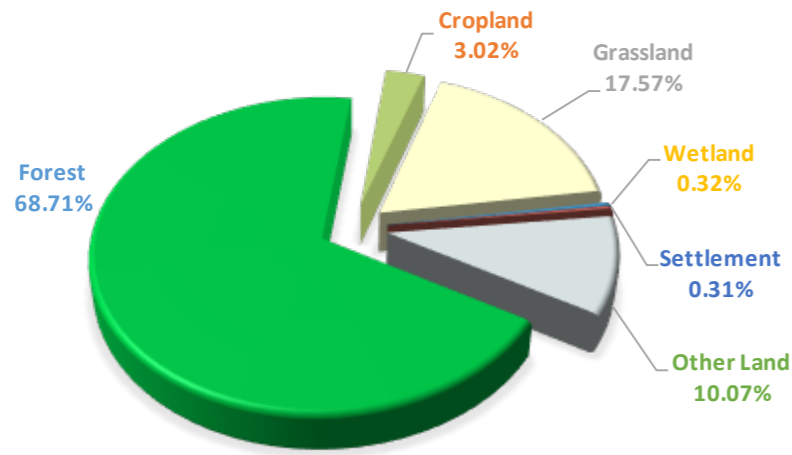


HATTIAN DISTRICT LULC Map - 2020



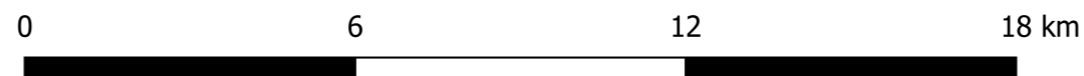
Legend

- Locality
- Major Road
- Other Road
- River
- District Boundary



* All areas are calculated in hectare

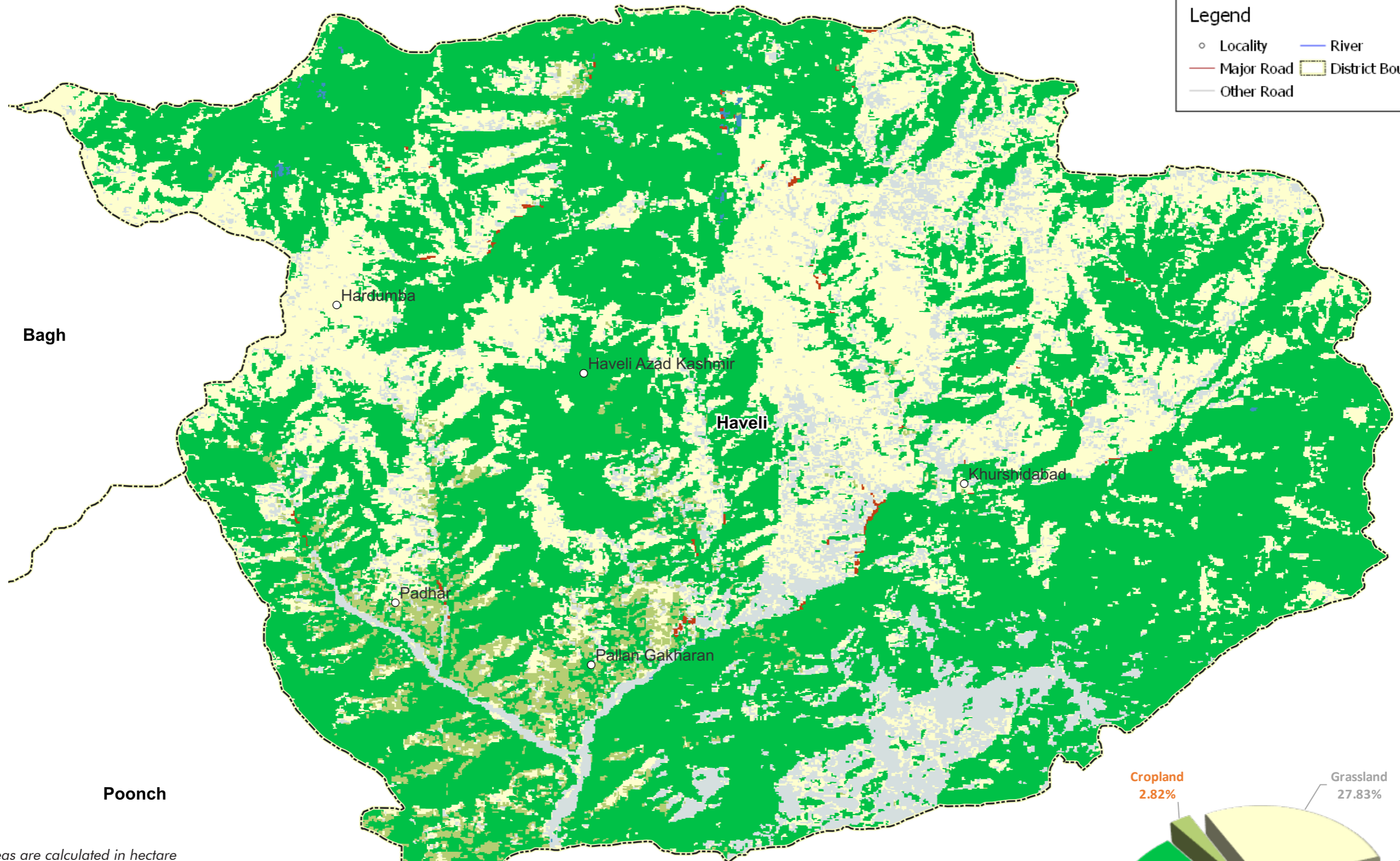
	Forest	51,624
	Cropland	2,268
	Grassland	13,206
	Wetland	243
	Settlement	234
	Other Land	7,564



