RIVER BASIN ATLAS OF NEPAL

Government of Nepal

Water and Energy Commission Secretariat (WECS)

Singhadurbar, Kathmandu, Nepal

2024

Government of Nepal
Water and Energy Commission Secretariat (WECS)
Singhadurbar, Kathmandu, Nepal

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Data source and disclaimer

1. The basin and sub-basin catchment areas are delineated in GIS from the DEM developed from the topographic data published by Survey Department of Nepal for the Nepalese part and SRTM 30m DEM for outside Nepal. The area figures used in the Atlas are calculated using projection system - UTM, Central Meridian - 84° East, Scale factor 0.9996, Datum - WGS 1984.
2. The basin or catchment areas reported may be different from the other published data due to different DEMs or topographical data used.
3. The river flow data are derived from the MIKE SHE modeling results which were used as inputs to the River Basin Models (MIKE Hydro Basin model). There may be some differences from the observed data published by DHM or data used by project specific studies due to the differences and uncertainties inherent in the input data and model parameters based on calibration and validation using available data at key locations. The data should therefore be used or interpreted considering the above.

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Introduction

The River Basin Atlas can be a comprehensive resource for understanding and managing river basins. It offers an abundance of information and data on the physical, ecological, and socio-economic characteristics of river basins, as well as the challenges and opportunities for sustainable water management. The atlas provides a basis for stakeholders to access and analyze information, share knowledge and experiences, and collaborate on solutions to water-related issues. The River Basin Atlas can be a valuable tool for researchers, policy makers, water managers, and all those interested in sustainable water management.

The River Basin Atlas provides a holistic view of the topography, hydrology, climate, and land use of each river basin. It also presents key socio-economic indicators, such as population density, infrastructure development, and water use. The atlas highlights the status of basin-wide water availability and its potential use.

Composition of the River Basin Atlas

The River Basin Atlas is divided in two sections. The first section provides maps and information at the national level covering the whole of Nepal. Whereas, the second section provides maps at basin level. Nepal is divided in to 10 river basins and the Southern Blocks. The 10 river basins are: Koshi, Gandaki, Karnali, Mahakali, Babai, West Rapti, Bagmati, Kamala, Kankai, and Mechi. In addition to these 10 river basins, drainage areas of the rivers originating from the Chure hills are defined as the Southern Block.

The major river of Nepal like the Koshi, Gandaki, Karnali and Mahalaki rivers orginate from the upper catchments in Nepal, India and Tibet (China). The medium rivers like the Mechi, Kankai, Kamala, Bagmati, West Rapti and Babai originate from the Mahabharat range. The smaller rivers in the Southern plains originate from the Siwalik Range, and are ephemeral and most dry in the dry season, Ground water available in the Terai plains. hills, valleys and the mountains supplement the surface water. The catchments in the upper elevations, in the High Himalayan Mountains, have glaciers, ice and snow which augment the dry season flows with glacier and snow melt. The direct surface runoff when rain occurs, glacier and snow melt in the pre-monsoon months, and the perennial groundwater baseflow make Nepal a rich country in water resources availability.

Though there are abundant water resources available in Nepal, the utilization is small compared to the availability. Agricultural fields lack reliable irrigation facility, households are deprived of dependable and safe domestic water supply. and reliable and accessible electricity supply. Drought in the dry season and water induced disasters in the wet season are regular phenomenon in Nepal.

River basins comprise many complex and correlated elements. Development activities in river basins should therefore be undertaken with full the consideration of the regional, social, environmental, and economic implications. Utilization of water for single purpose affects the use in other sectors. So, a comprehensive river basin planning is necessary for the optimal, socially acceptable and environmentally sustainable use of water and land resources in the river basins.

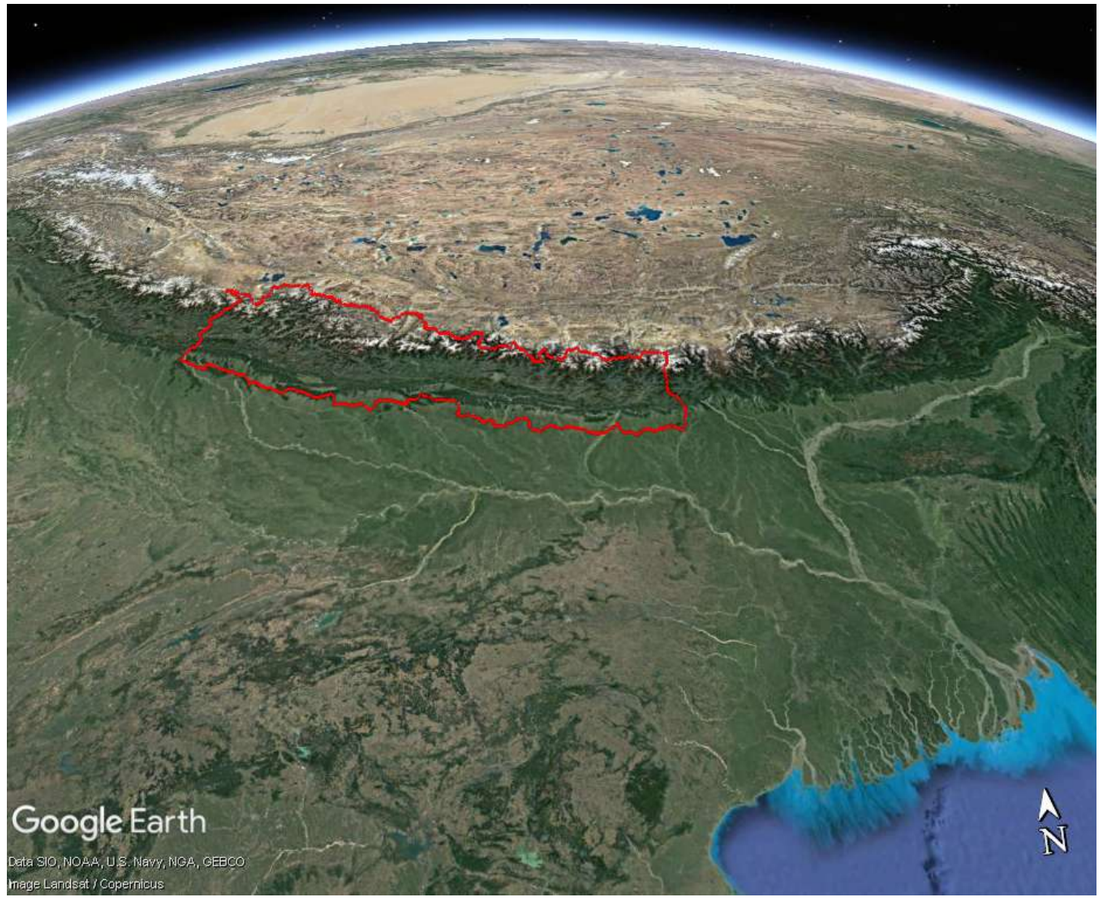


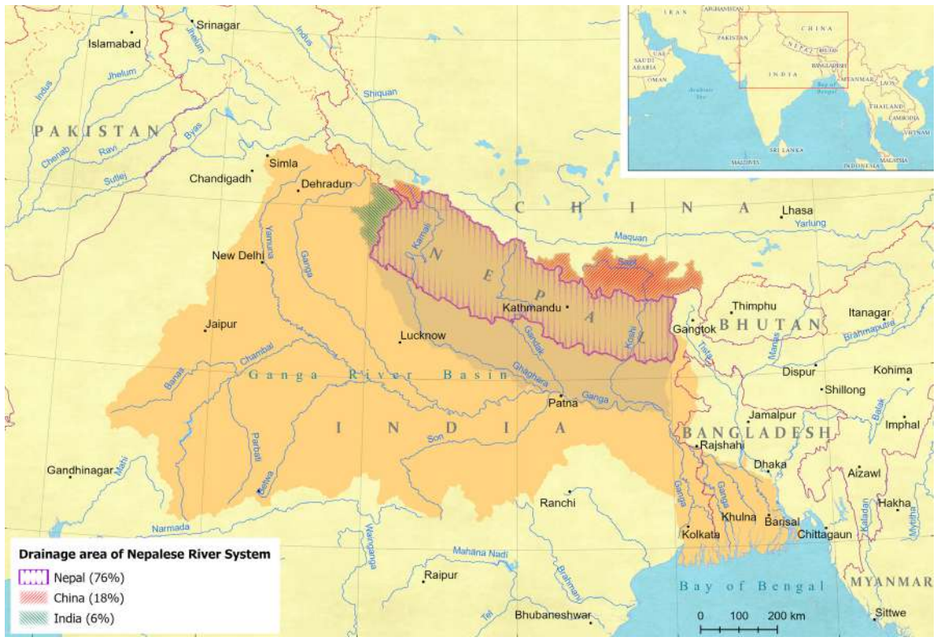
Figure 1.1: Nepal from Satellite

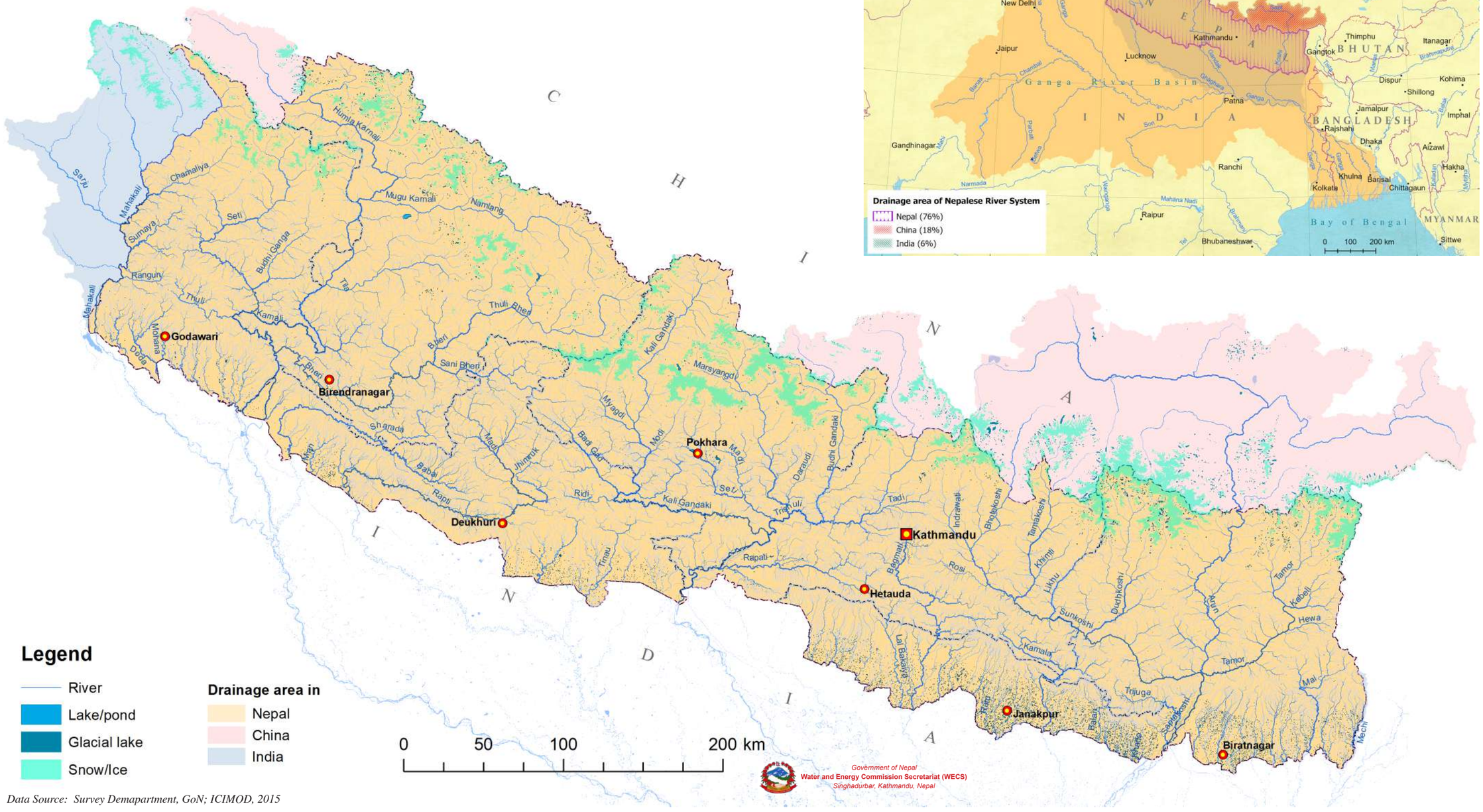
Climate change in Nepal in recent years has affected the discharge pattern of rivers resulting in an increase in flood and drought events. The rivers are facing an increased high flow, decrease in low flows, and more intense rainfall with reduction of the number of rainy days.

Most of the big rivers in Nepal have religious and cultural values. These rivers are also sources of livelihood to millions of people that depend on it for irrigation and domestic use. The rivers also produce hydropower needed for economic growth and prosperity of the country.

Water resources have many crucial functions and requires a holistic planning approach at the river basin level for their optimal utilization. If the competing demands on available water resources exceed their availability, it may result in unsustainable abstraction of the resources and conflict among competing users. So, proper river basin planning is a basic requirement for optimal and sustainable management of river basins. Summary results of the integrated water resources planning and development are presented in this River Basin Atlas.

Drainage System of Nepal

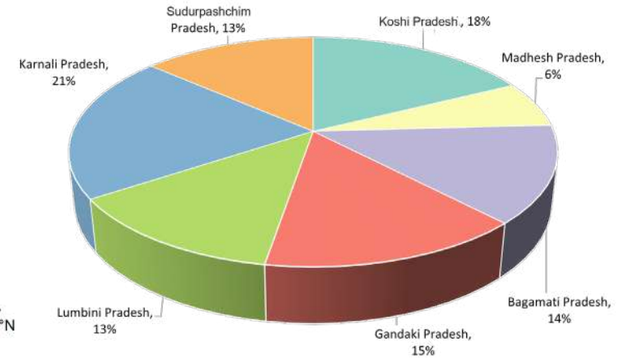




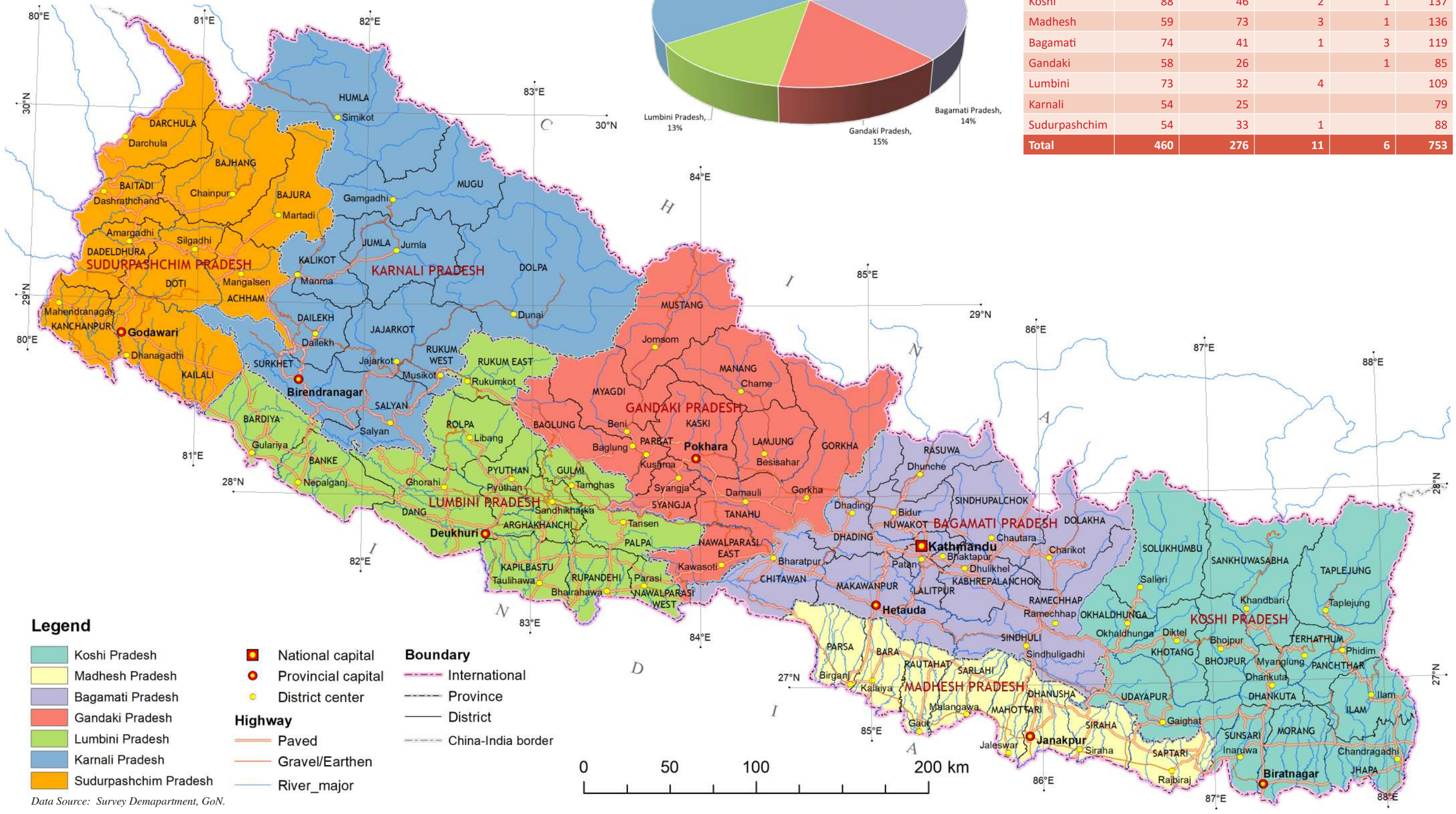
Data Source: Survey Demapartment, GoN; ICIMOD, 2015

Section 1 - Nepal

Administrative Division of Nepal



Province	Local Government				
	Gaunpa-lika	Nagarpalika	Upamah-anagarpa-lika	Mahanag-arpalika	Total
Koshi	88	46	2	1	137
Madhesh	59	73	3	1	136
Bagamati	74	41	1	3	119
Gandaki	58	26		1	85
Lumbini	73	32	4		109
Karnali	54	25			79
Sudurpashchim	54	33	1		88
Total	**460**	**276**	**11**	**6**	**753**



Data Source: Survey Demapartment, GoN.

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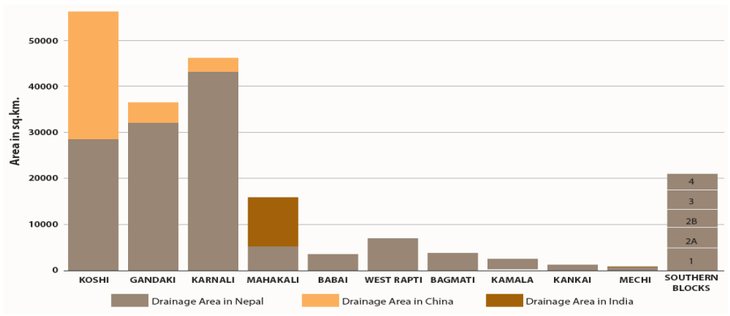
River Basin of Nepal



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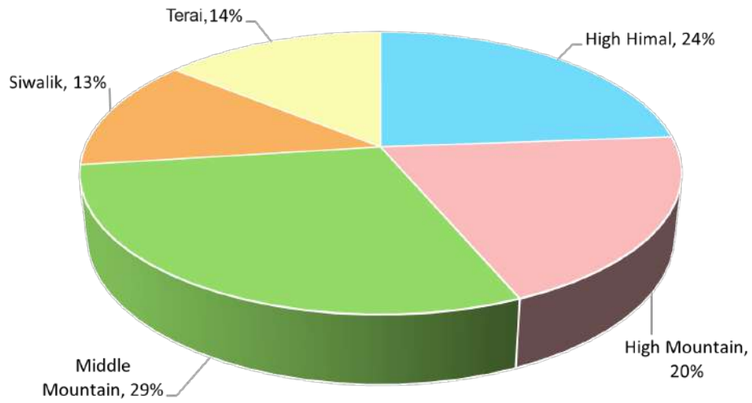
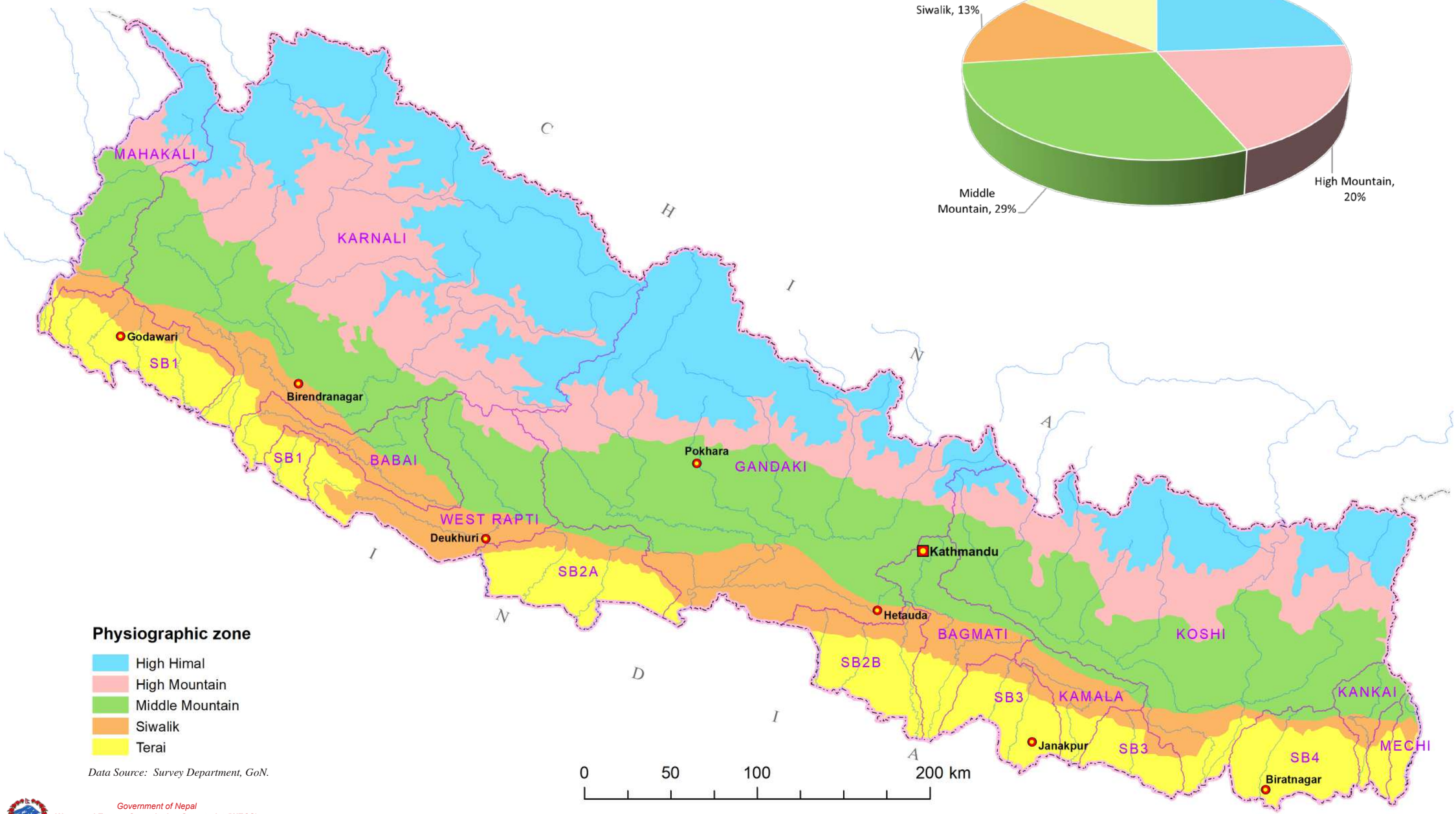
For the purpose of the present Atlas, ten major and medium river basins:(1) Koshi, (2) Gandaki, (3) Karnali, (4) Mahakali, (5) Babai, (6) West Rapti, (7) Bagmati, (8) Kamala, (9) Kankai, and (10) Mechi, and four southern basin blocks are considered. The river basins in the southern part of the country draining into India are grouped into four southern blocks; namely, Southern Block-1 consisting of Khutia, Mohana, Donda, Chaoudhar and other small local rivers; Southern Block-2a consisting of Banganga, Tinau, Rohini and other small local rivers; Southern Block-2b consisting of Lal Bakeya and other small local rivers; Southern Block-3 consisting of Khando, Balan, Rato, Lakhendehi and other small local rivers; and Southern Block-4 consisting of Mawa Ratwa, Birin, Budhi, Chisan and other smaller rivers.