HAVELI DISTRICT LULC MAP - 2020

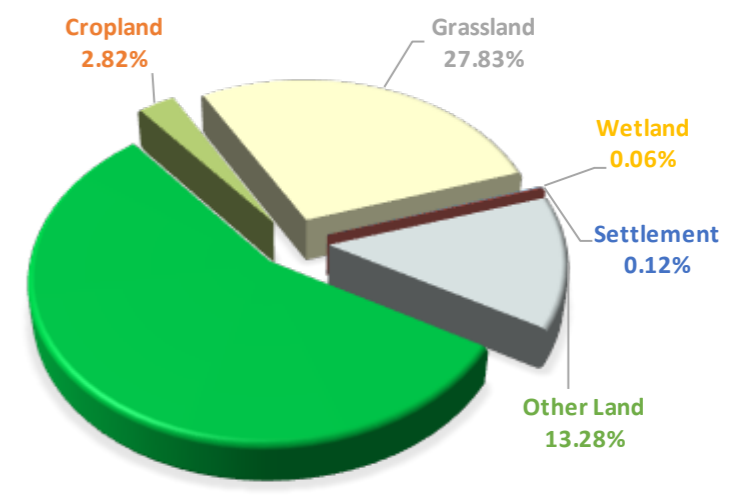
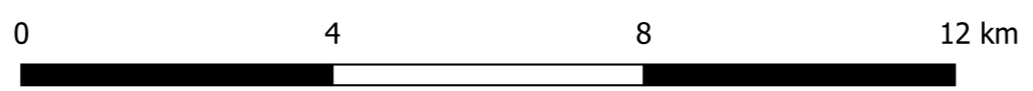
Legend

- Locality
- Major Road
- Other Road
- River
- ▭ District Boundary



* All areas are calculated in hectare

	Forest	31,677
	Cropland	1,596
	Grassland	15,778
	Wetland	35
	Settlement	70
	Other Land	7,528

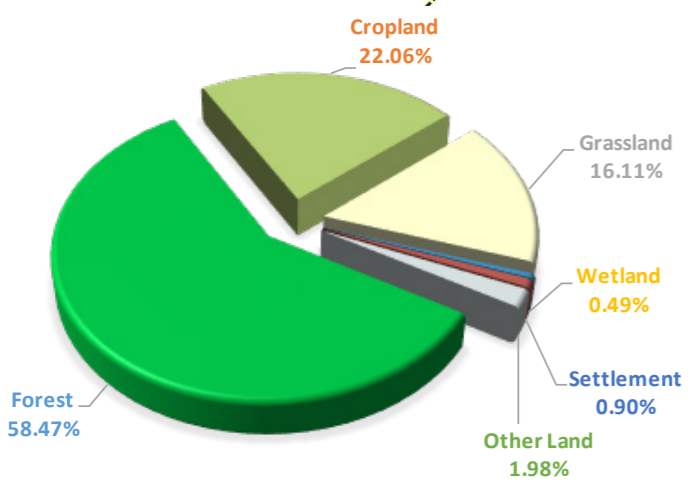
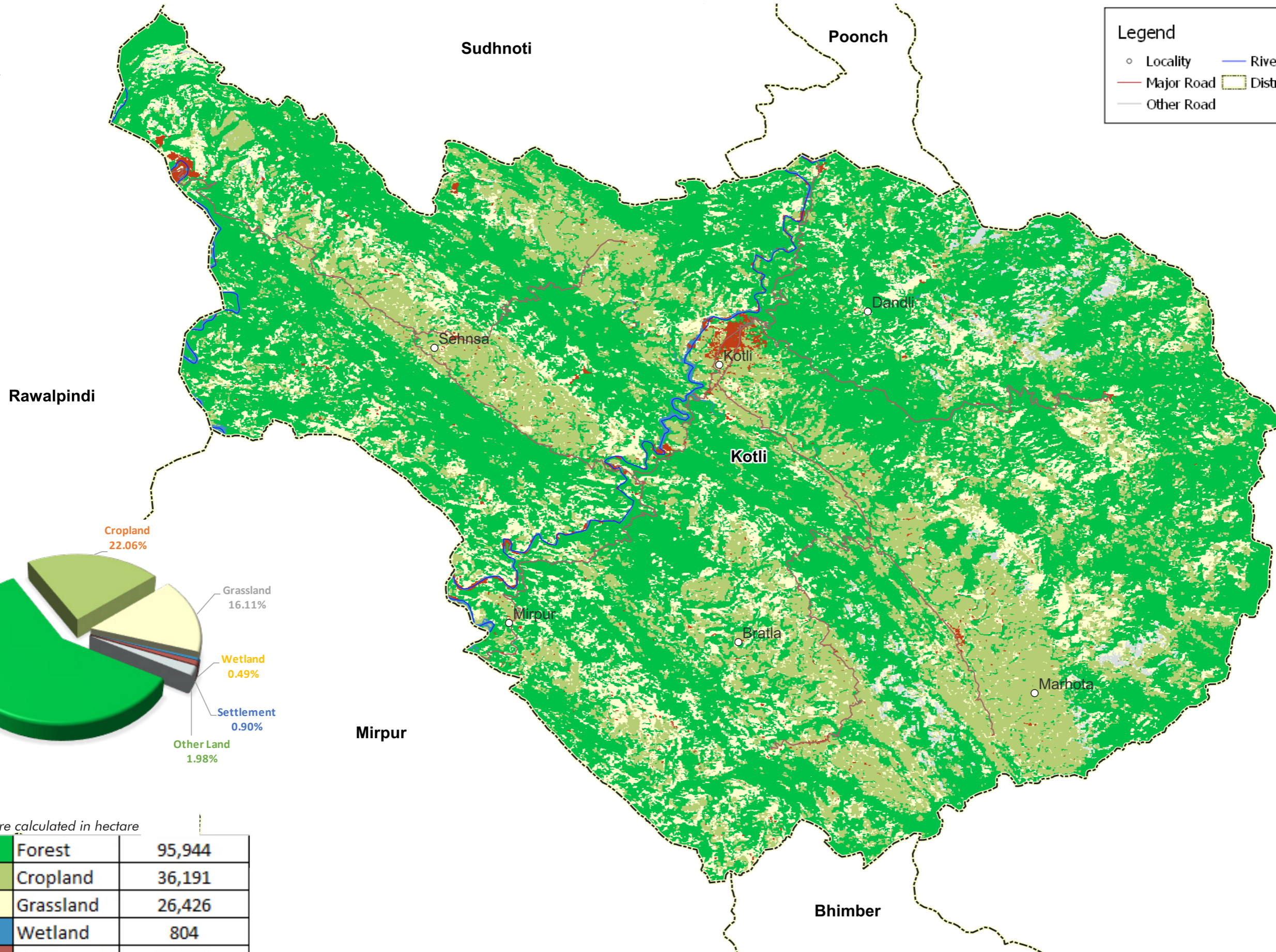