Koshi, Gandaki, Karnali, Mahakali and Mechi river basins have catchments extended beyond the border of Nepal. These basins have a total catchment area of 46,311 km^2 outside Nepal, in China and India.

Physiographic Division





Data Source: Survey Department, GoN.

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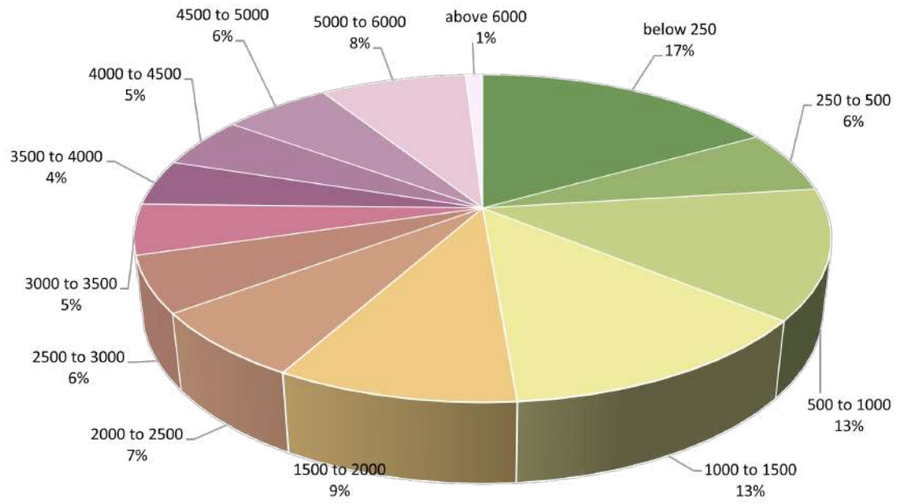
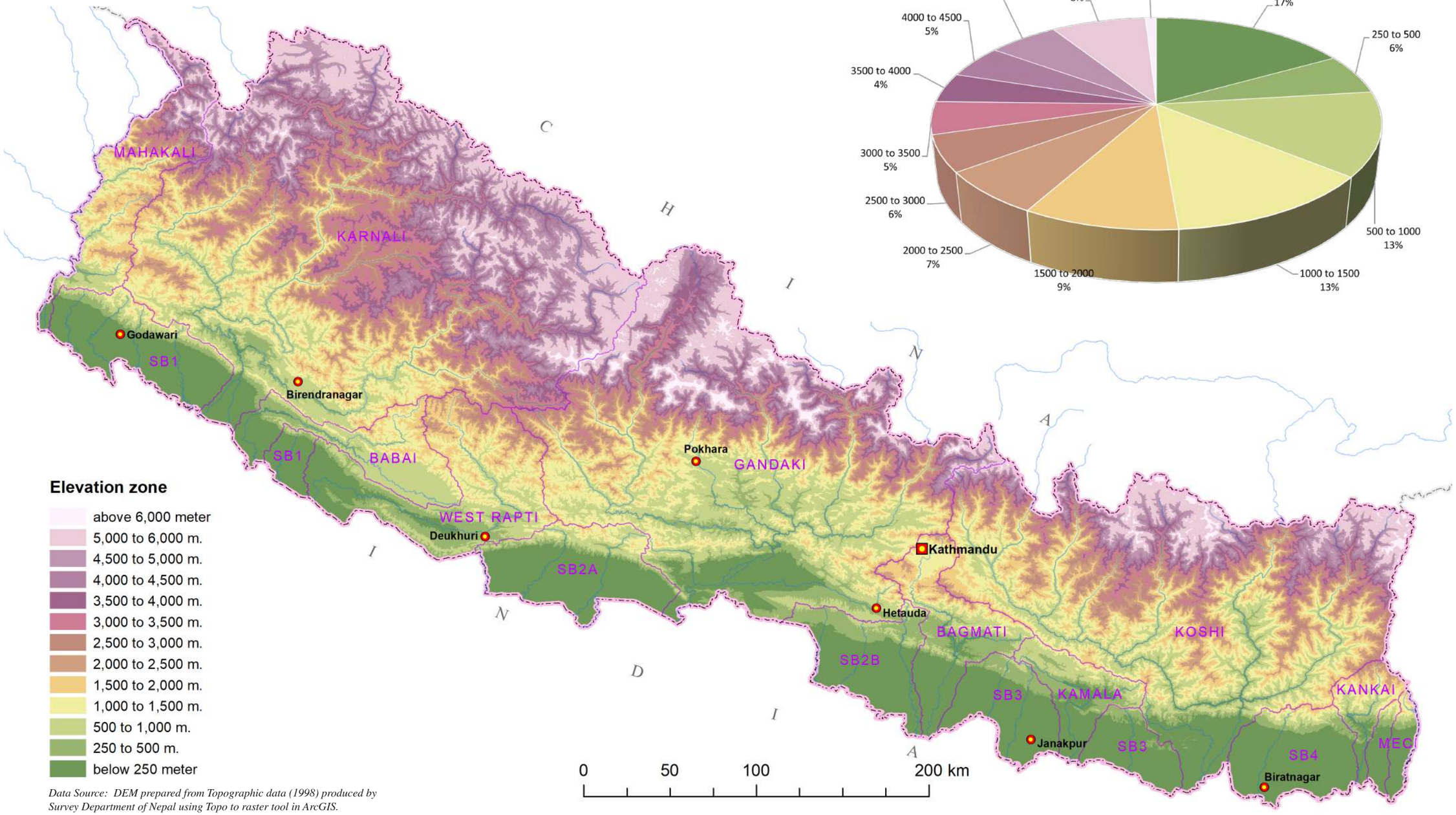
Elevation Zone





Data Source: DEM prepared from Topographic data (1998) produced by Survey Department of Nepal using Topo to raster tool in ArcGIS.

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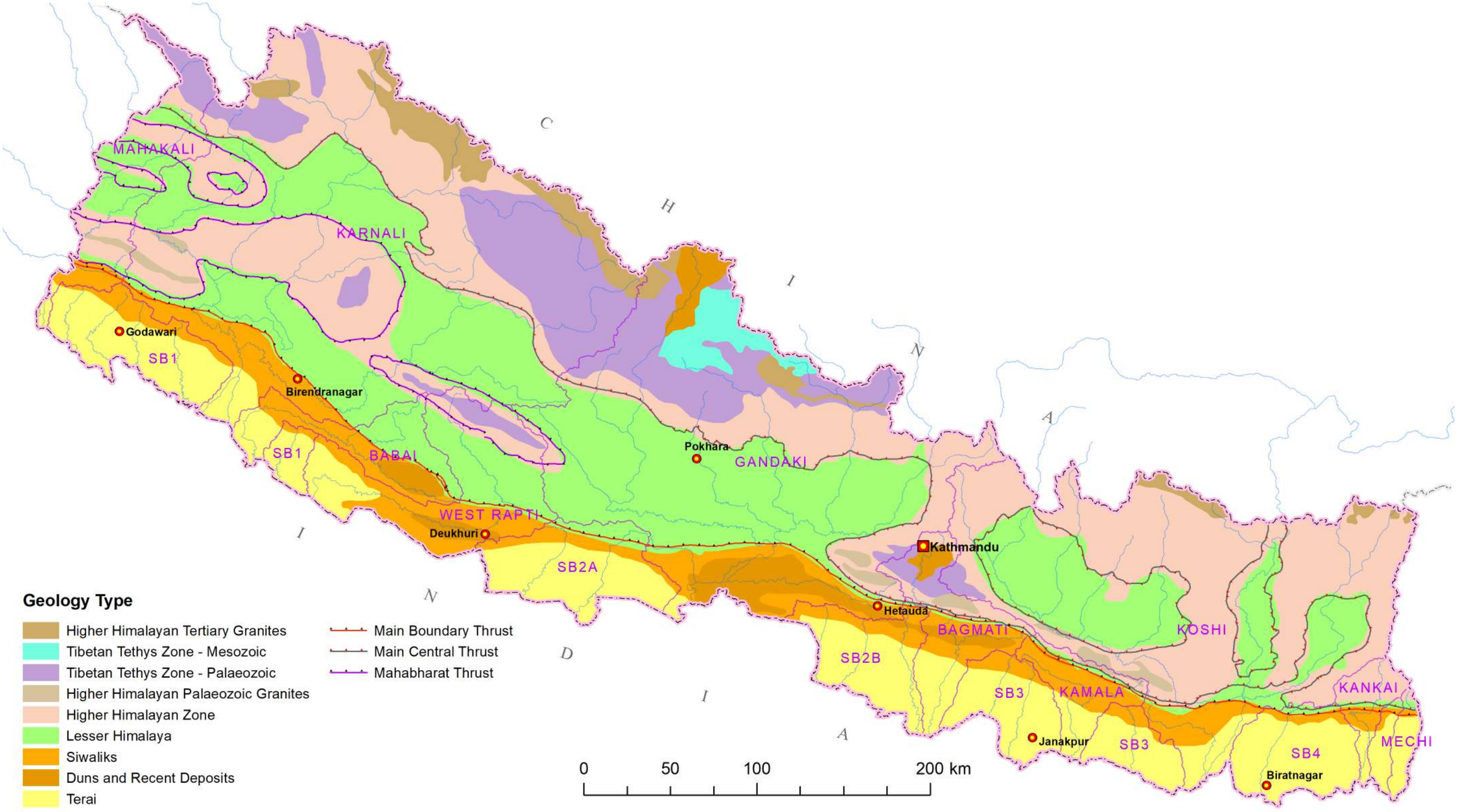
Geology



Data Source: Geological Map of Nepal - Scale 1:1,000,000, Department of Mines and Geology, GoN.

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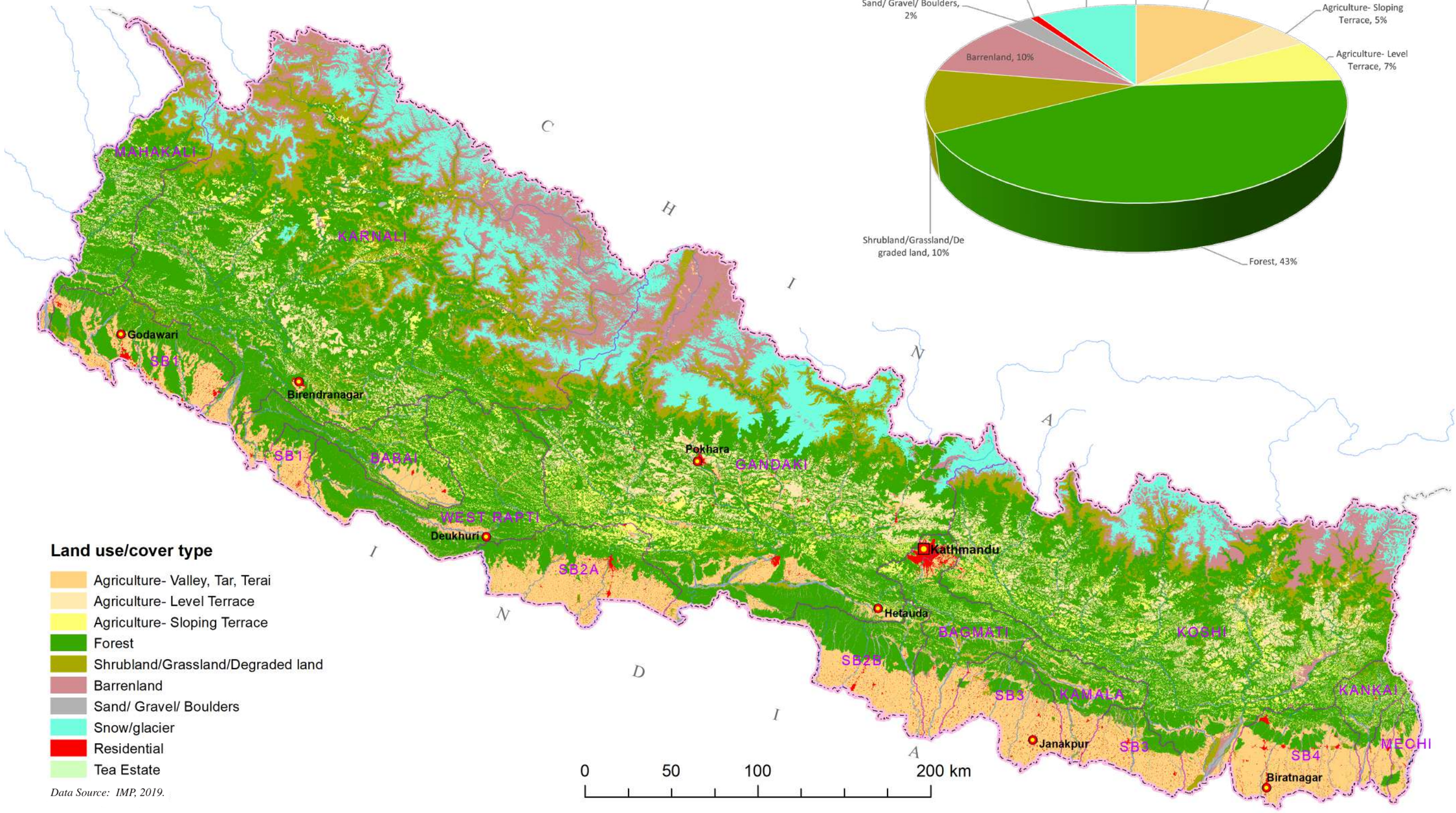
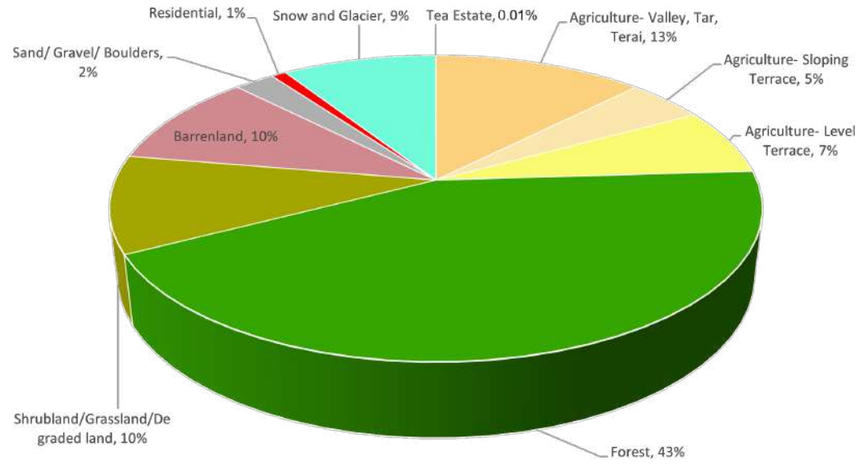
Land Use/Cover





Data Source: IMP, 2019.

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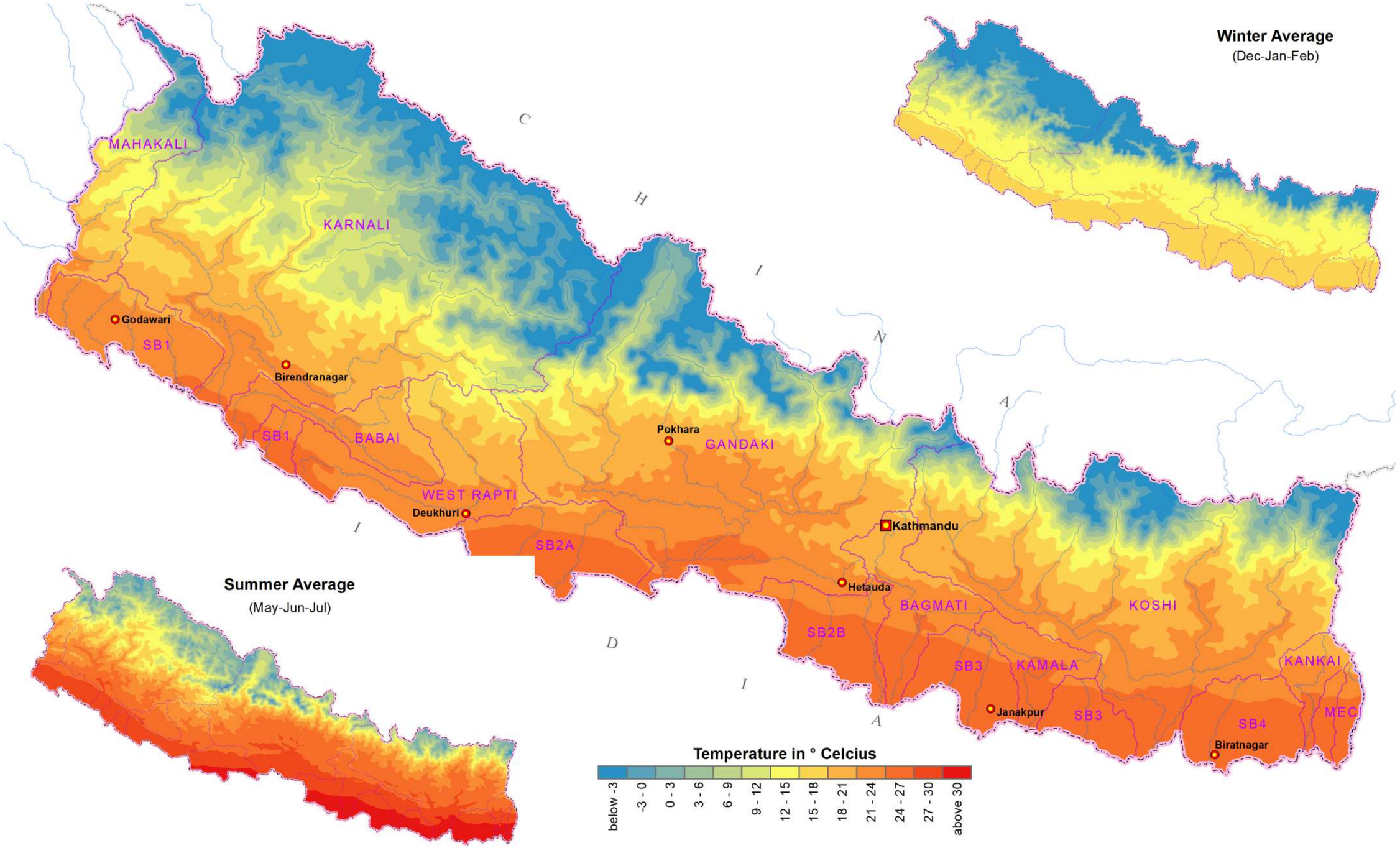
Average Temperature Distribution



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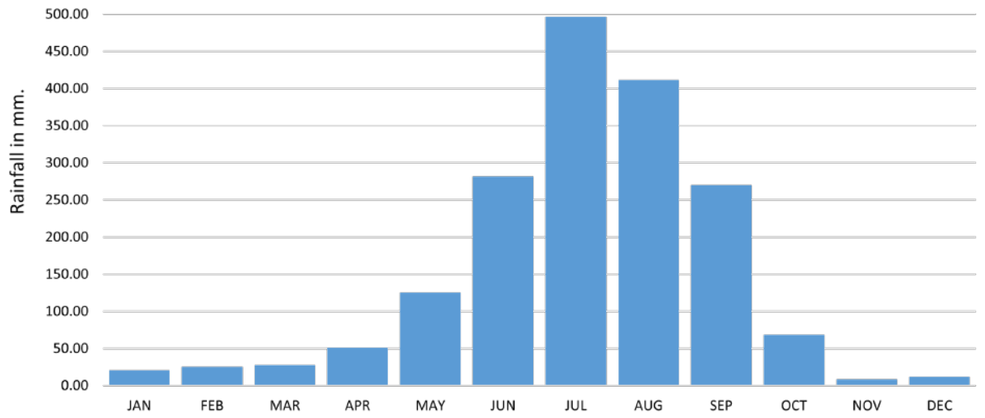
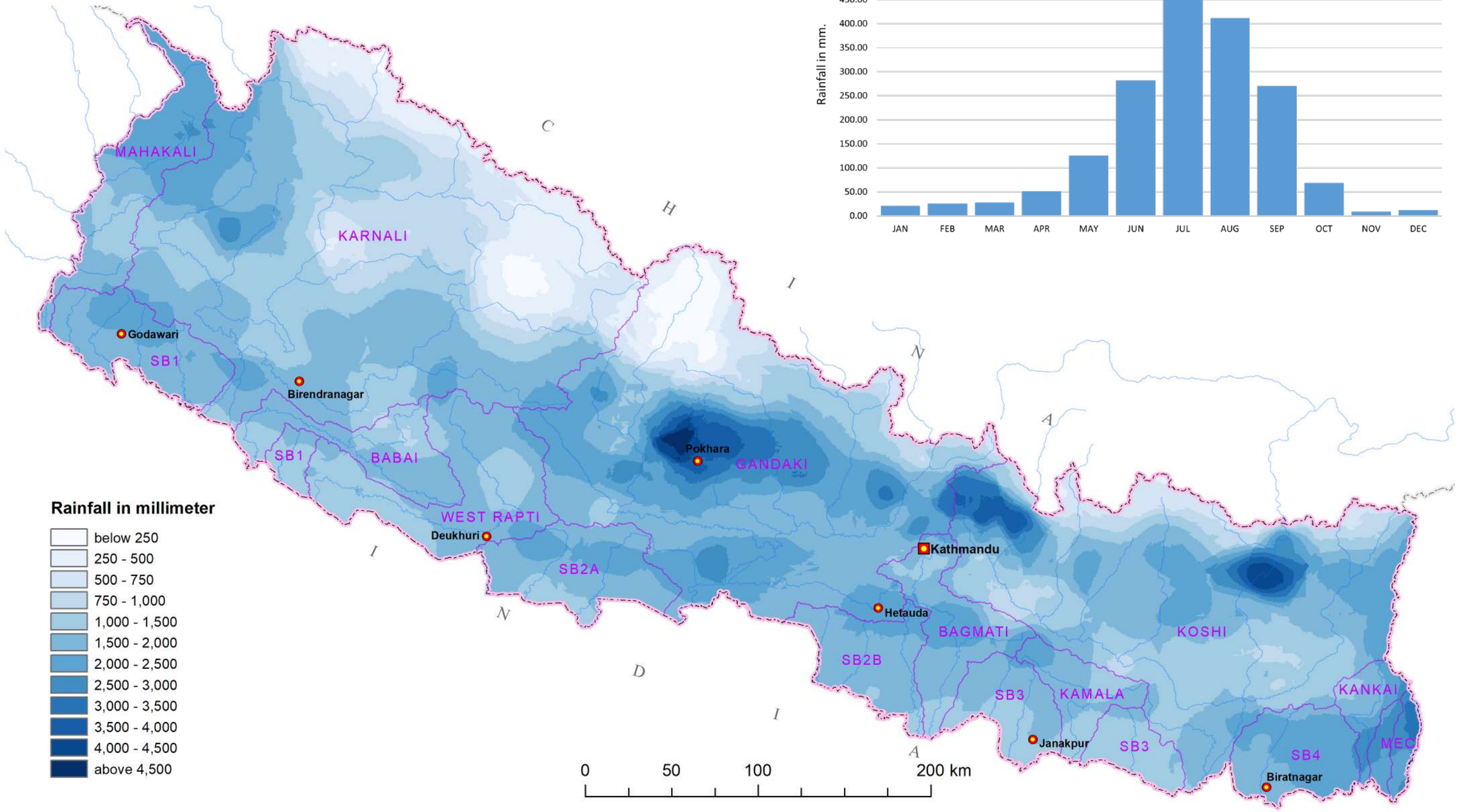
Data Source: Surface generated from DHM Temperature Data - 1985-2015.

Annual Average Rainfall Distribution





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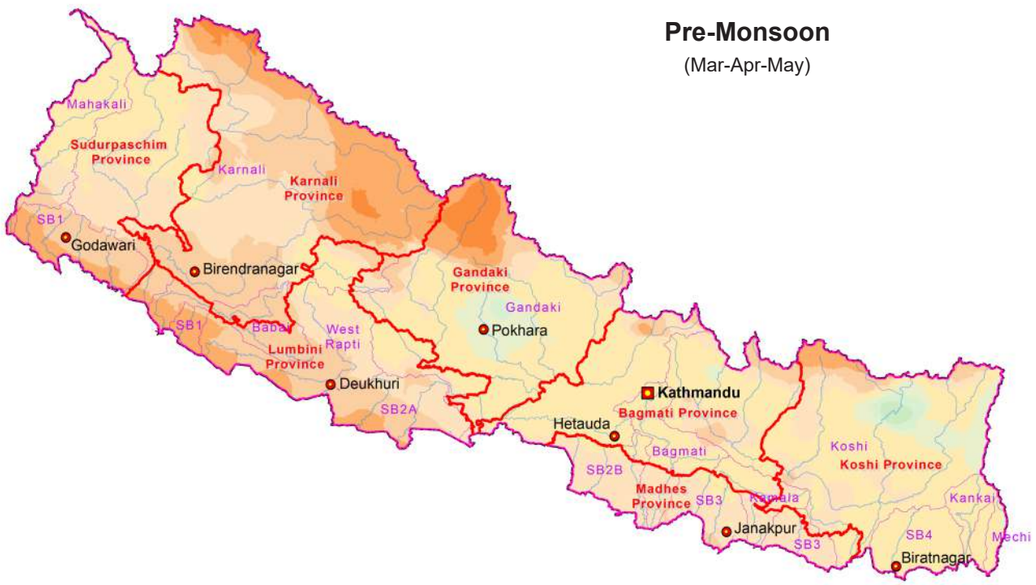
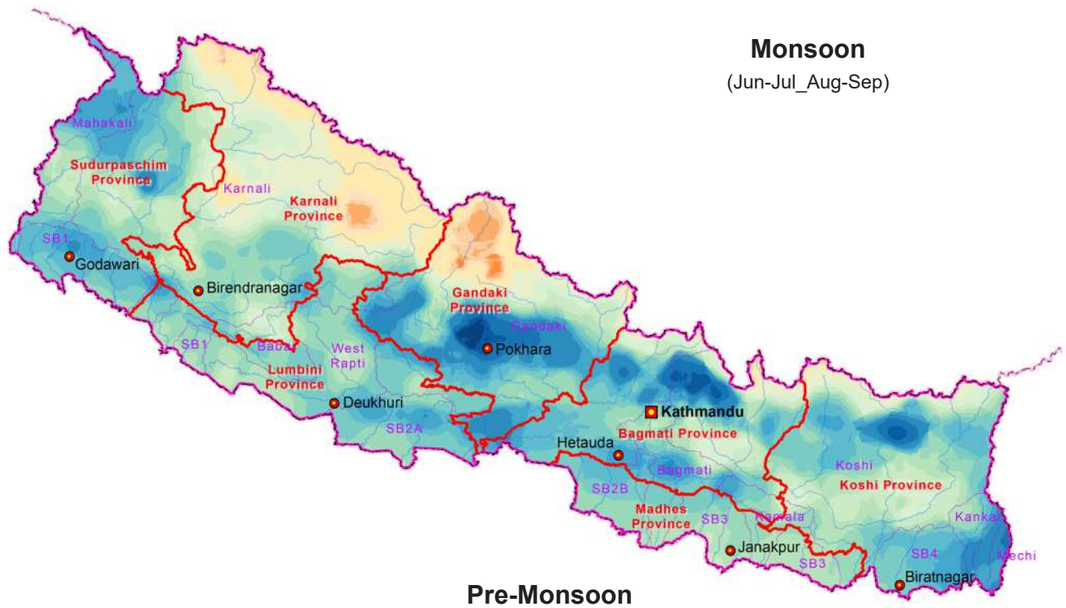
Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

Seasonal Average Rainfall Distribution

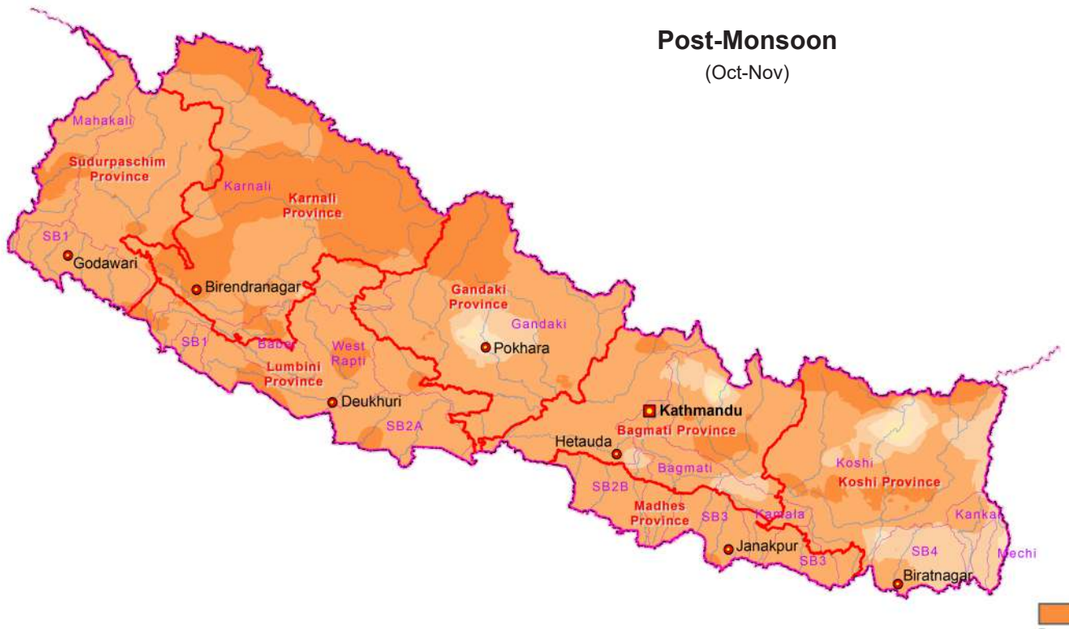
Pre-Monsoon
(Mar-Apr-May)



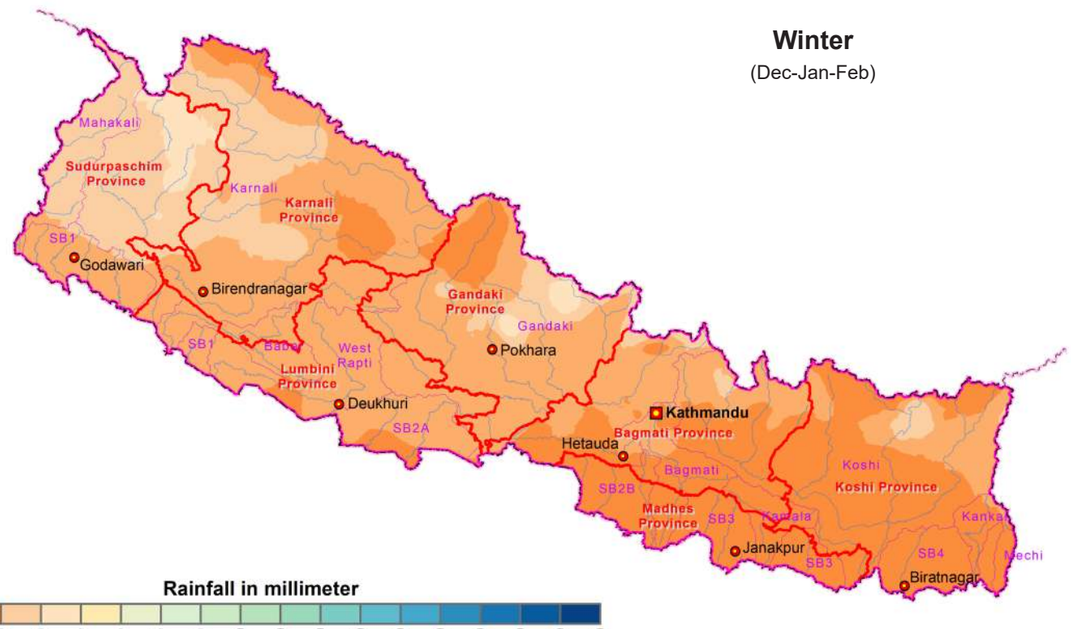
Monsoon
(Jun-Jul_Aug-Sep)



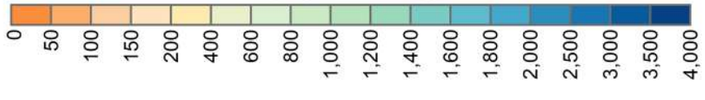
Post-Monsoon
(Oct-Nov)



Winter
(Dec-Jan-Feb)



Rainfall in millimeter



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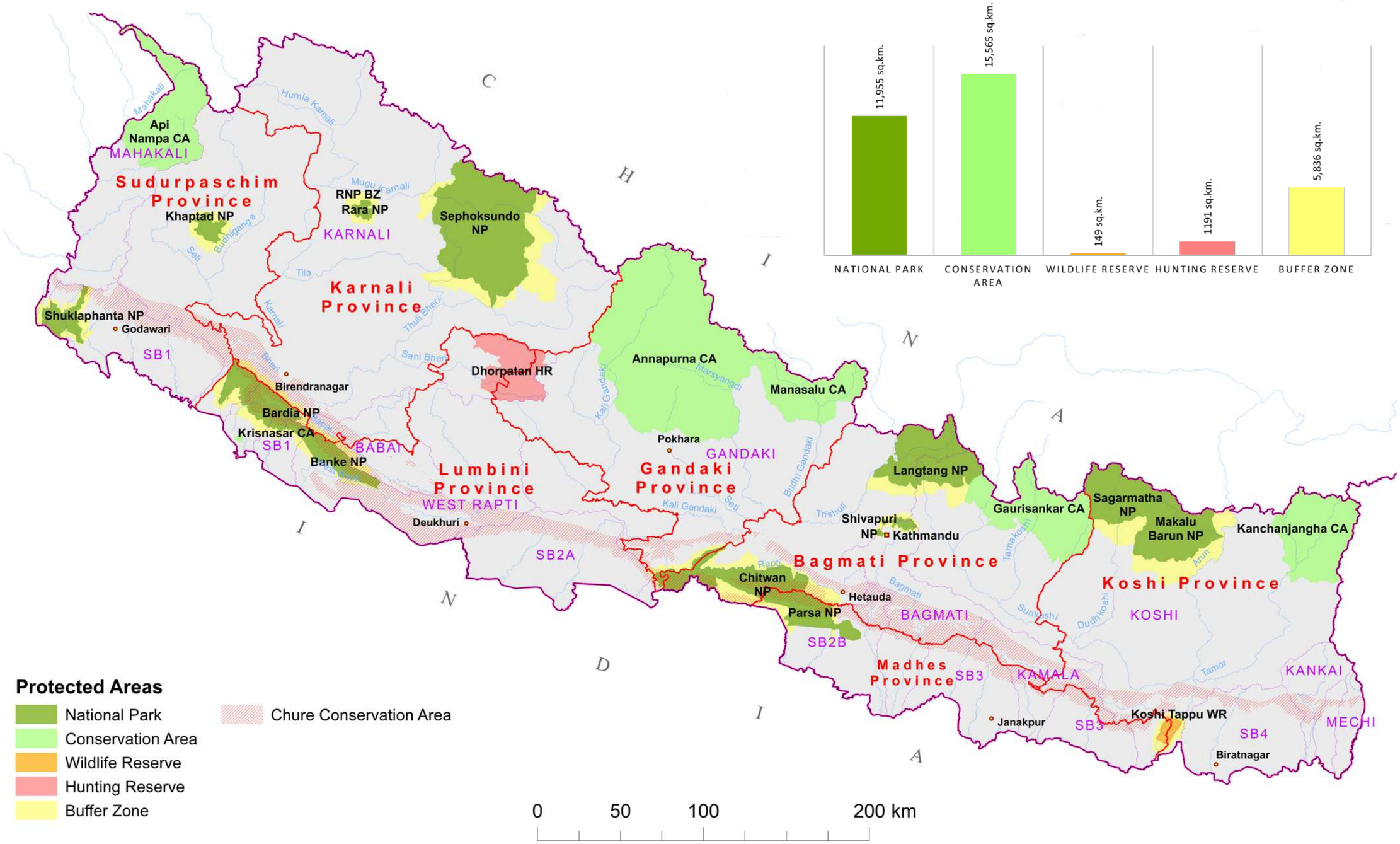
Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

Protected Areas



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Data Source: DNPWC & PCTMCDB , GoN, 2022

Road Network

Source: DOR, Nepal, 2022

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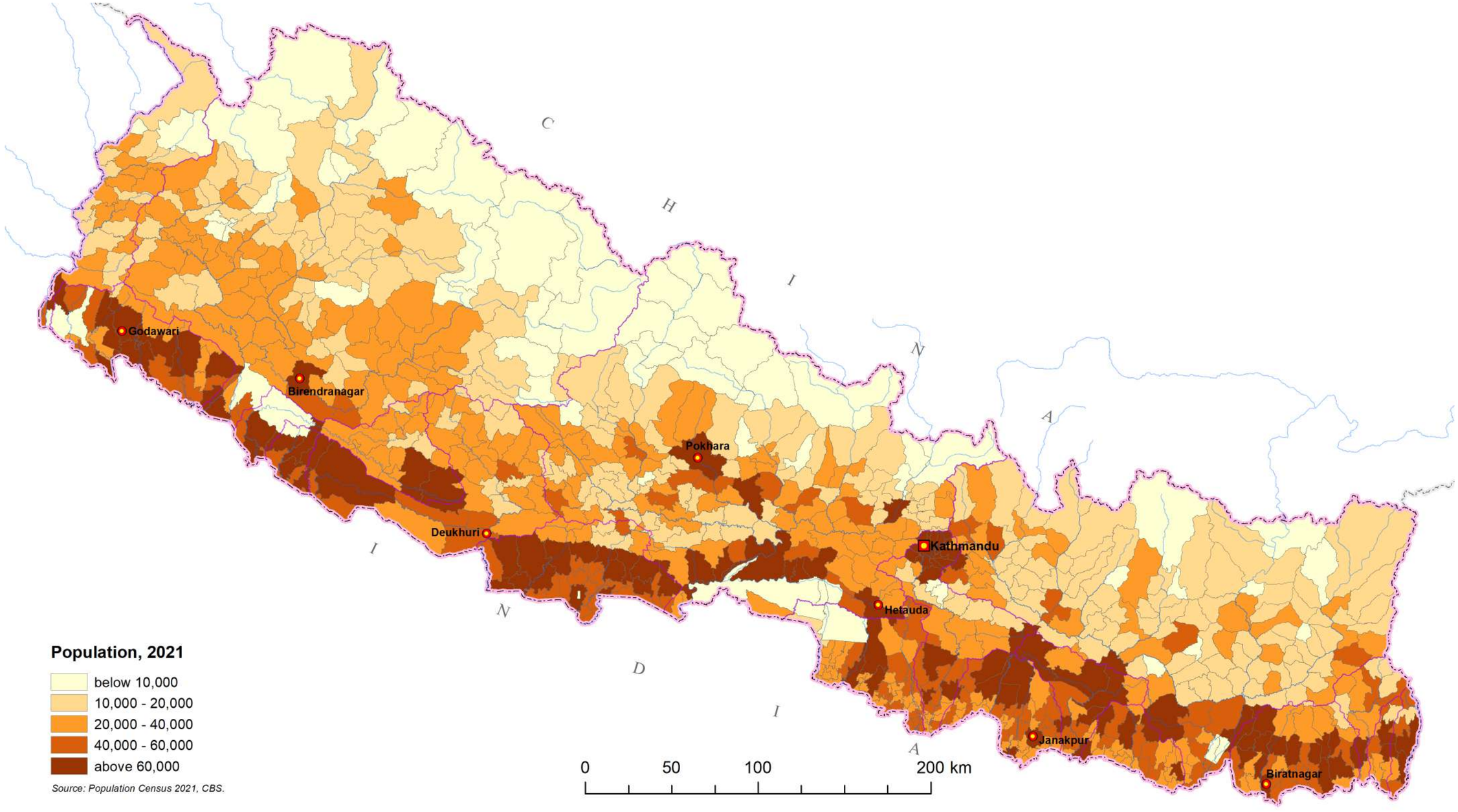
Population Distribution



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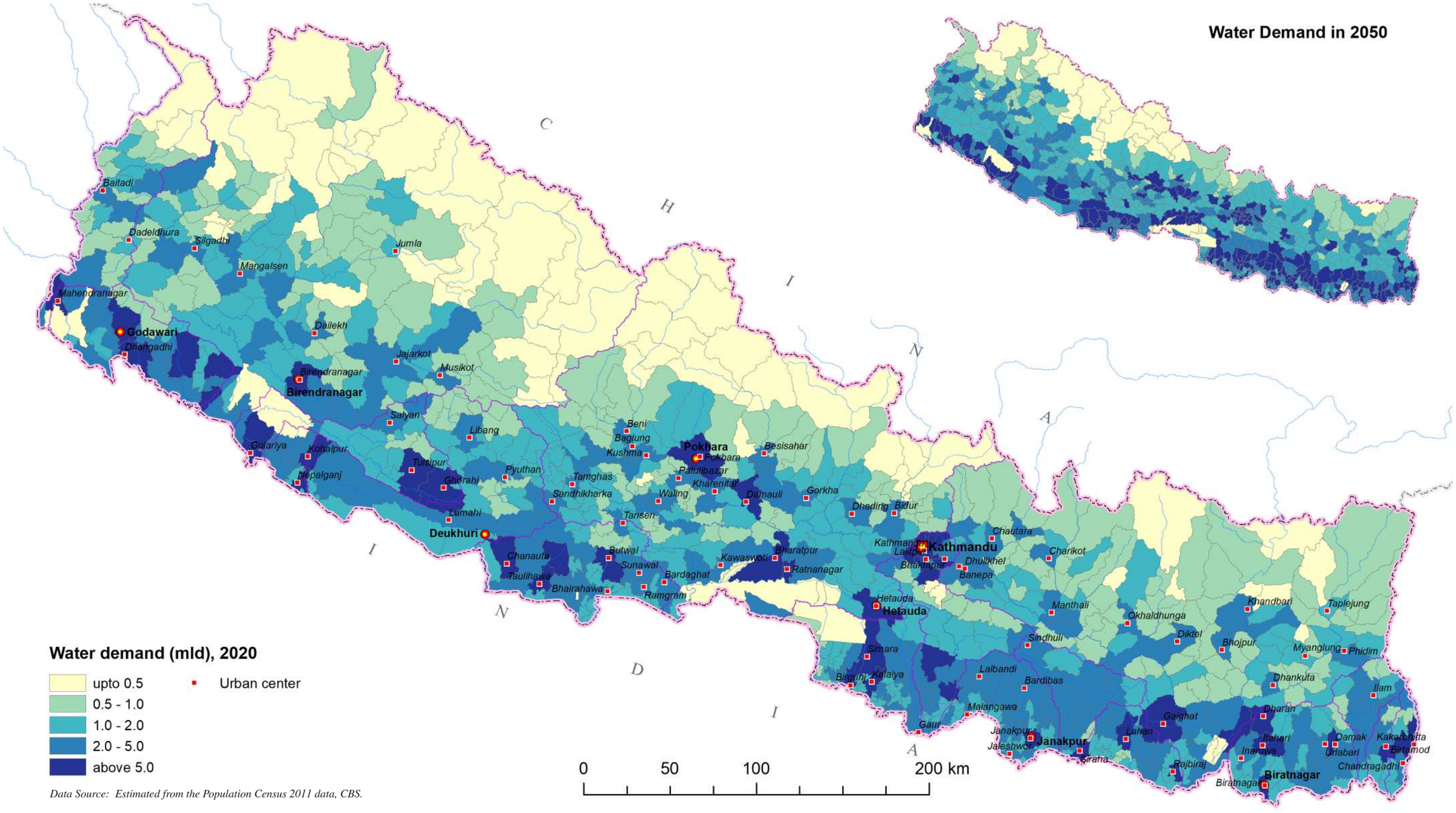
Domestic Water Demand



Data Source: Estimated from the Population Census 2011 data, CBS.

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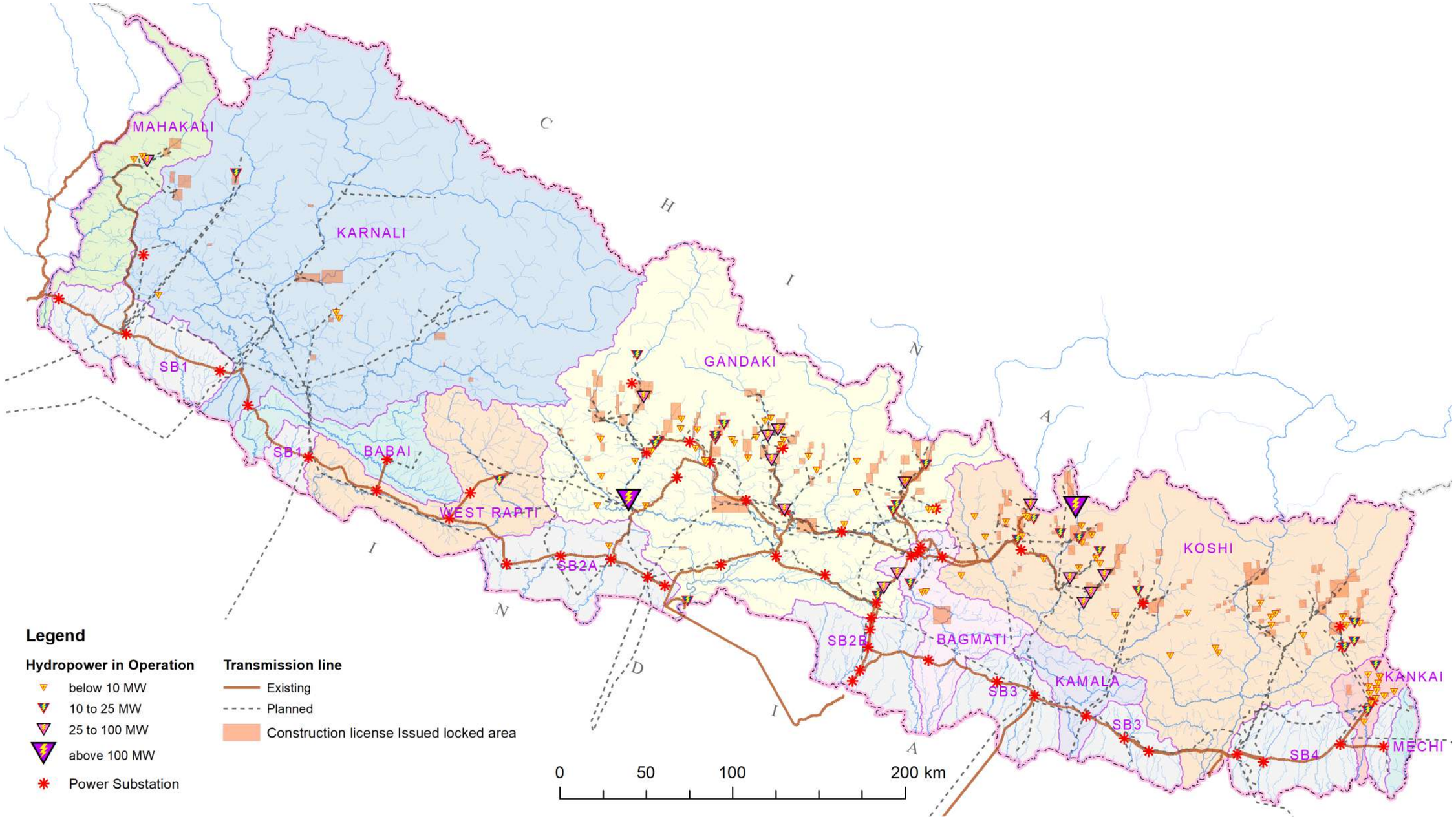
Hydropower Projects



Data Source: DOED, GoN.