KOTLI DISTRICT LULC MAP - 2020



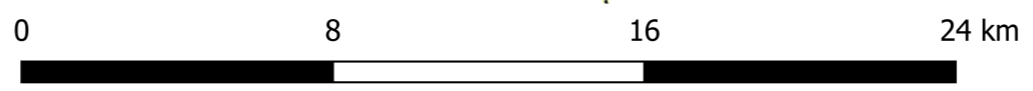
Legend

- Locality
- Major Road
- Other Road
- River
- District Boundary

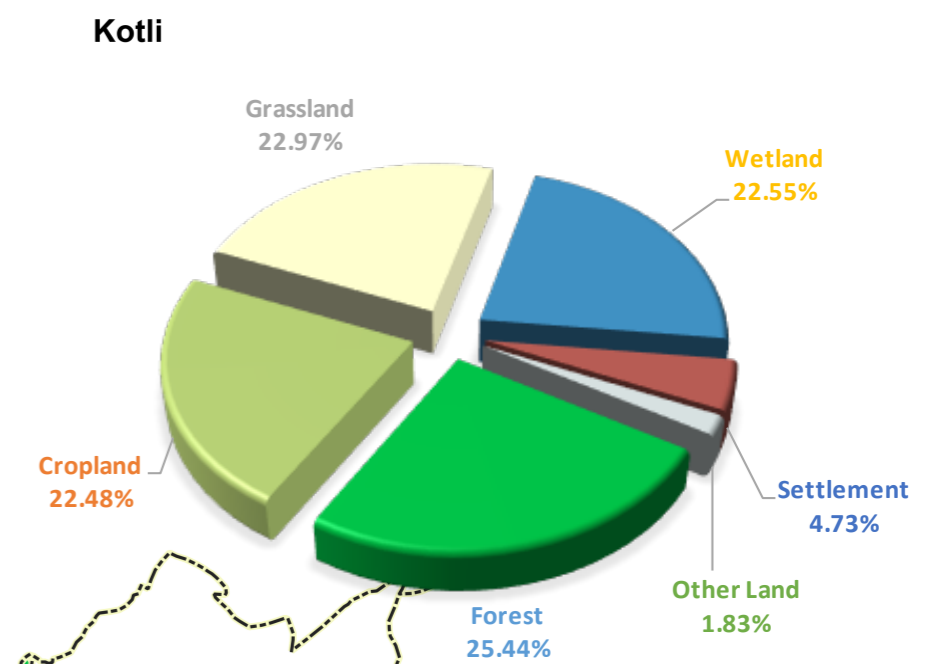
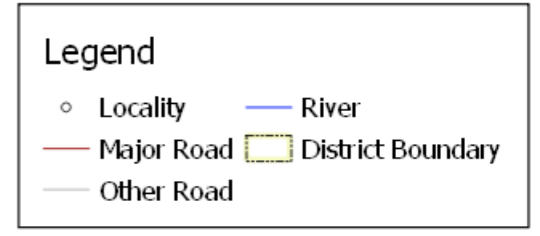
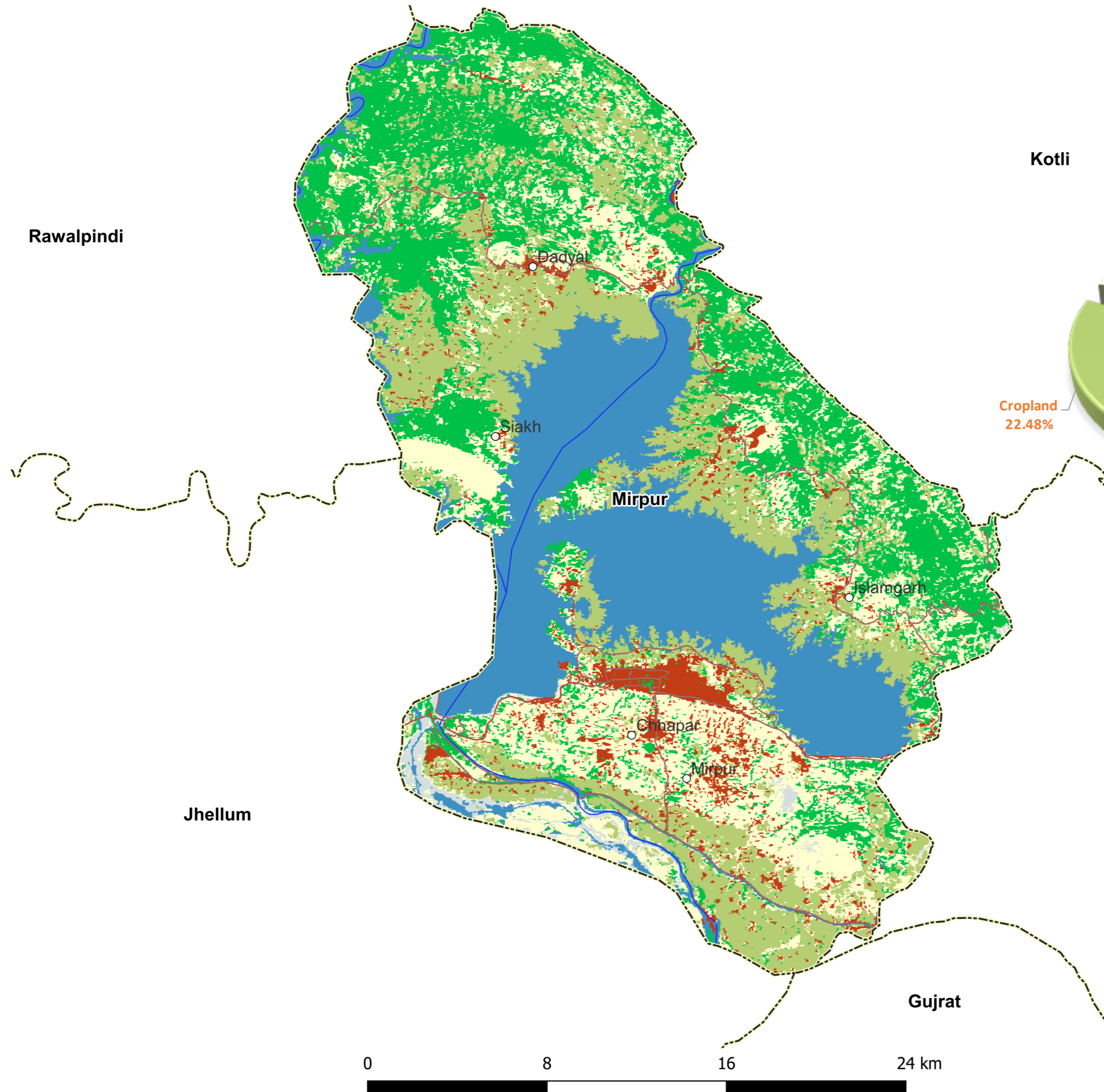