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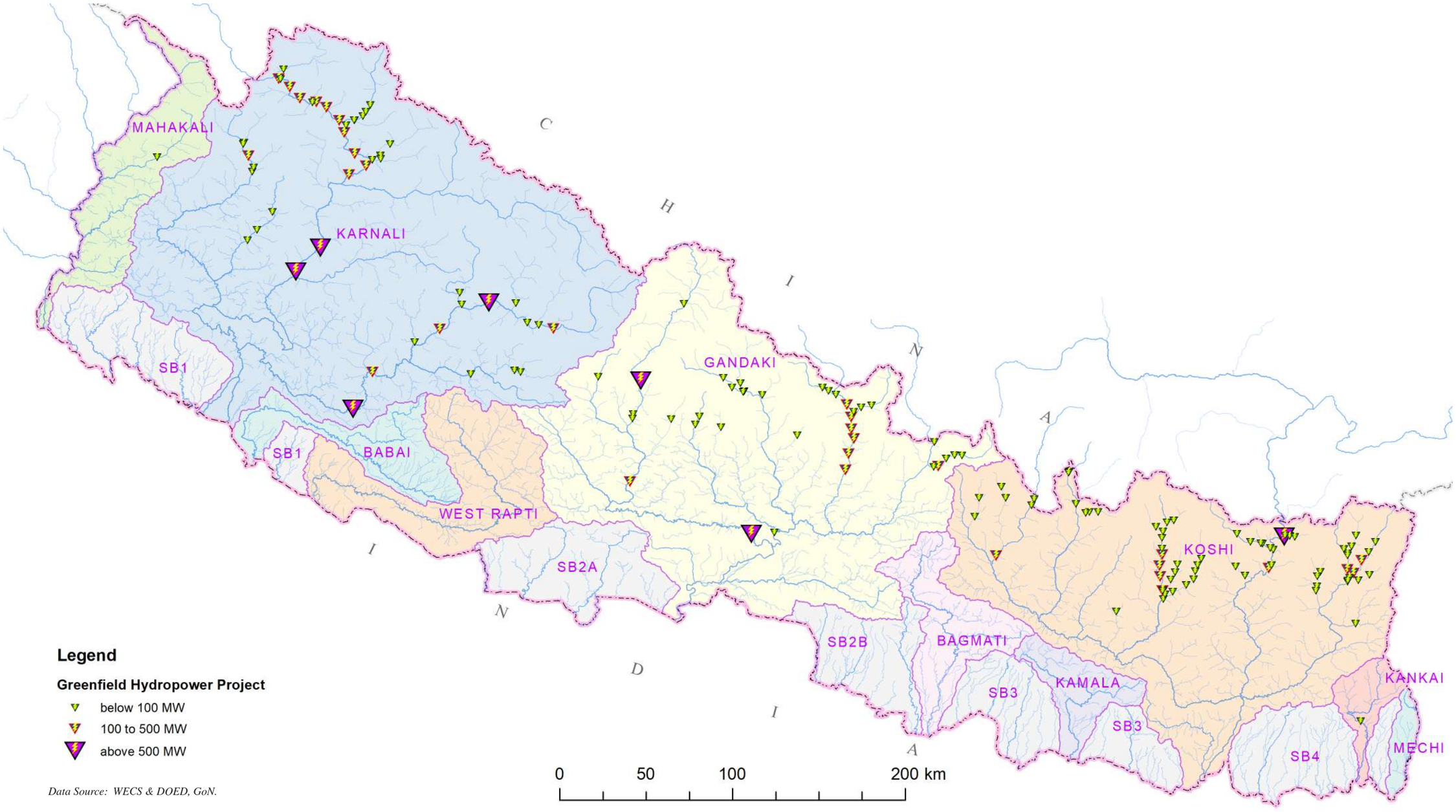
Data Source: DOED, GoN (as of March 2023).

Greenfield Hydropower Projects



Data Source: WECS & DOED, GoN.

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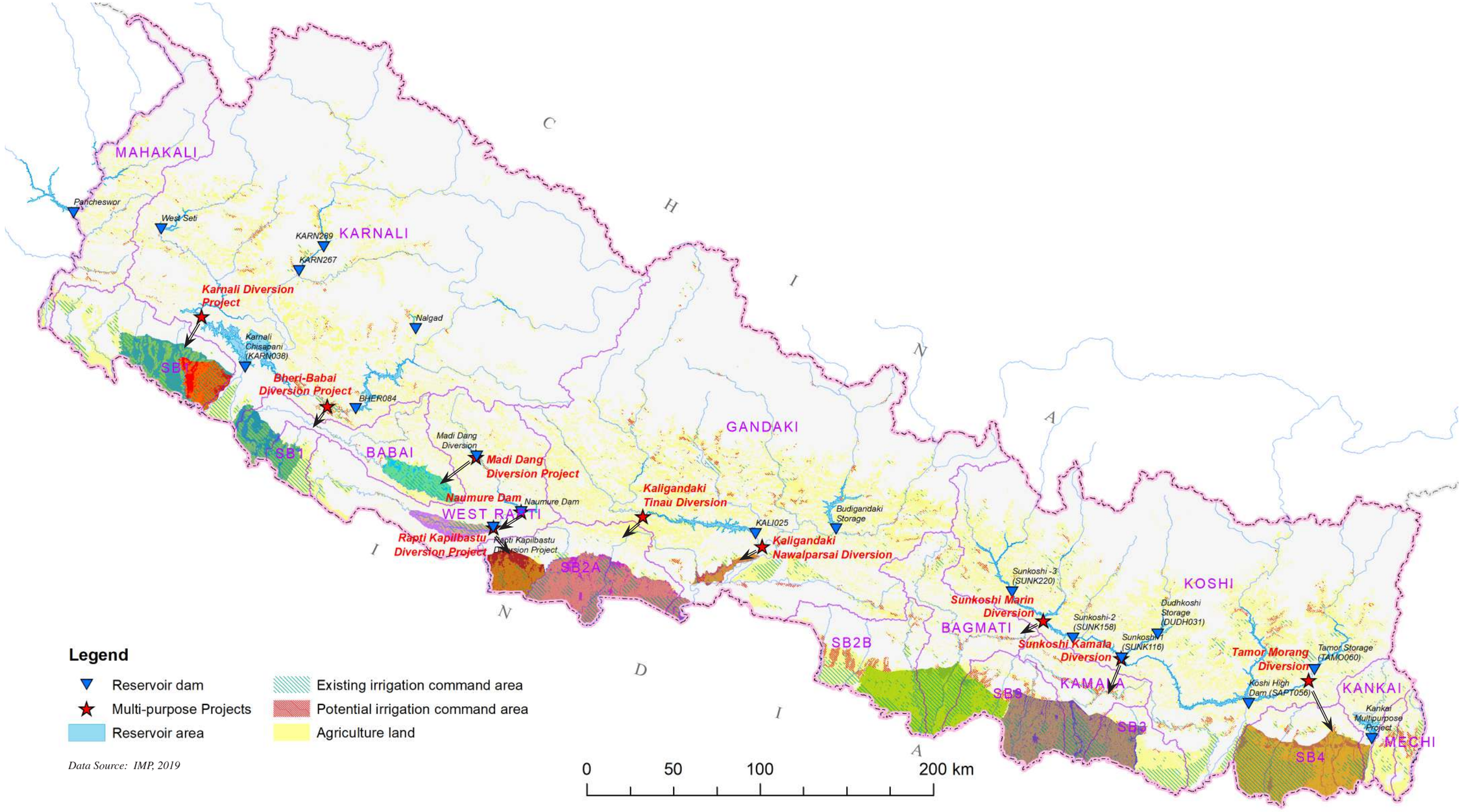
Multi Purpose Projects



Data Source: IMP, 2019

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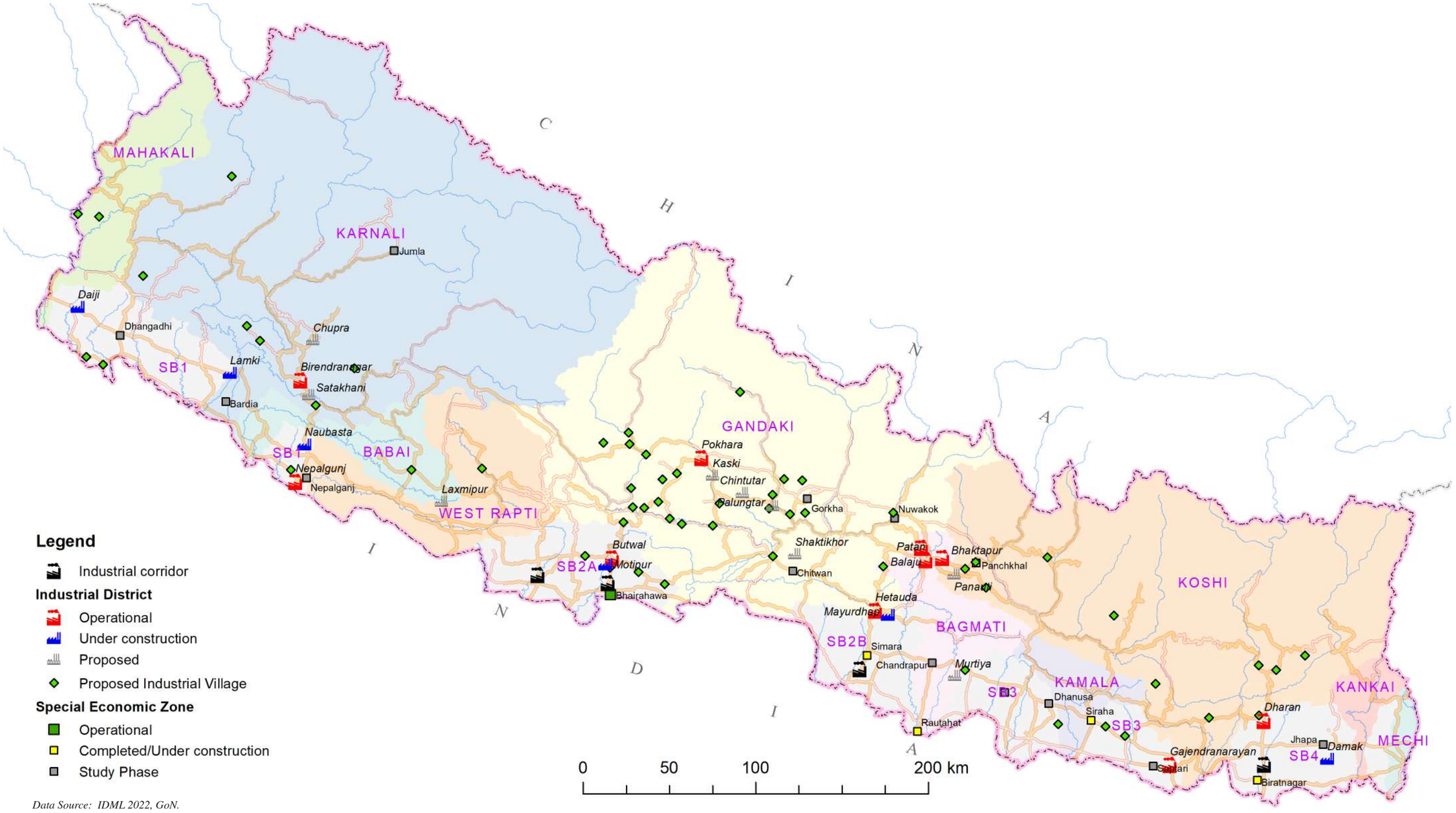
Existing and Planned Industrial Districts



Legend

- Industrial corridor

Industrial District

- Operational
- Under construction
- Proposed
- Proposed Industrial Village

Special Economic Zone

- Operational
- Completed/Under construction
- Study Phase

Data Source: IDML 2022, GoN.

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Section 2 - River Basin

1. Koshi Basin

Koshi Basin

Koshi River Basin is a transboundary river basin located in eastern Nepal. The basin, in Nepal, extends from 85° 23' 11.39" to 88° 12' 05.75" East longitudes and 26° 26' 20.40" to 28° 12' 12.23" North latitudes. The Koshi river basin covers about 18.8 percent area of the country. Most of the rivers of the basin originate from the High Himalayas and drain southwards to India. The river is also called 'Sapta-Koshi' as Koshi has seven major tributaries viz. Sun Koshi, Indrawati, Tama Koshi, Likhu, Dudh Koshi, Arun and Tamor. Some of the tributaries of the Koshi, Bhotekoshi, Tamakoshi and Arun - originate from China. The total area of the basin up to Nepal-India Border is about 56,145 km², of which 27,818 km² lies within Nepal and 28,327 km² lies in China. Basin areas within Nepal include parts of Koshi, Madhesh and Bagmati Provinces of Nepal. The basin contains the high Himalayas rising to above 8,000 m in the North, including Sagarmatha (Mt. Everest, 8848.86m), the highest mountain in the world. The southern area, called Terai in Nepal, is a part of the flat lands of the Gangetic Plains with elevation as low as 65 m.

The basin covers partial area of 22 districts with 144 local bodies with 98 Gaunpalikas, 45 Nagarapalikas, and 1 Upamahanagarpalika with the total population of 2,915,792 as per estimated from the Population census, 2021. Three inter-basin diversion projects are planned in the basin; first, the Sunkoshi Marin Diversion to divert water to Bagmati Basin; second, the Sunkoshi Kamala Diversion to divert water to Kamala Basin; and third, the Tamor Morang diversion to supply water to eastern Terai districts.

Figure 2.1: Koshi River flows down to Terai plain land

Salient Features of Koshi Basin

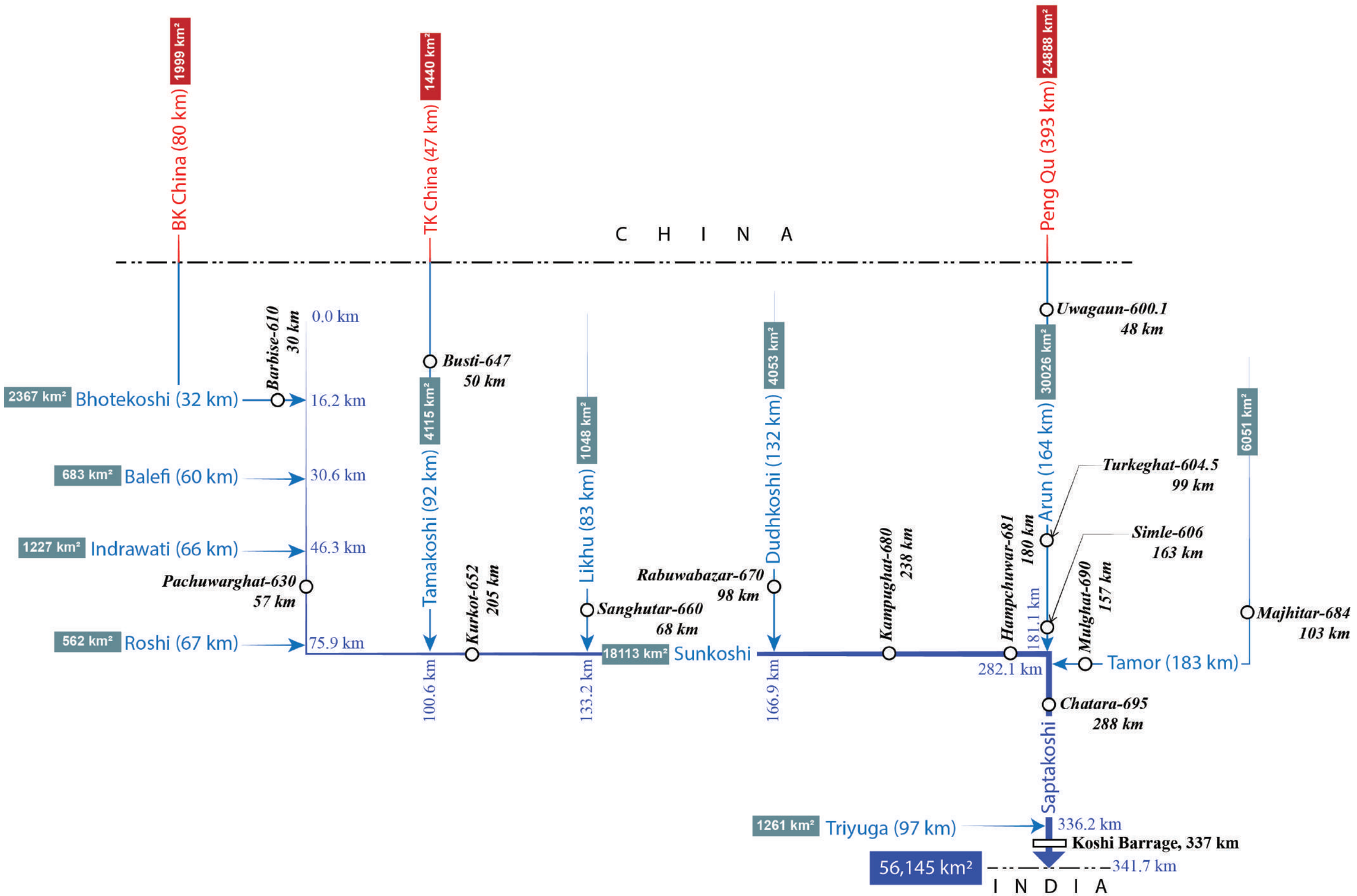
Basin location	*Latitudes: 26°26'20" to 28°12'23" N* *Longitudes: 85°23'11" to 88°12'06" E*
Catchment area	*27818 sq.km (Nepal) and 28327 sq.km (China)*
Major rivers	*Tamor (183 km), Arun (164 km), Dudhkoshi (132 km), Likhu (83 km),Tamakoshi (92 km), Sunkoshi (282 km), Indrawati (66 km)*
River length	*Sunkoshi: 453 km (China to Nepal-India border), Sunkoshi: 342 km (up to Nepal-India border), Arun: 615 km (China to Nepal-India border) and Arun: 221 km (up to Nepal-India border)*
Elevation	*Maximum - 8,848.86 m.; Minimum - 63 m.*
Hydro-meteorological stations	*59 Meteorological stations* *22 Hydrological stations*
Flood forecasting stations	*5*
Average annual rainfall	*1,667 mm*
Average river flow (Nepal - India border)	*1,826.5 cumec; 57,601 MCM (annual)*
Existing hydropower stations and Capacity (DOED, 01.04.2023)	*44; 1005 MW*
Agriculture land	*624,516 ha.*
Total irrigated area in basin (as per inventory of IMP, 2019)	*81,813 ha. (2025)* *106,399 ha. (2050)*
Total population (extimated from of Population Census, 2021)	*2,915,792*
Forest land	*1,294,200 ha.*
Total water demand (for 2025)	*Irrigation demand:1254 MCM* *Domestic demand: 175 MLD*
Administrative units	*Pradesh: Koshi, Bagmati, and Madhesh* *Districts: 21* *Local Bodies:* *(99 Gaupalika; 44Nagarpalika;* *12 Upa-mahanagarpalika)*

Administrative Division of Koshi Basin

Table 2.1 List of Local Bodies in Koshi Basin

SN	Province	District	Name of Local Body	% of Area
1	Koshi	Taplejung	Aathrai Tribeni GP	100
2			Maiwakhola GP	100
3			Meringden GP	100
4			Mikwakhola GP	100
5			Phaktanglung GP	100
6			Phungling NP	100
7			Sidingba GP	100
8			Sirijangha GP	100
9			Pathibhara Yangwarak GP	100
10		Panchthar	Falelung GP	100
11			Falgunanda GP	100
12			Hilihang GP	100
13			Kummayak GP	100
14			Miklajung GP	100
15			Phidim NP	100
16			Tumbewa GP	100
17			Yangwarak GP	100
18		Sunsari	Barah NP	68
19			Dharan UMNP	17
20			Koshi GP	98
21		Dhankuta	Chaubise GP	85
22			Chhathar Jorpati GP	100
23			Dhankuta NP	100
24			Shahidbhumi GP	100
25			Mahalaxmi NP	100
26			Pakhribas NP	100
27			Sangurigadhi GP	100
28		Terhathum	Aathrai GP	100
29			Chhathar GP	100
30			Laligurans NP	100
31			Menchayam GP	100
32			Myanglung NP	100
33			Phedap GP	100
34		Sankhu-wasabha	Bhotkhola GP	100
35			Chainpur NP	100
36			Chichila GP	100
37	Koshi	Sankhu-wasabha	Dharmadevi NP	100
38			Khandbari NP	100
39			Madi NP	100
40			Makalu GP	100
41			Panchakhapan NP	100
42			Sabhapokhari GP	100
43			Silichong GP	100
44		Bhojpur	Aamchowk GP	100
45			Arun GP	100
46			Bhojpur NP	100
47			Hatuwagadhi GP	100
48			Pauwadungma GP	100
49			Ramprasad Rai GP	100
50			Salpasilichho GP	100
51			Shadananda NP	100
52			Tyamkemaiyung GP	100
53		Solukhumbu	Thulung Dudhkoshi GP	100
54			Dudhkoshi GP	100
55			Khumbu Pasanglahmu GP	100
56			Likhupike GP	100
57			Mahakulung GP	100
58			Nechasalyan GP	100
59			Solududhakunda NP	100
60			Sotang GP	100
61		Okhaldhunga	Champadevi GP	100
62			Chisankhugadhi GP	100
63			Khijidemba GP	100
64			Likhu GP	100
65			Manebhanjyang GP	100
66			Molung GP	100
67			Siddhicharan NP	100
68			Sunkoshi GP	100
69		Khotang	Ainselukhark GP	100
70			Barahapokhari GP	100
71			Diprung GP	100
72			Halesi Tuwachung NP	100
73	Koshi	Khotang	Jantedhunga GP	100
74			Kepilasagadhi GP	100
75			Khotehang GP	100
76			Rawa Besi GP	100
77			Rupakot Majhuwagadhi NP	100
78			Sakela GP	100
79		Udayapur	Belaka NP	100
80			Chaudandigadhi NP	100
81			Katari NP	28
82			Rautamai GP	98
83			Limchunbung GP	100
84			Tapli GP	100
85			Triyuga NP	81
86			Udayapurgadhi GP	11
87	Madhesh	Saptari	Agnisair Krishna Savaran GP	75
88			Hanumannagar Kankalini NP	100
89			Kanchanrup NP	100
90			Mahadeva GP	77
91			Rajbiraj NP	2
92			Rupani GP	2
93			Saptakoshi NP	100
94			Tilathi Koiladi GP	60
95			Tirahut GP	100
96	Bagamati	Sindhuli	Golanjor GP	96
97			Kamalamai NP	2
98			Phikkal GP	100
99			Sunkoshi GP	100
100			Tinpatan GP	13
101		Ramechhap	Doramba GP	100
102			Gokulganga GP	100
103			Khadadevi GP	100
104			Likhu Tamakoshi GP	100
105			Manthali NP	100
106			Ramechhap NP	100
107			Sunapati GP	100
108			Umakunda GP	100
109	Bagamati	Dolakha	Baiteshwor GP	100
110			Bhimeshwor NP	100
111			Bigu GP	100
112			Gaurishankar GP	100
113			Jiri NP	100
114			Kalinchok GP	100
115			Melung GP	100
116			Sailung GP	100
117			Tamakoshi GP	100
118		Sindhupalchok	Balefi GP	100
119			Barhabise NP	100
120			Bhotekoshi GP	100
121			Chautara SangachokGadhi NP	100
122			Helambu GP	100
123			Indrawati GP	100
124			Jugal GP	100
125			Lisangkhu Pakhar GP	100
126			Melamchi NP	100
127			Panchpokhari Thangpal GP	100
128			Sunkoshi GP	100
129			Tripurasundari GP	100
130		Kabhrepalan-chok	Banepa NP	100
131			Bethanchowk GP	75
132			Bhumlu GP	100
133			Chaurideurali GP	100
134			Dhulikhel NP	100
135			Mandandeupur NP	100
136			Namobuddha NP	100
137			Panauti NP	100
138			Panchkhal NP	100
139			Roshi GP	97
140			Temal GP	100
141		Lalitpur	Mahalaxmi NP	17
142		Bhaktapur	Suryabinayak NP	2
143		Kathmandu	Shankharapur NP	50
144		Nuwakot	Shivapuri GP	2

River Flow Line Diagram of Koshi River



River System

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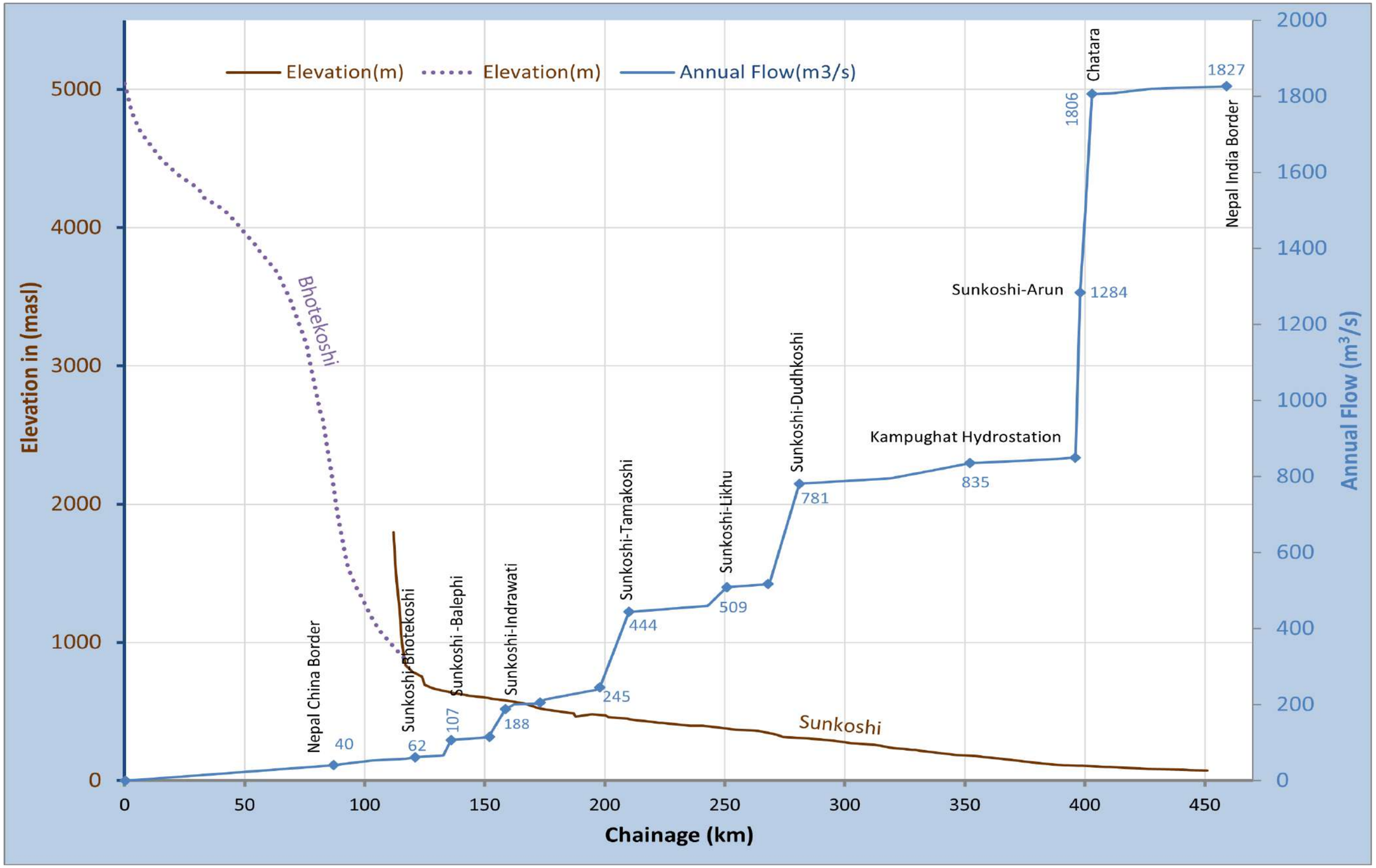
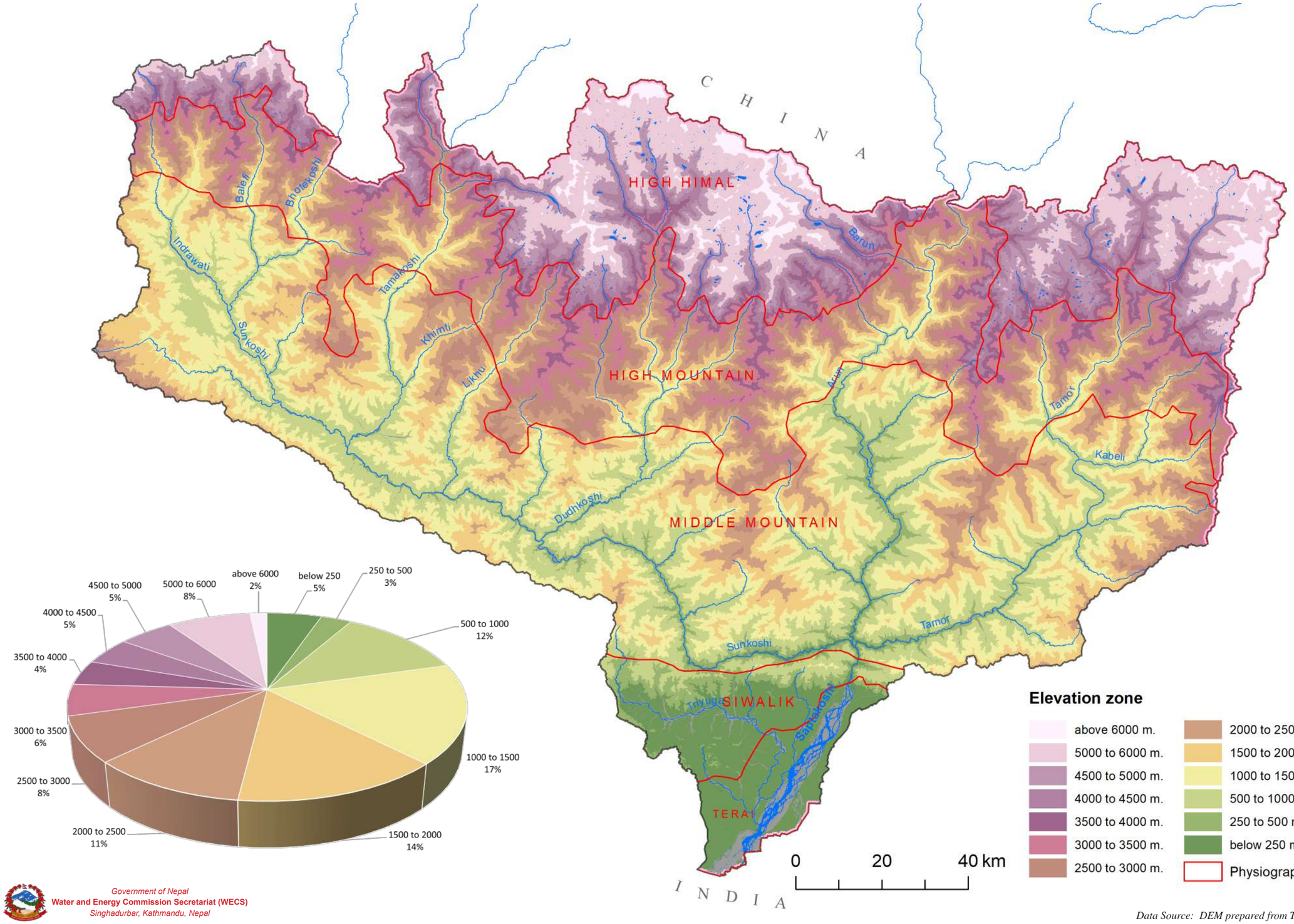
River Profile and Annual Flow



Elevation Zone



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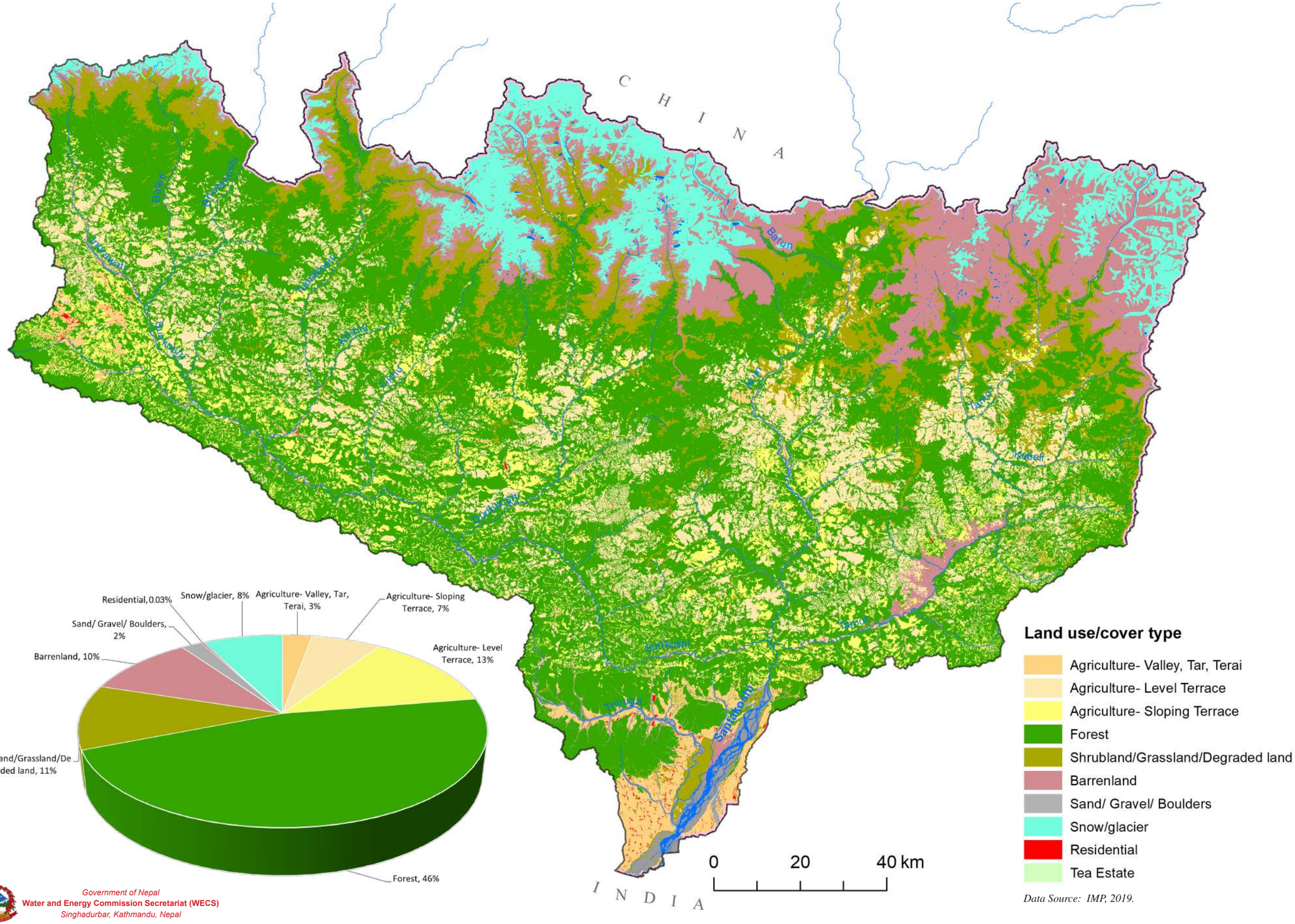
Data Source: DEM prepared from Topographic data.

Land Use/Cover



Data Source: IMP, 2019.

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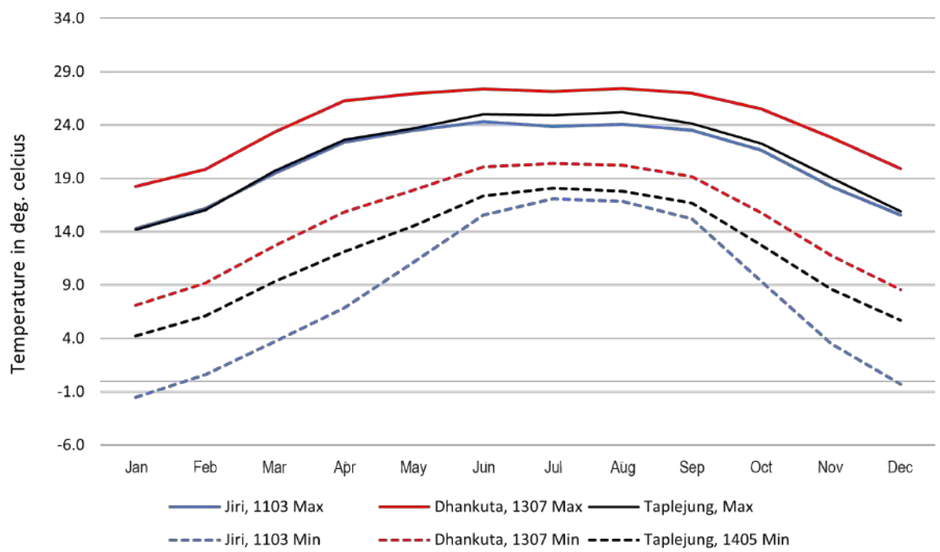
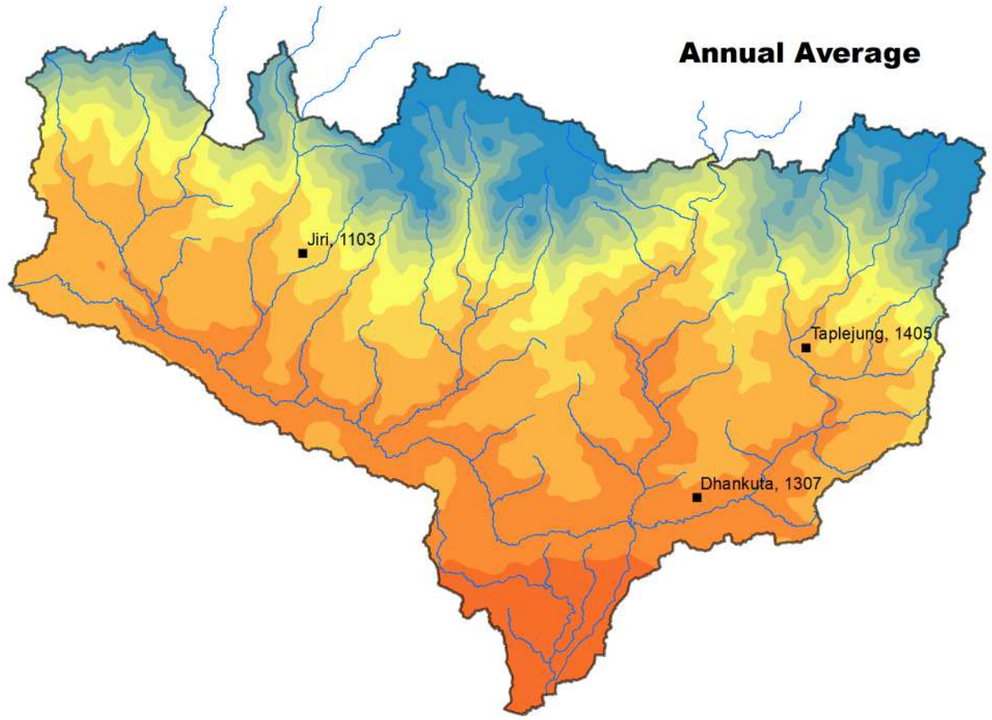
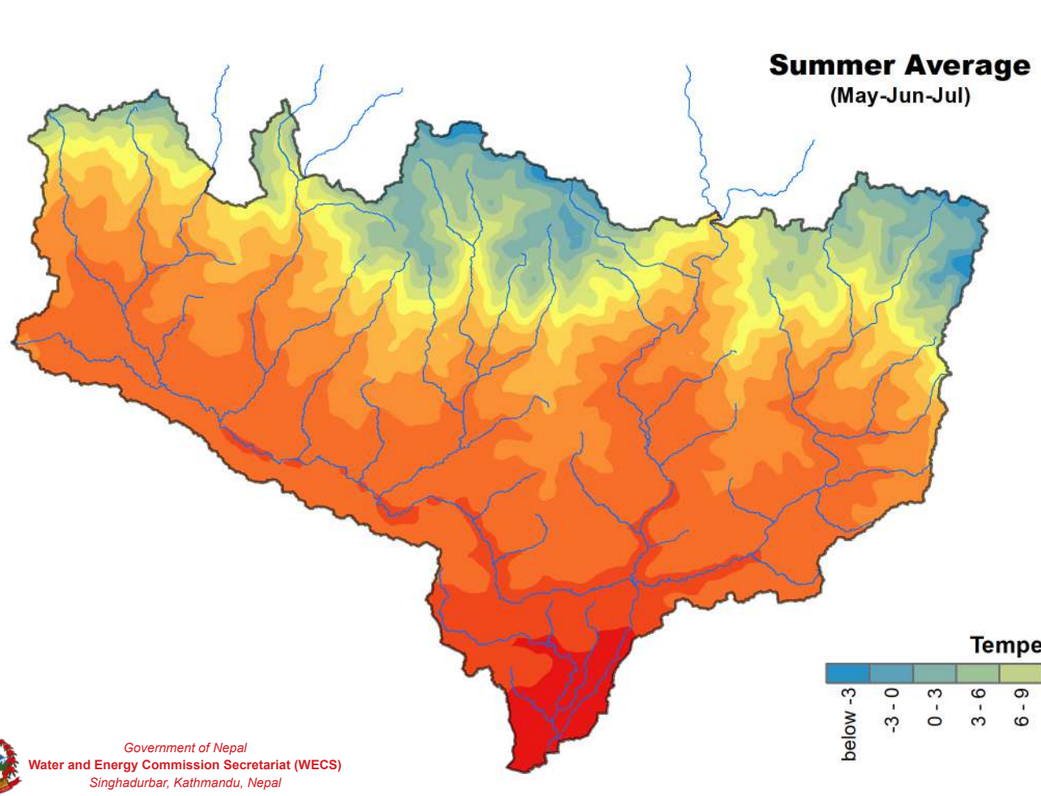
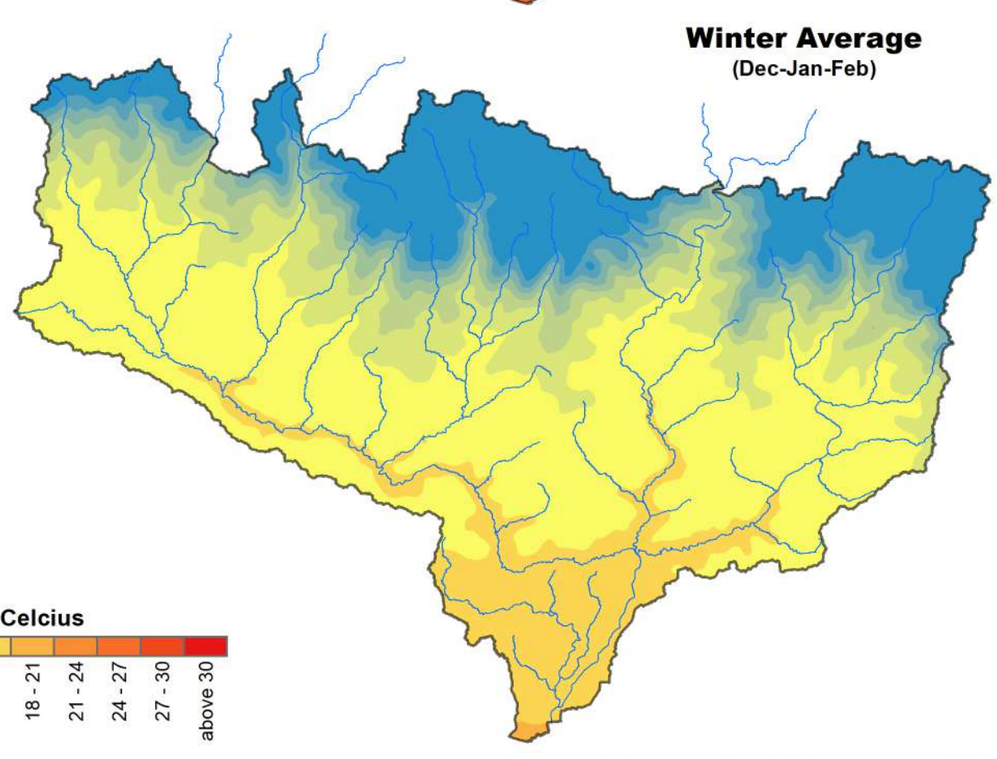
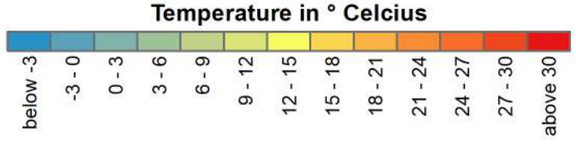
Average Temperature Distribution











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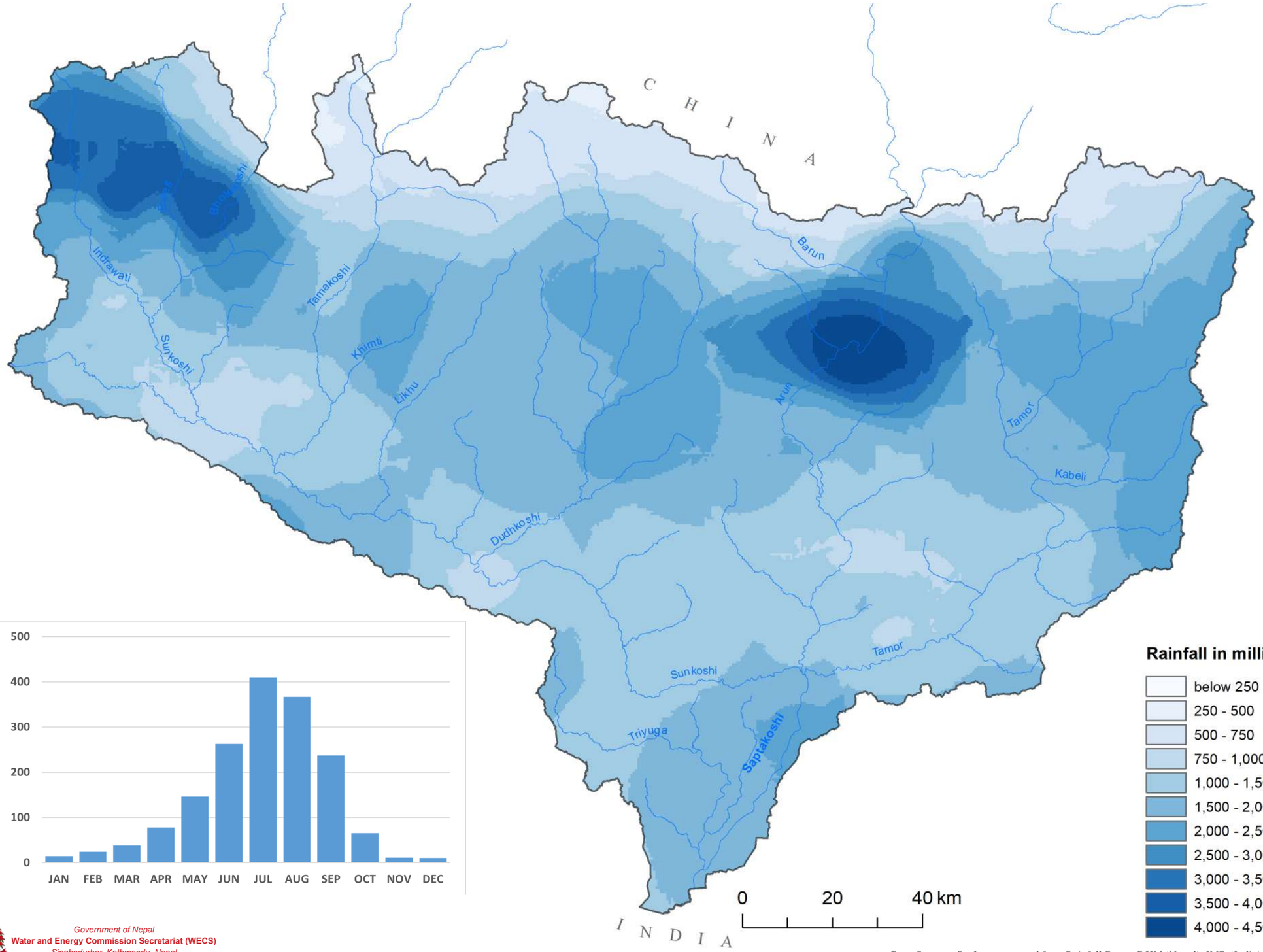
Data Source: Surface generated from DHM Temperature Data - 1985-2015.