* All areas are calculated in hectare

	Forest	95,944
	Cropland	36,191
	Grassland	26,426
	Wetland	804
	Settlement	1,472
	Other Land	3,245



MIRPUR DISTRICT LULC MAP - 2020

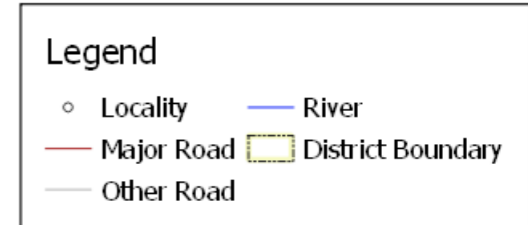
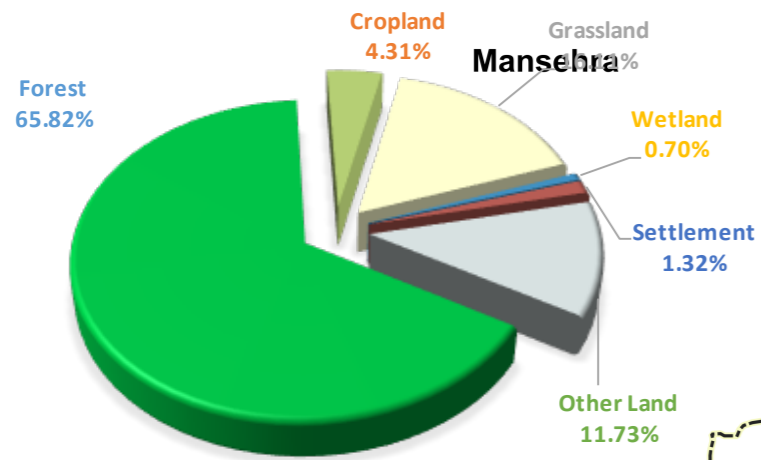


Bhimber

** All areas are calculated in hectare*

	Forest	23,129
	Cropland	20,433
	Grassland	20,885
	Wetland	20,502
	Settlement	4,296
	Other Land	1,667