Annual Average Rainfall Distribution



Rainfall in millimeter

- below 250
- 250 - 500
- 500 - 750
- 750 - 1,000
- 1,000 - 1,500
- 1,500 - 2,000
- 2,000 - 2,500
- 2,500 - 3,000
- 3,000 - 3,500
- 3,500 - 4,000
- 4,000 - 4,500

Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

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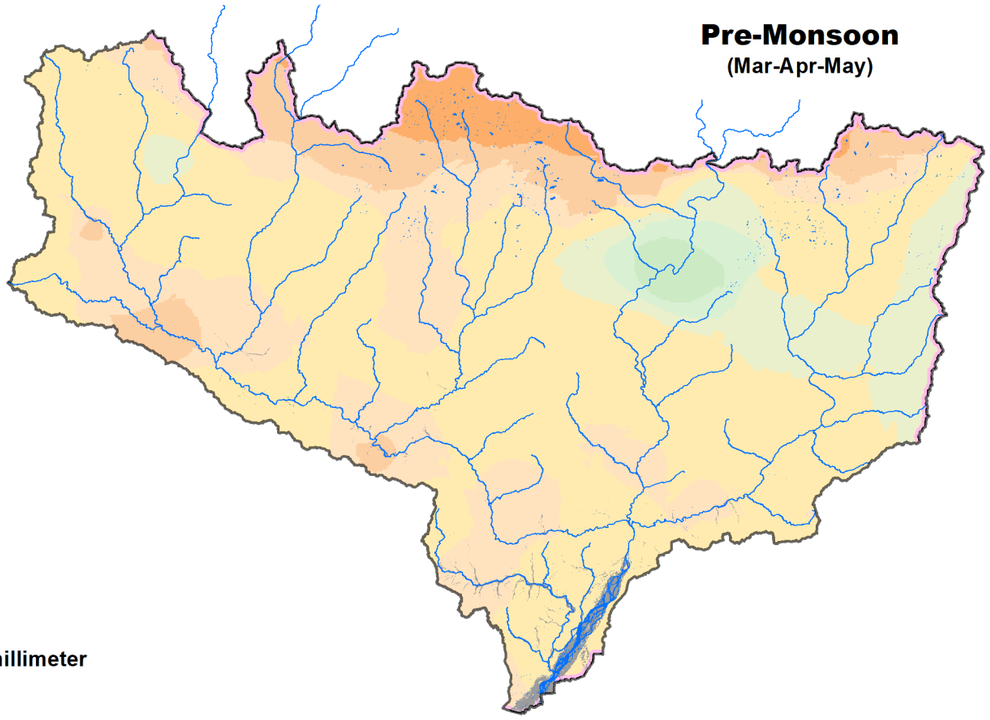
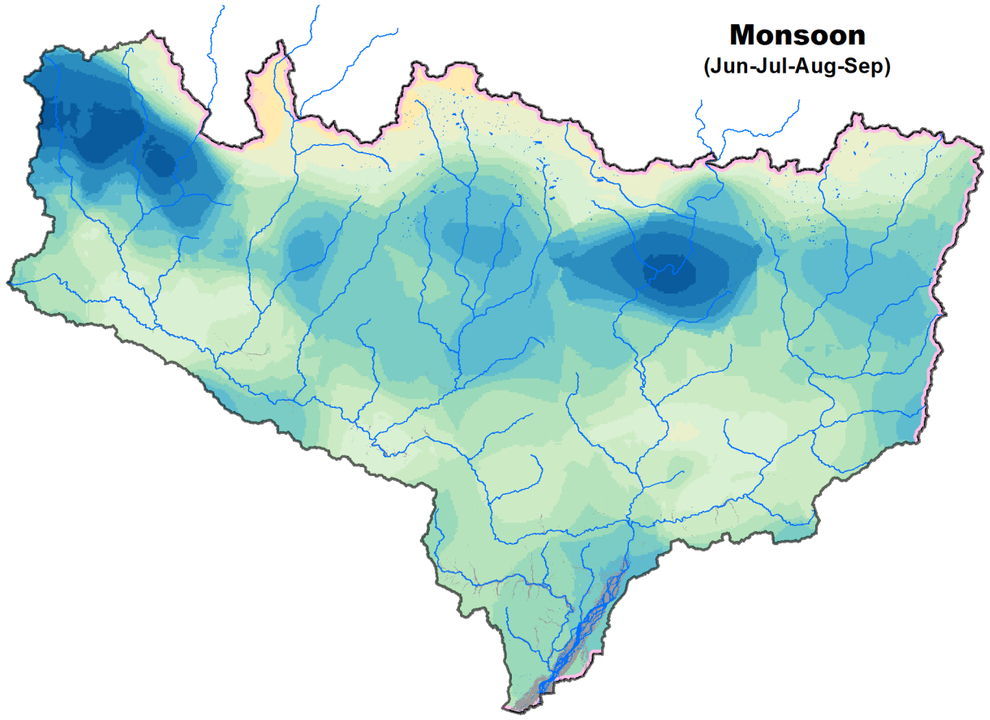
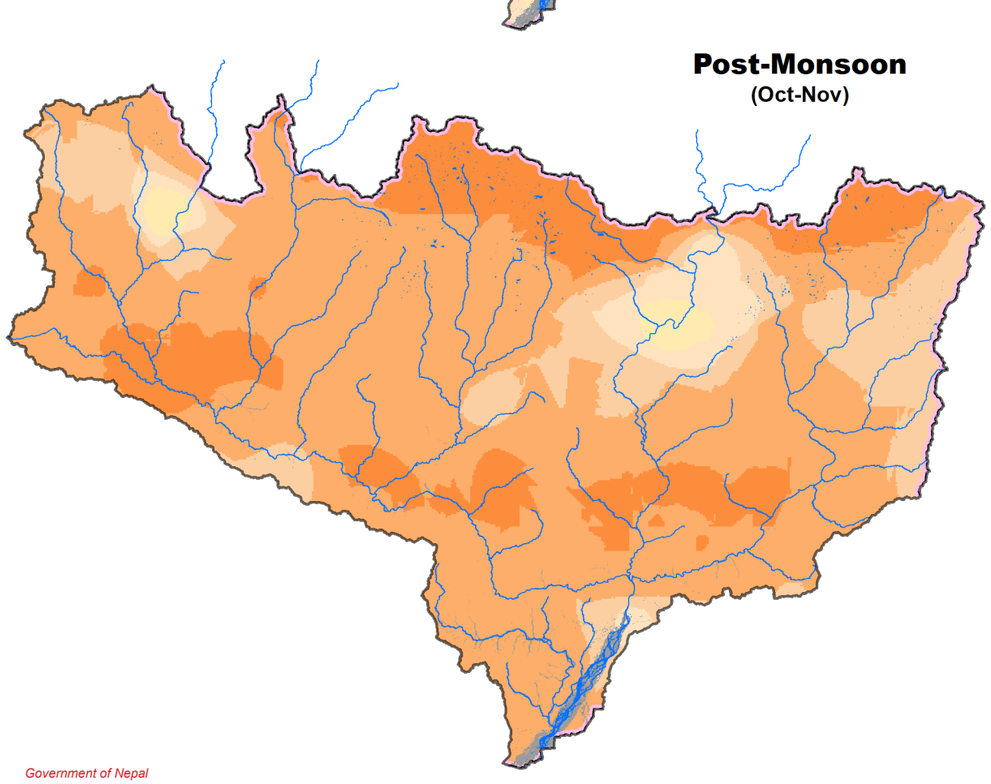
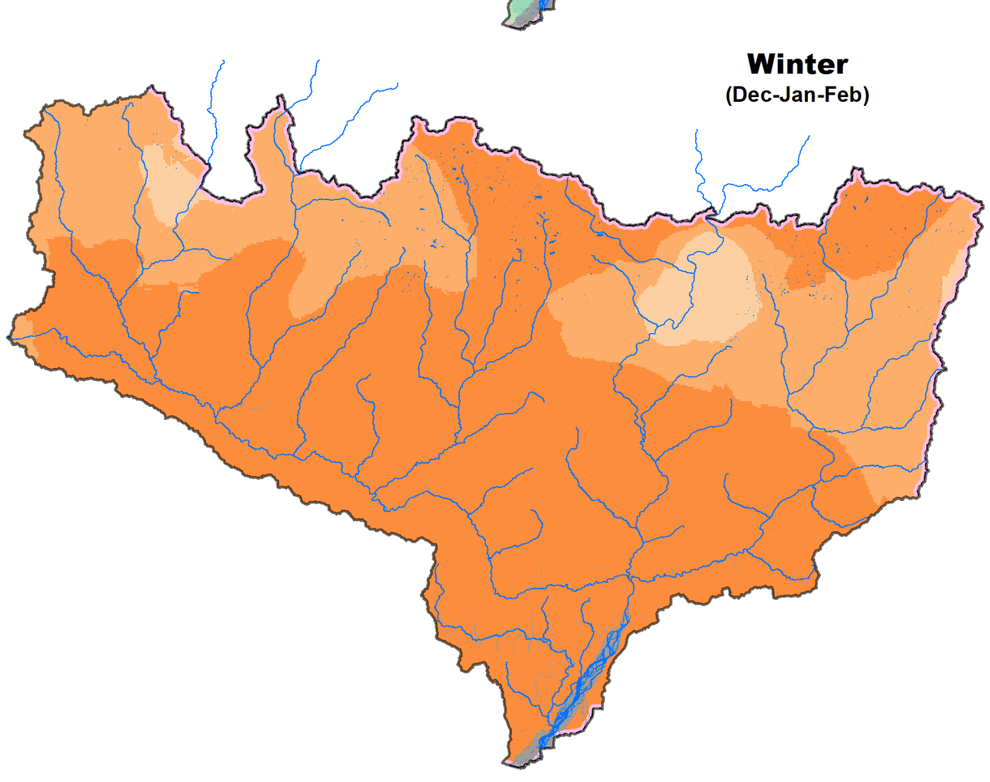
Seasonal Average Rainfall Distribution









Rainfall in millimeter

0
50
100
150
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000
2,500
3,000
3,500
4,000

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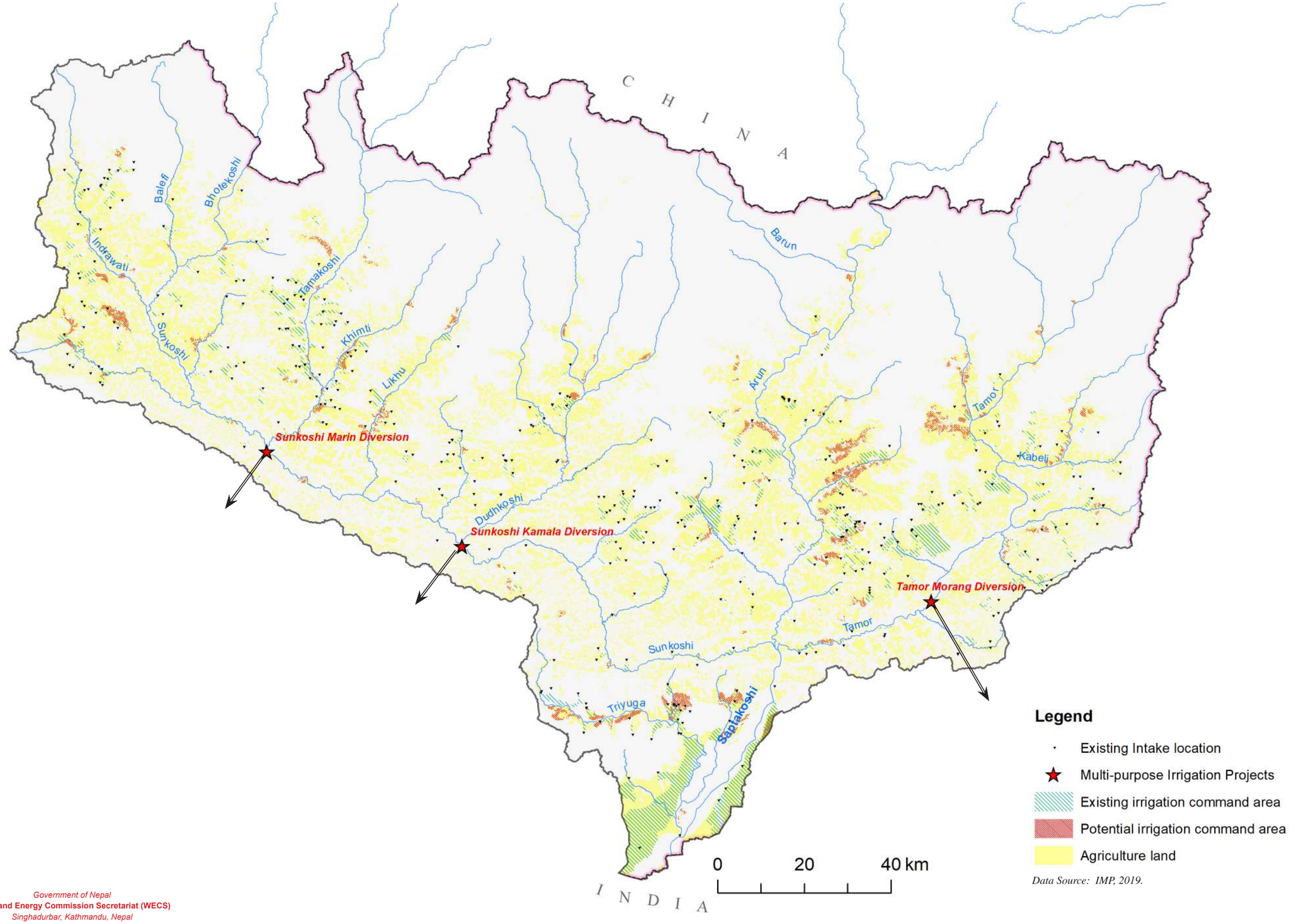
Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

Irrigation Projects



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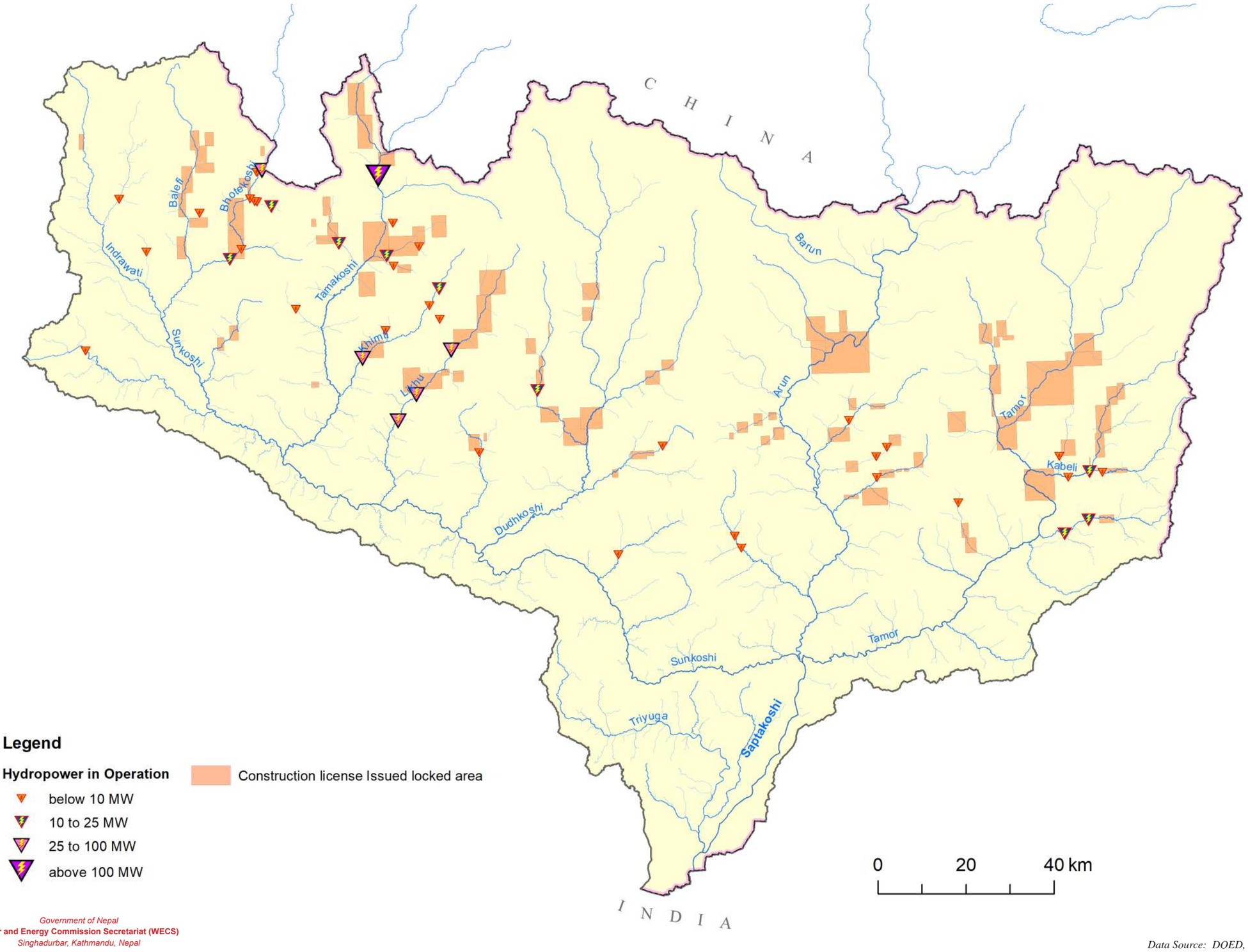
Hydropower Projects



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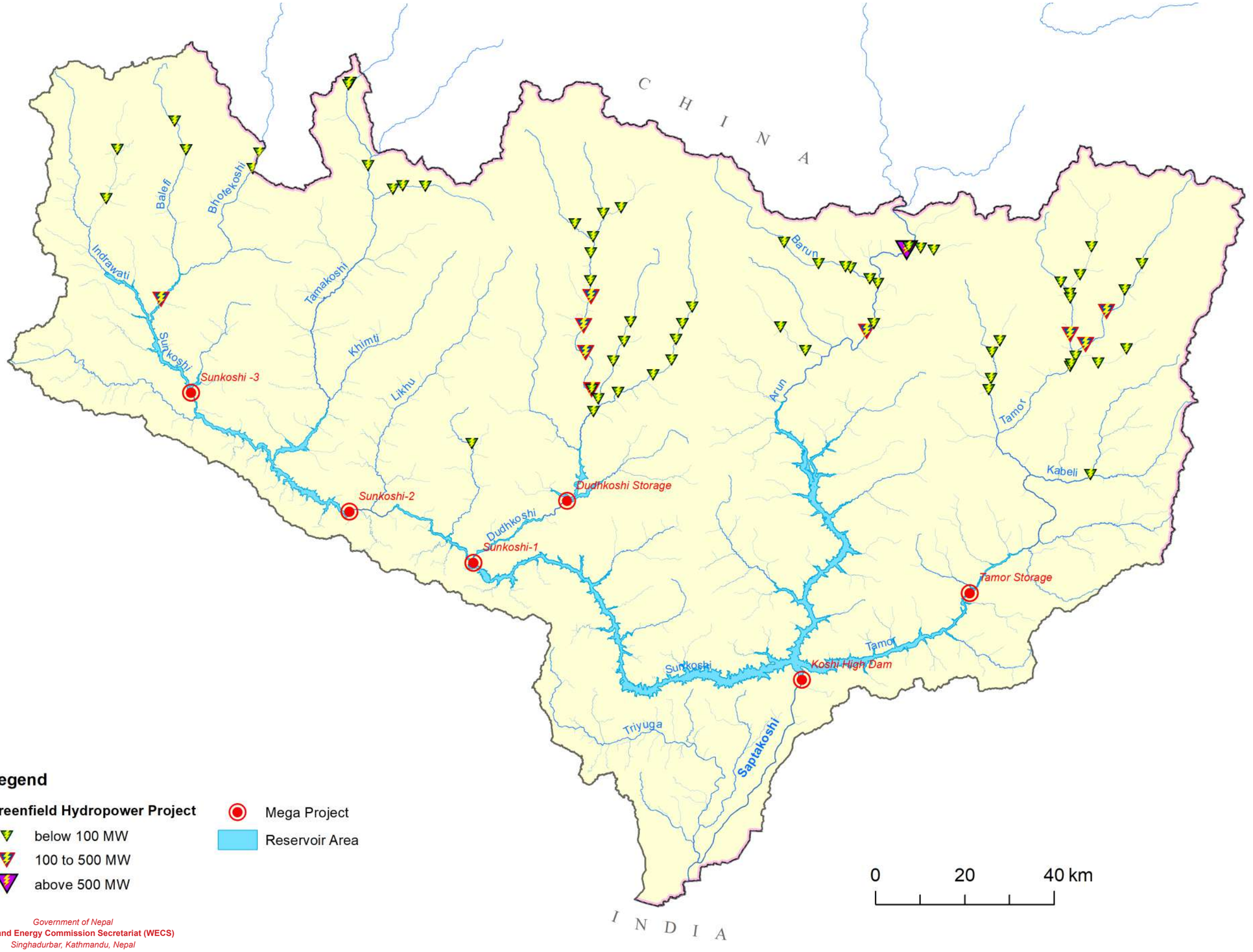
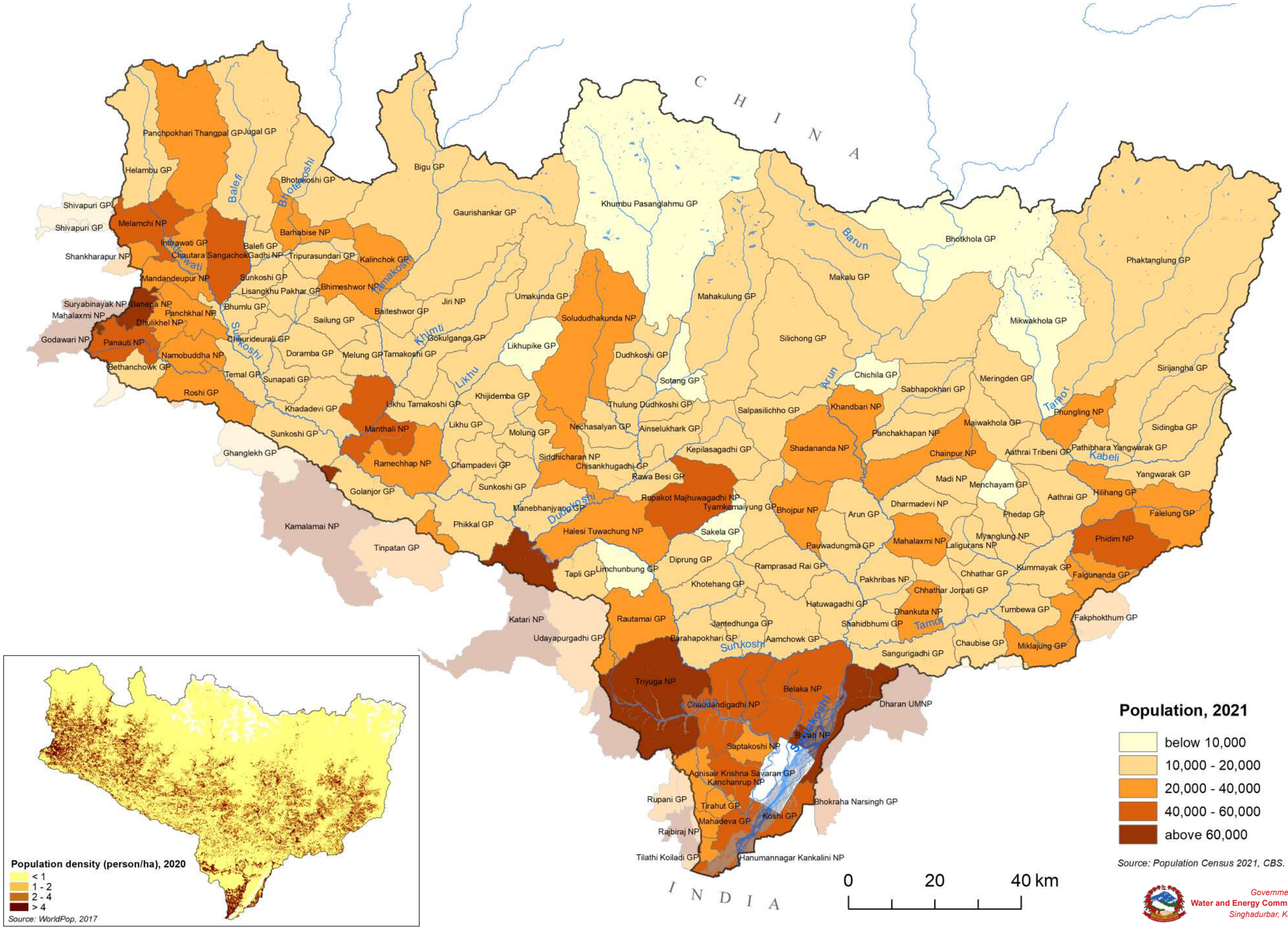
Data Source: DOED, GoN (as of March 2023).

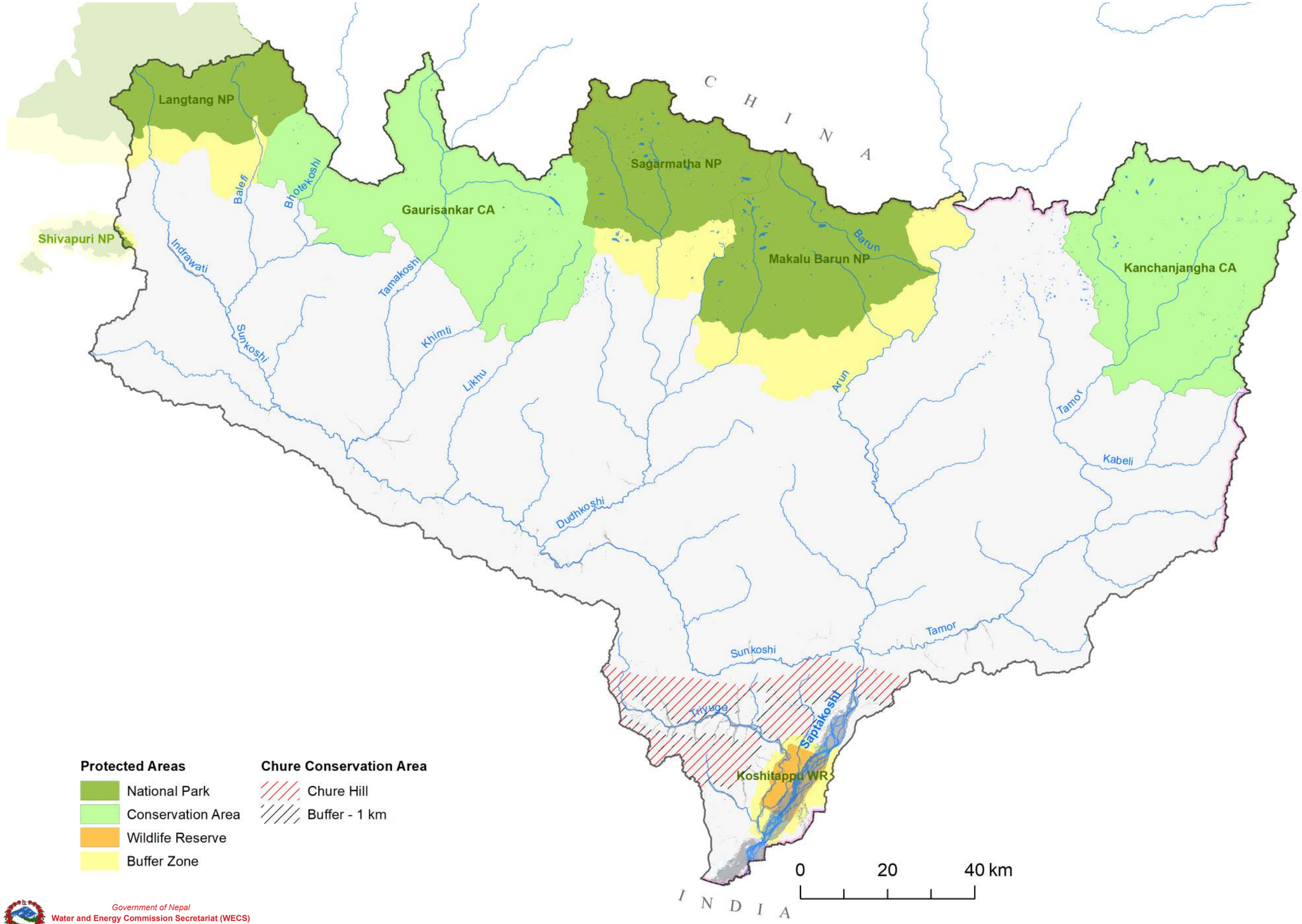
Greenfield Hydropower Projects



Population Distribution and Density



Protected Areas



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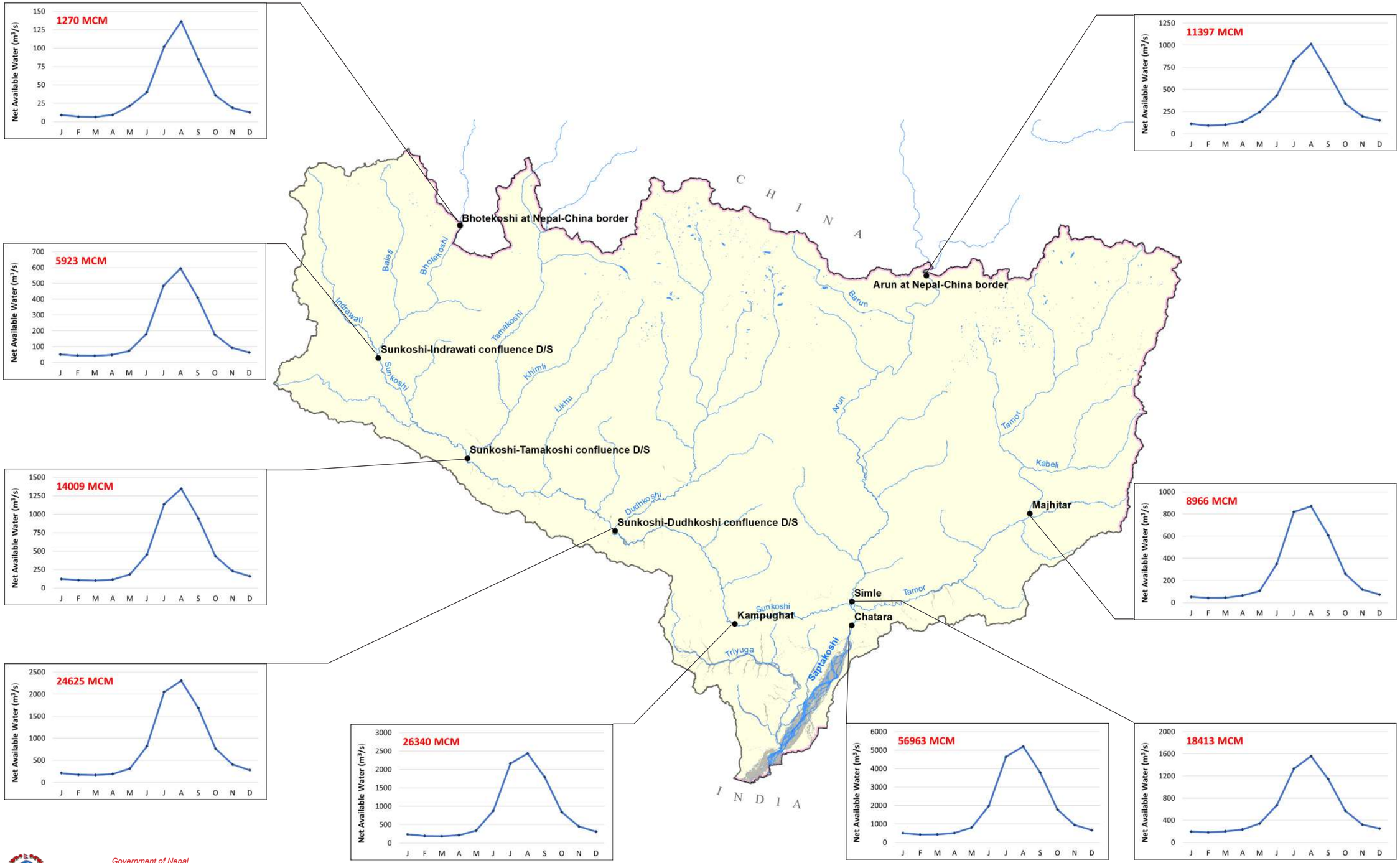
Data Source: DNPWC & PCTMCDB , GoN, 2022

Hydrographs at Major River Nodes



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2. Gandaki Basin

Gandaki Basin

The Gandaki River Basin is one of the major river basins in Nepal. The basin lies in the central part of Nepal, with Koshi River Basin in the east and Karnali River Basin in the west. The river is also called 'Sapta Gandaki (Seven Gandakis)' or Narayani, south of Devghat where Kali Gandaki and Trishuli Ganga meet. The river is called Gandak as it enters India.

The Gandaki River is a trans-boundry river basin and it passes through China, Nepal and India. The main course of the river (Kaligandaki) originates from Nhubine Himal Glacier in Mustang District. The total area of the basin up to Nepal-India Border is about 36,497 km², of which 32,148 km² lies within Nepal and 4,349 km² lies in China. The basin consists of many Himalayan peaks, of which three are more than 8,000m high. Dhawalagiri (8167 m) which is the seventh highest peak in the world lies in the western part of the basin. Manaslu (8163 m). the eighth highest peak. and Annapurna-1 (8091 m), the tenth highest peak, lie in central part of the basin.

The Gandaki River Basin covers areas of three provinces: Gandaki, Bagmati and Lumbini. The basin covers partial area of 21 districts with 161 local bodies with 112 Gaunpalikas, 46 Nagarapalikas, 1 Upamahanagarpalika, and 2 Mahanagarpalika with the total population of population of 4,848,295 as per estimated from the Population census, 2021.

The Gandaki Basin has a long-term mean annual flow of 1,952.3 m³/s at Nepal - India border. The major tributaries of the system are Trishuli, Budhi Gandaki, Daurandi, Marsyangdi, Seti, and Kali Gandaki. Other tributaries are Madi, Modi and Rapti (East). The Gandak Barrage is a major structure in the Gandaki River, from which irrigation canals are taken to India and Nepal. There are many irrigation schemes in the mountain, hills and Terai areas of this basin.

Figure 2.2: Narayani River flows down to Chitwan valley

Salient Features of Gandaki Basin

Basin location	*Latitudes: 27°20'47" to 29°19'53" N* *Longitudes: 81°13'57" to 82°36'08" E*
Catchment area	*32,148 sq.km. (Nepal)* *4,349 sq.km. (China)*
Major rivers	*Kerun Khola (China -119 km), Trishuli (183 km), Budhigandaki (146 km), Marsyangdi (176 km), Daraudi (70 km), Madi (77 km), Seti (148 km), Kaligandaki (403 km), East Rapti (142 km) and Narayani River (109 km)*
River length	*411 km (up to Nepal-India border)*
Elevation	*Maximum - 8,167 m.; Minimum - 79 m.*
Hydro-meteorological stations	*79 Meteorological stations* *27 Hydrological stations*
Flood forecasting stations	*5*
Average annual rainfall	*1,823 mm*
Average river flow (Nepal - India border)	*1,952.3 cumec; 61,568 MCM (annual)*
Existing hydropower stations and Capacity (DOED, March2023)	*49; 808.7 MW*
Agriculture land	*668,857 ha.*
Existing big irrigation systems	*2*
Total irrigated area in basin (as per inventory of IMP, 2019)	*64,838 ha.(2025)* *96,933 ha. (2050)*
Total population (extimated from Population Census, 2021)	*4,848,295*
Forest land	*1,326,400 ha.*
Total water demand (2025)	*Irrigation demand:1155 MCM* *Domestic demand: 312 MLD*
Administrative units	*Pradesh: Bagmati, Gandaki, and Lumbini* *Districts: 21* *Local Bodies:* *(112 Gaupalika; 46 Nagarpalika; 1 Upa-mahanagarpalika; 2 Mahanagarpalika)*

Administrative Division of Gandaki Basin

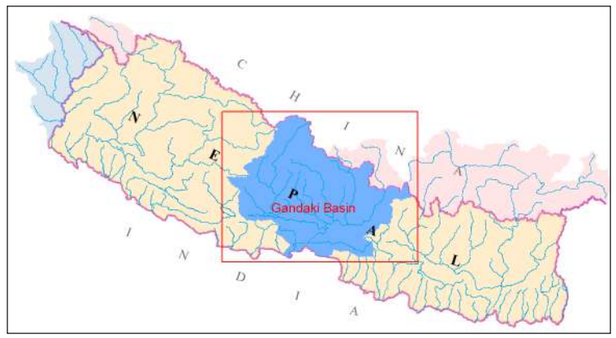
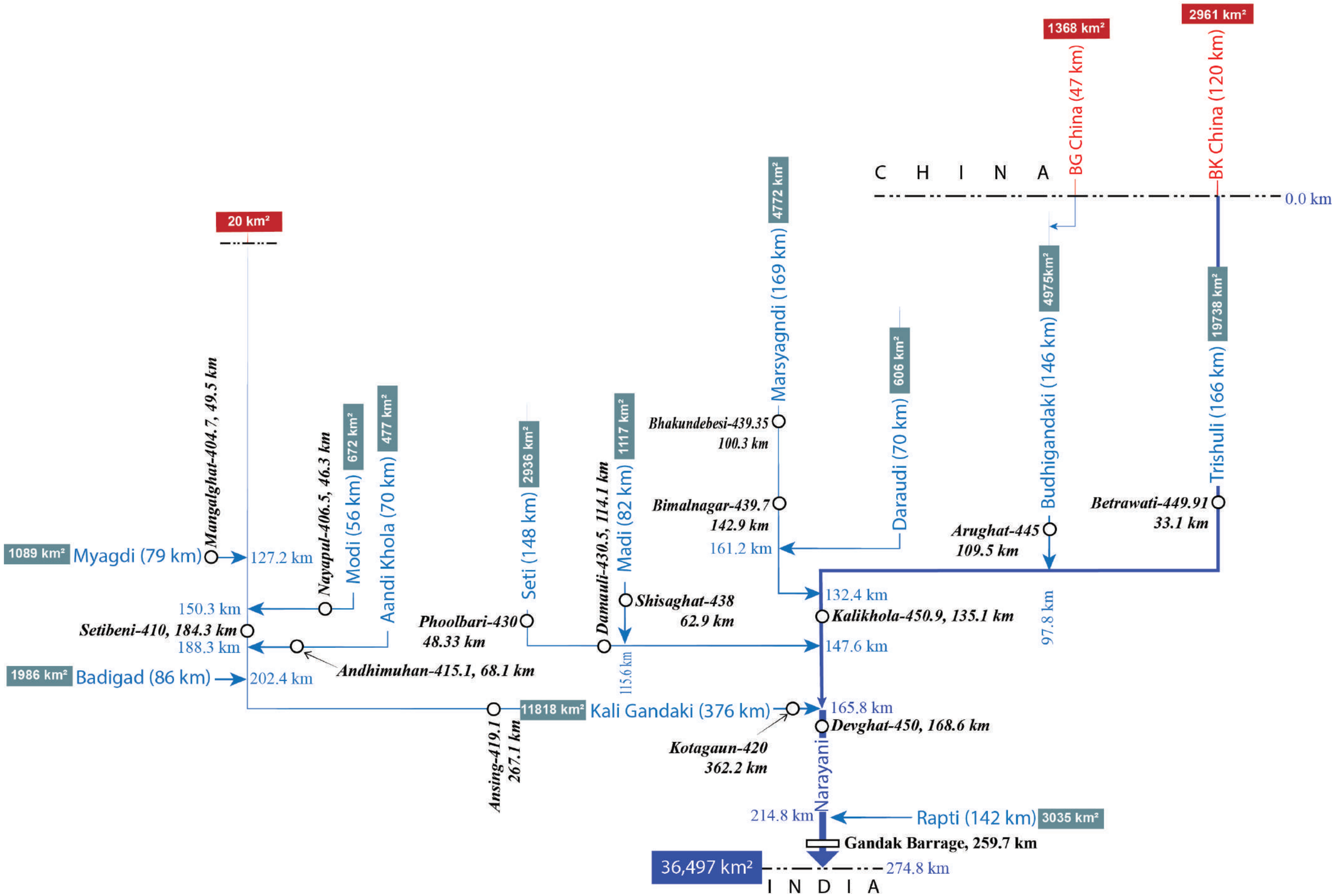


Table 2.2 List of Local Bodies in Gandaki Basin

SN	Province	District	Name of Local Body	% of Area
1	Bagamati	Chitawan	Bharatpur MNP	100
2			Ichchhyakamana GP	100
3			Kalika NP	100
4			Khairahani NP	100
5			Madi NP	100
6			Rapti NP	100
7			Ratnanagar NP	100
8		Dhading	Benighat Rorang GP	100
9			Dhunibesi NP	100
10			Gajuri GP	100
11			Galchi GP	100
12			Gangajamuna GP	100
13			Jwalamukhi GP	100
14			Khaniyabash GP	100
15			Netrawati Dabjong GP	100
16			Nilakantha NP	100
17			Rubi Valley GP	100
18			Siddhalek GP	100
19			Thakre GP	100
20			Tripura Sundari GP	100
21		Kathmandu	Chandragiri NP	8
22			Nagarjun NP	8
23			Tarakeshwor NP	14
24		Makawanpur	Bhimphedi GP	76
25			Hetauda UMNP	93
26			Kailash GP	100
27			Makawanpurgadhi GP	85
28			Manahari GP	100
29			Raksirang GP	100
30			Thaha NP	40
31		Nuwakot	Belkotgadhi NP	100
32			Bidur NP	100
33			Dupcheshwar GP	100
34			Kakani GP	100
35			Kispang GP	100
36			Likhu GP	100
37			Myagang GP	100
38			Panchakanya GP	100
39			Shivapuri GP	98
40			Suryagadhi GP	100
41			Tadi GP	100
42	Bagamati	Nuwakot	Tarkeshwar GP	100
43		Rasuwa	Aamachhodingbo GP	100
44			Gosaikunda GP	100
45			Kalika GP	100
46			Naukunda GP	100
47			Uttargaya GP	100
48		Sindhupalchok	Melamchi NP	1
49	Gandaki	Baglung	Badigad GP	100
50			Baglung NP	100
51			Bareng GP	100
52			Dhorpatan NP	100
53			Galkot NP	100
54			Jaimuni NP	100
55			Kanthekhola GP	100
56			Nisikhola GP	100
57			Tamankhola GP	92
58			Tarakhola GP	100
59		Gorkha	Aarughat GP	100
60			Ajirkot GP	100
61			Barpak Sulikot GP	100
62			Bhimsentapa GP	100
63			Chum Nubri GP	100
64			Dharche GP	100
65			Gandaki GP	100
66			Gorkha NP	100
67			Palungtar NP	100
68			Sahid Lakhan GP	100
69			Siranchok GP	100
70		Kaski	Annapurna GP	100
71			Machhapuchchhre GP	100
72			Madi GP	100
73			Pokhara MNP	100
74			Rupa GP	100
75		Lamjung	Besishahar NP	100
76			Dordi GP	100
77			Dudhpokhari GP	100
78			Kwholasothar GP	100
79			Madhyanepal NP	100
80			Marsyangdi GP	100
81			Rainas NP	100
82			Sundarbazar NP	100
83	Gandaki	Manang	Chame GP	100
84			Manang Nishyang GP	100
85			Narpa Bhumi GP	100
86			Nashon GP	100
87		Mustang	Baragung Muktikhsetra GP	100
88			Gharapjhong GP	100
89			Lo-ghekar Damodarkund GP	100
90			Lomanthang GP	100
91			Thasang GP	100
92		Myagdi	Annapurna GP	100
93			Beni NP	100
94			Dhaulagiri GP	94
95			Malika GP	100
96			Mangala GP	100
97			Raghuganga GP	100
98		Nawalparasi East	Binayee Tribeni GP	100
99			Bulingtar GP	100
100			Bungdikali GP	100
101			Devchuli NP	100
102			Gaidakot NP	100
103			Hupsekot GP	100
104			Kawasoti NP	100
105			Madhyabindu NP	100
106		Parbat	Bihadi GP	100
107			Jaljala GP	100
108			Kushma NP	100
109			Mahashila GP	100
110			Modi GP	100
111			Painyu GP	100
112			Phalebas NP	100
113		Syangja	Aandhikhola GP	100
114			Arjunchaupari GP	100
115			Bhirkot NP	100
116			Biruwa GP	100
117			Chapakot NP	100
118			Galyang NP	100
119			Harinas GP	100
120			Kaligandagi GP	100
121			Phedikhola GP	100
122			Putalibazar NP	100
123			Waling NP	100
124	Gandaki	Tanahu	Anbukhaireni GP	100
125			Bandipur GP	100
126			Bhanu NP	100
127			Bhimad NP	100
128			Byas NP	100
129			Devghat GP	100
130			Ghiring GP	100
131			Myagde GP	100
132			Rhishing GP	100
133			Shuklagandaki NP	100
134	Lumbini	Arghakhanchi	Bhumekasthan NP	4
135			Chhatradev GP	100
136			Malarani GP	60
137			Panini GP	72
138			Sandhikharka NP	91
139		Gulmi	Chandrakot GP	100
140			Chatrakot GP	100
141			Dhurkot GP	100
142			Gulmidarbar GP	100
143			Isma GP	100
144			Kaligandaki GP	100
145			Madane GP	59
146			Malika GP	100
147			Musikot NP	100
148			Resunga NP	100
149			Rurukshetra GP	100
150			Satyawati GP	100
151		Nawalparasi West	Bardaghat NP	20
152			Pratappur GP	42
153			Sunwal NP	5
154			Susta GP	96
155		Palpa	Bagnaskali GP	74
156			Mathagadhi GP	36
157			Nisdi GP	100
158			Purbakhola GP	97
159			Rainadevi Chhahara GP	45
160			Rambha GP	94
161			Rampur NP	100
162			Ribdikot GP	38
163			Tansen NP	45