MUZAFFARABAD DISTRICT LULC MAP - 2020



Abbottabad

Neelum

Hattian

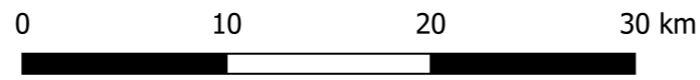
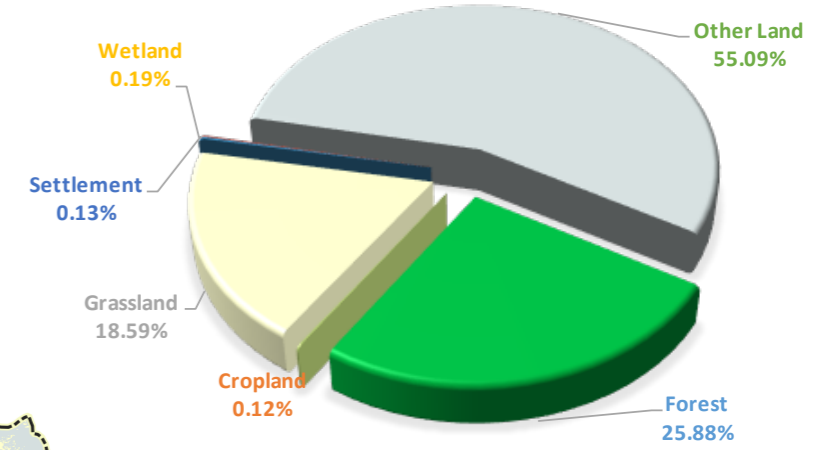
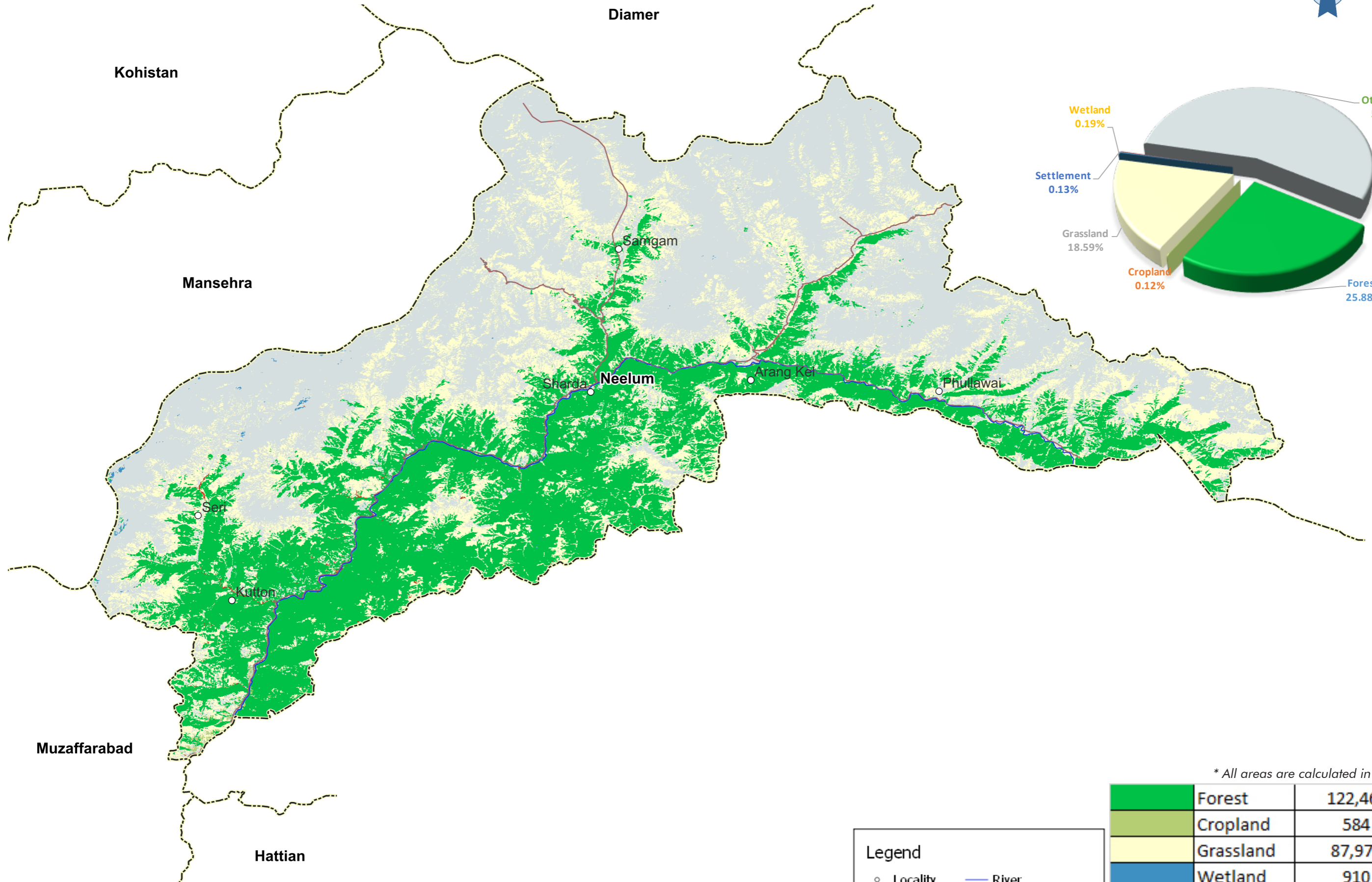
Bagh

* All areas are calculated in hectare

	Forest	93,040
	Cropland	6,095
	Grassland	22,778
	Wetland	995
	Settlement	1,864
	Other Land	16,584

0 9 18 27 km

NEELUM DISTRICT LULC MAP - 2020



Legend

- Locality — River
- Major Road □ District Boundary
- Other Road

** All areas are calculated in hectare*

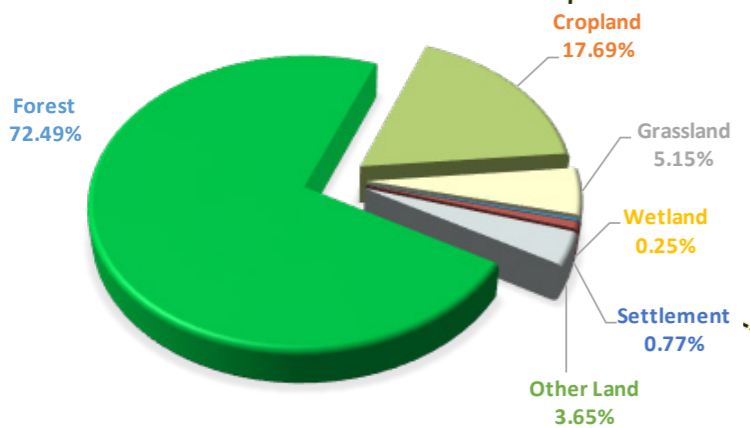
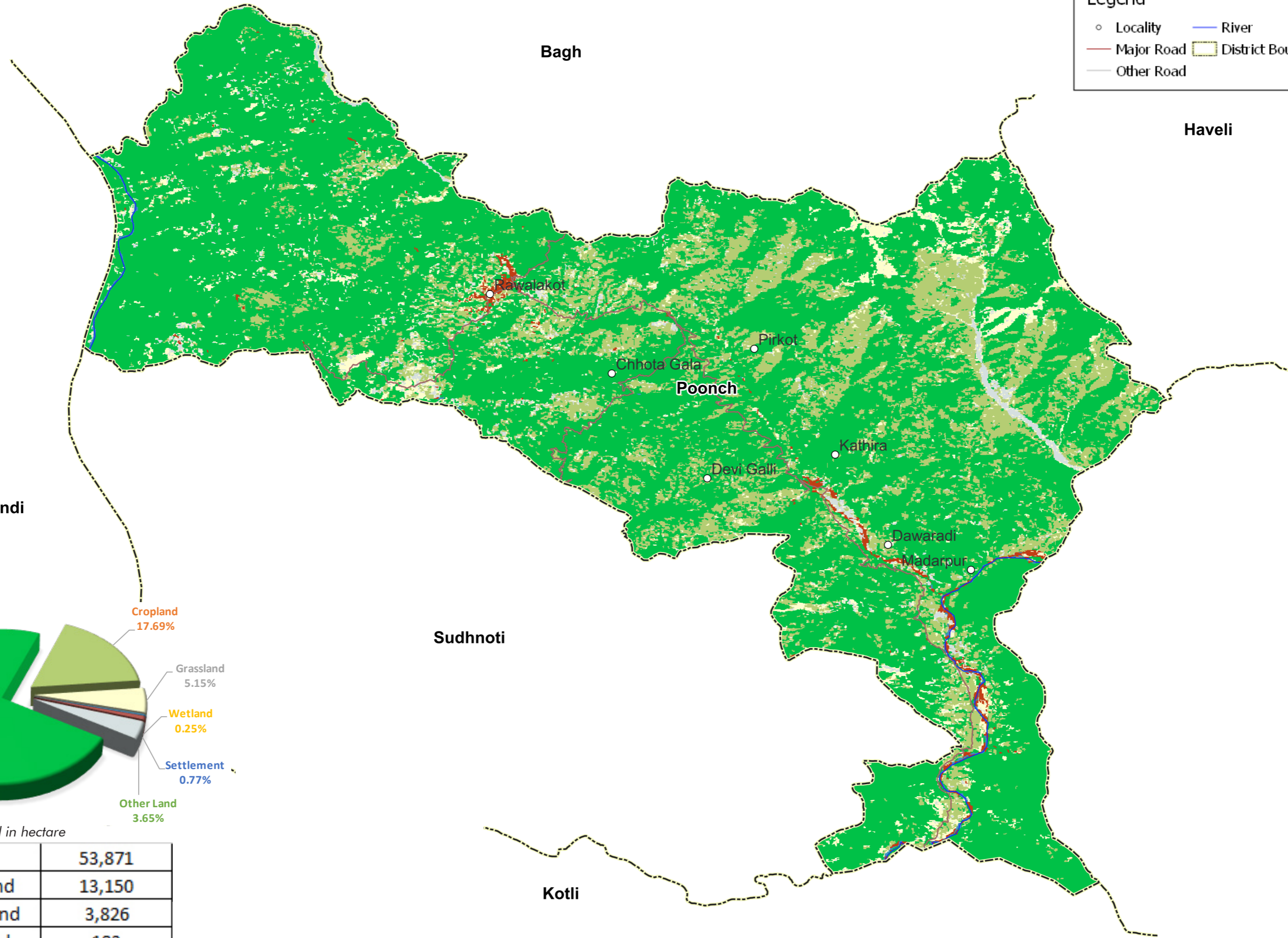
	Forest	122,466
	Cropland	584
	Grassland	87,973
	Wetland	910
	Settlement	605
	Other Land	260,672

POONCH DISTRICT LULC MAP - 2020



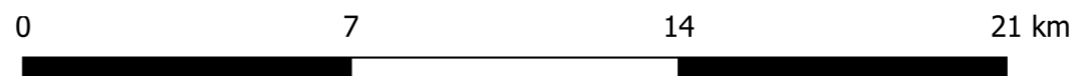
Legend

- Locality
- River
- Major Road
- District Boundary
- Other Road



* All areas are calculated in hectare

Forest	53,871
Cropland	13,150
Grassland	3,826
Wetland	183
Settlement	574
Other Land	2,713

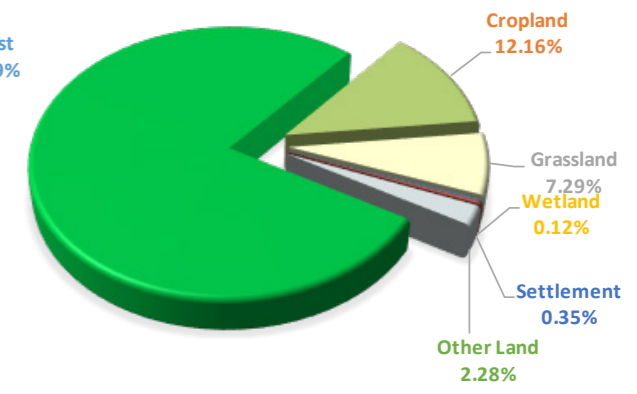
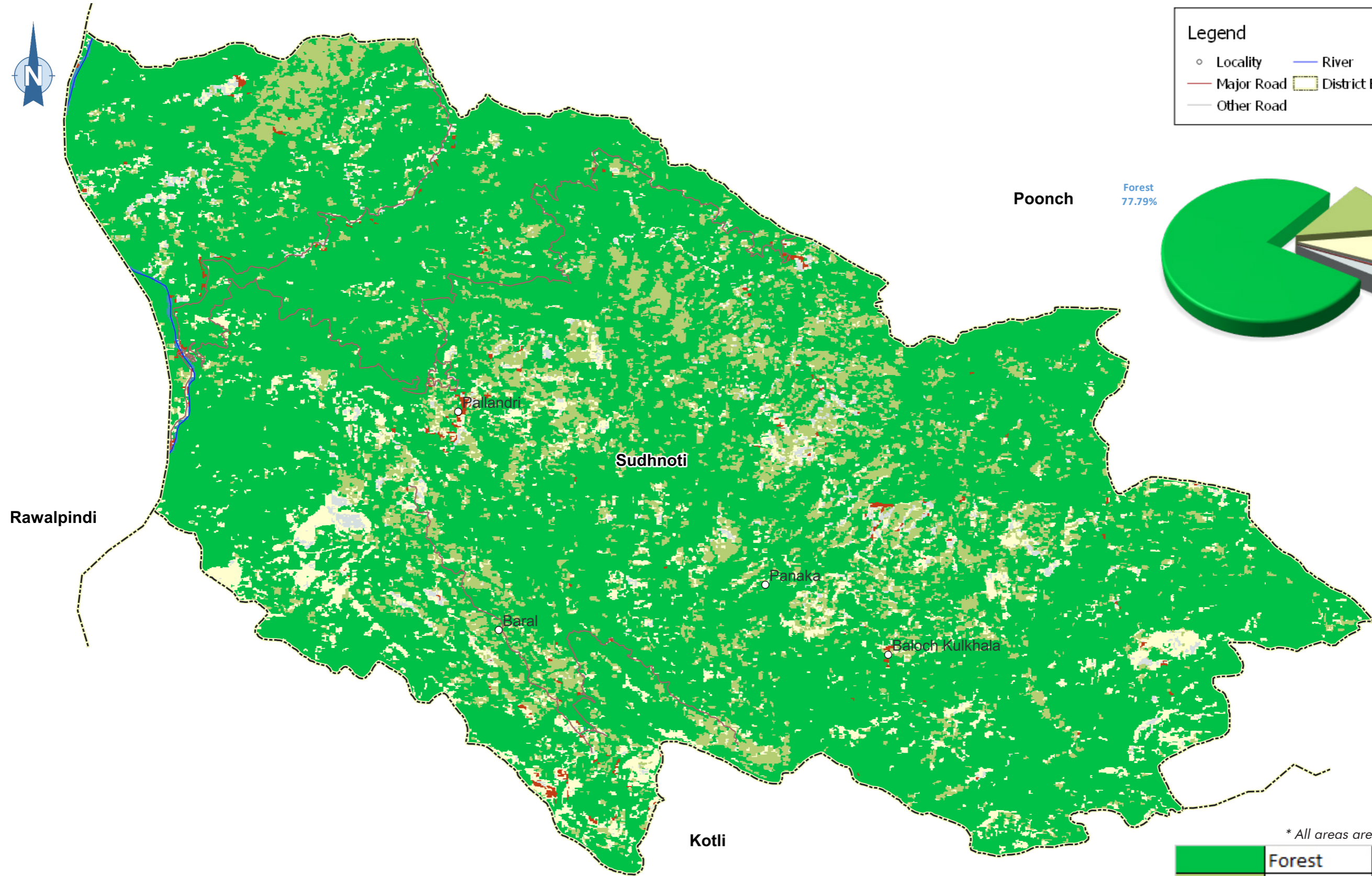


SUNDHNOTI DISTRICT LULC MAP - 2020



Legend

- Locality
- Major Road
- Other Road
- River
- District Boundary

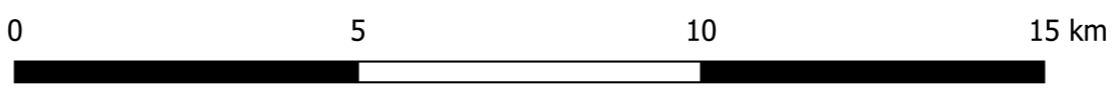


Rawalpindi

Poonch

Sudhnoti

Kotli



* All areas are calculated in hectare

	Forest	44,445
	Cropland	6,949
	Grassland	4,168
	Wetland	66
	Settlement	202
	Other Land	1,304



Why we are here:

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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