River Flow Line Diagram of Gandaki River



River System

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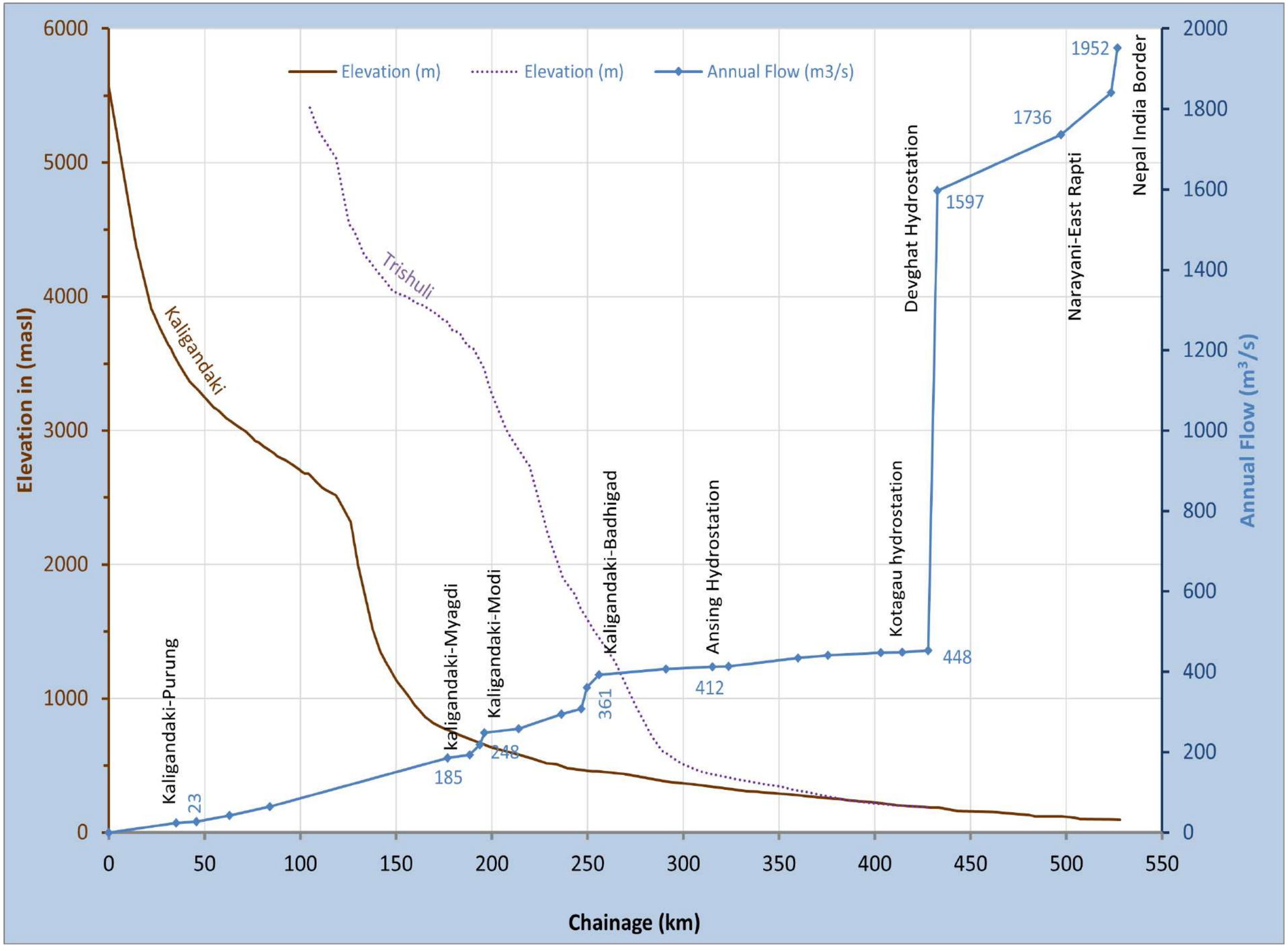
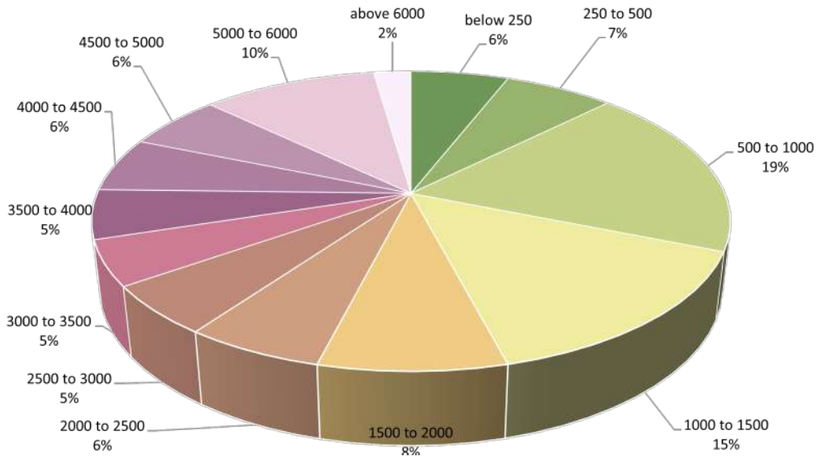
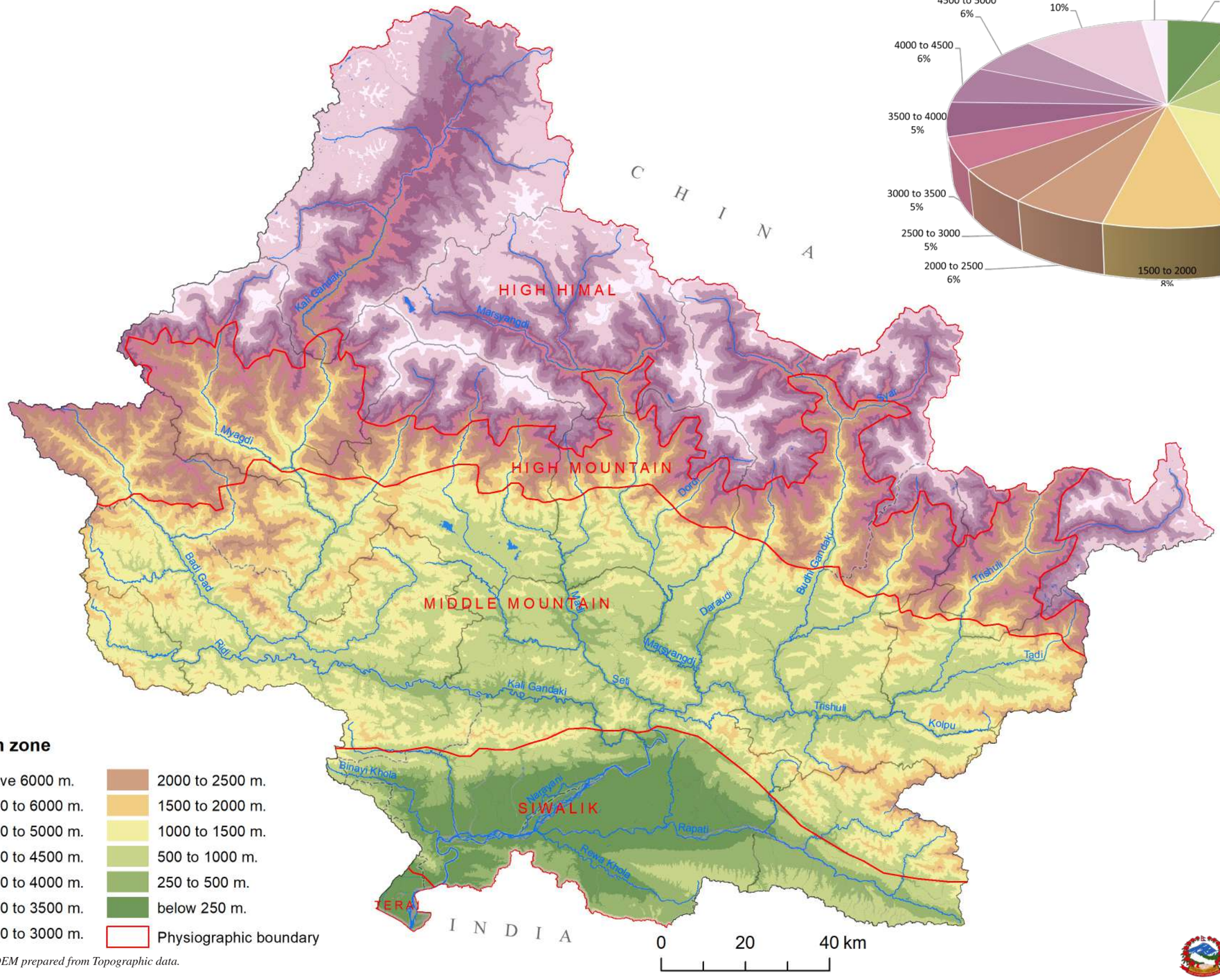
River Profile and Annual Flow



Elevation Zone





Elevation zone

- above 6000 m.
- 5000 to 6000 m.
- 4500 to 5000 m.
- 4000 to 4500 m.
- 3500 to 4000 m.
- 3000 to 3500 m.
- 2500 to 3000 m.
- 2000 to 2500 m.
- 1500 to 2000 m.
- 1000 to 1500 m.
- 500 to 1000 m.
- 250 to 500 m.
- below 250 m.
- Physiographic boundary

Data Source: DEM prepared from Topographic data.

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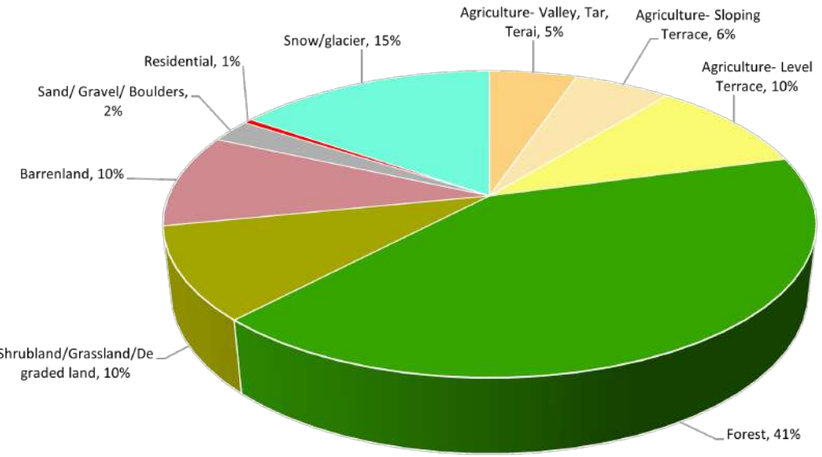
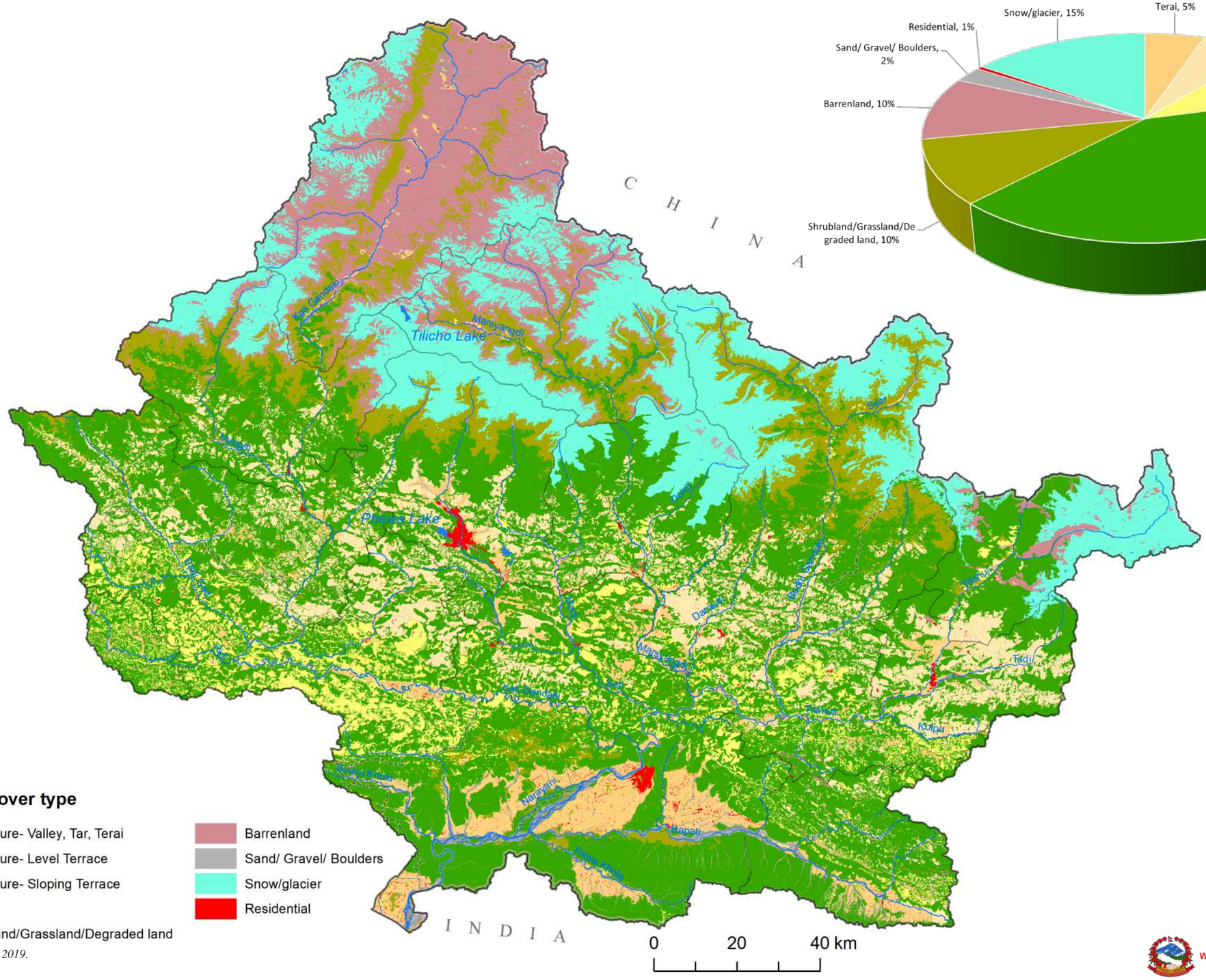
Land Use/Cover





Land use/cover type

- Agriculture- Valley, Tar, Terai
- Agriculture- Level Terrace
- Agriculture- Sloping Terrace
- Forest
- Shrubland/Grassland/Degraded land
- Barrenland
- Sand/ Gravel/ Boulders
- Snow/glacier
- Residential

Data Source: IMP, 2019.

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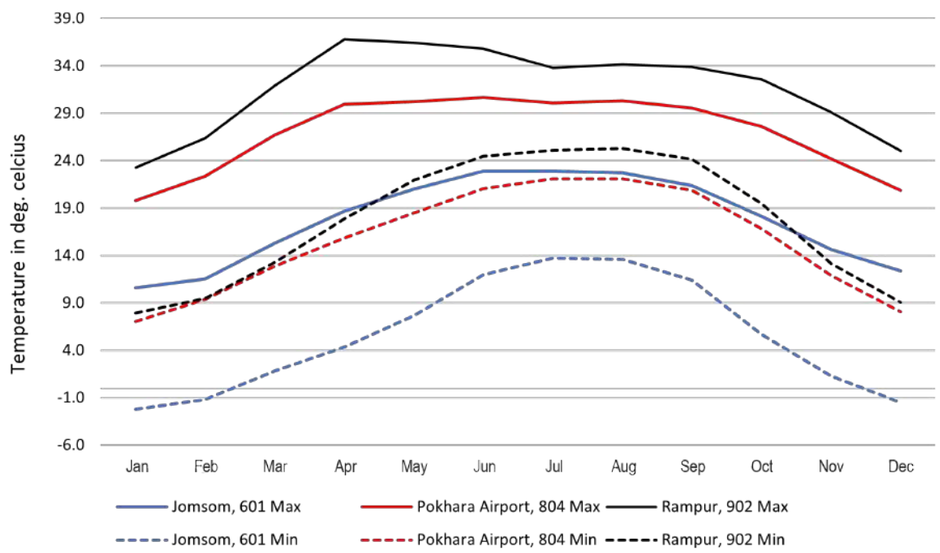
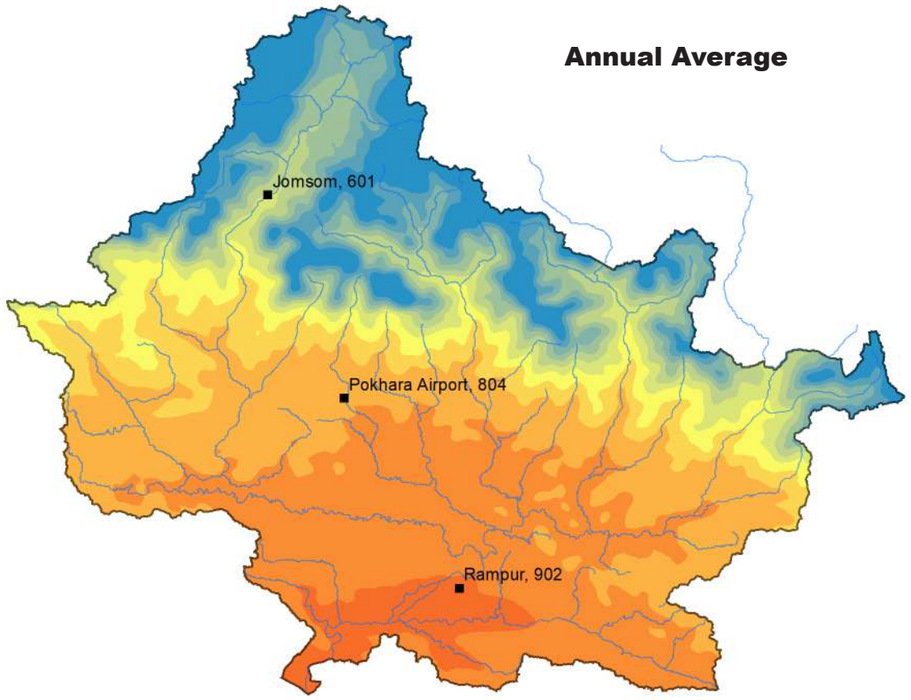
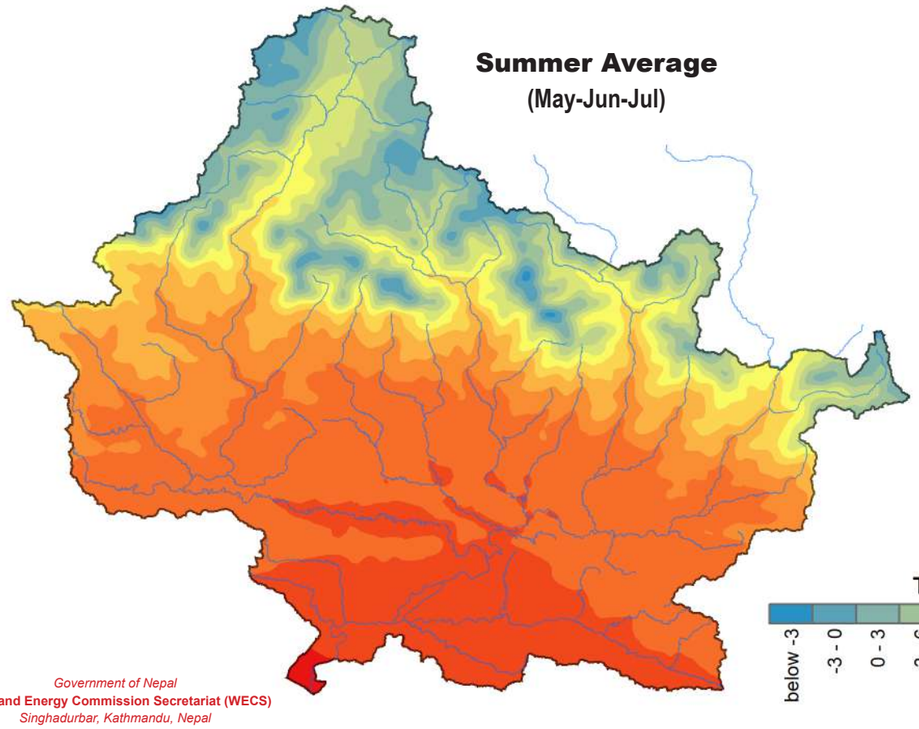
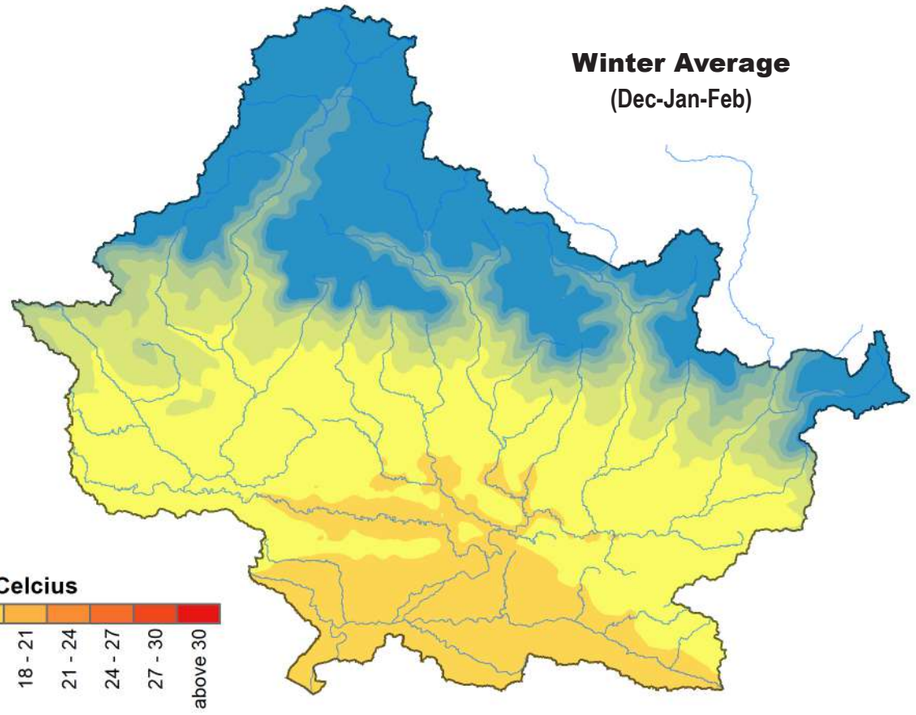
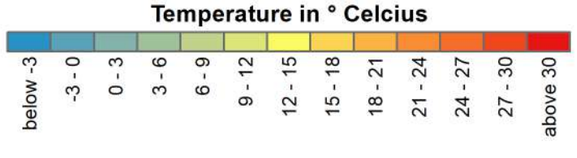
Average Temperature Distribution











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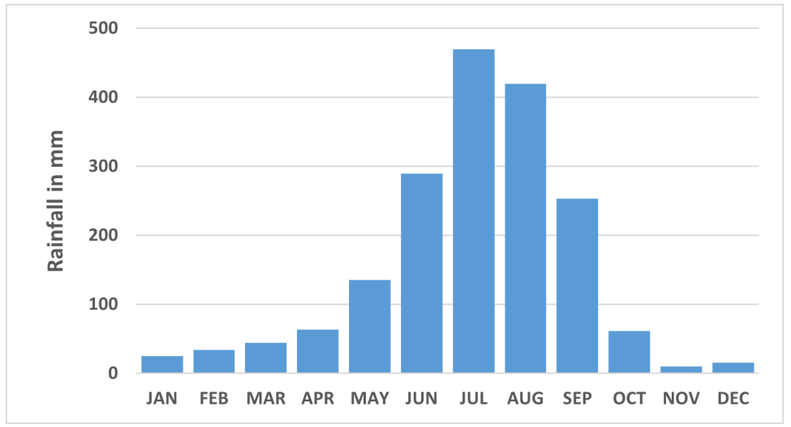
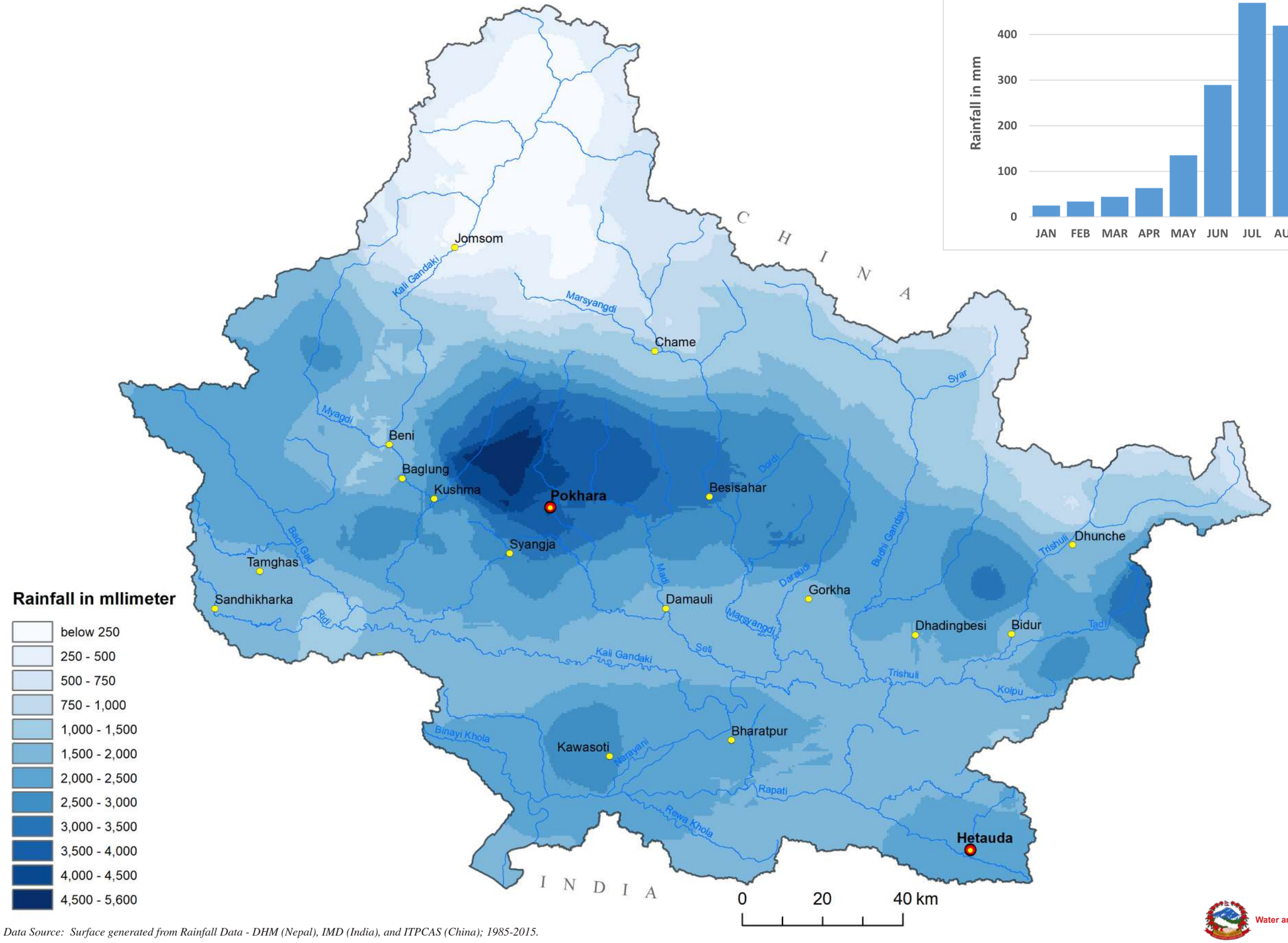
Data Source: Surface generated from DHM Temperature Data - 1985-2015.

Annual Average Rainfall Distribution





Rainfall in mllimeter

- below 250
- 250 - 500
- 500 - 750
- 750 - 1,000
- 1,000 - 1,500
- 1,500 - 2,000
- 2,000 - 2,500
- 2,500 - 3,000
- 3,000 - 3,500
- 3,500 - 4,000
- 4,000 - 4,500
- 4,500 - 5,600

Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

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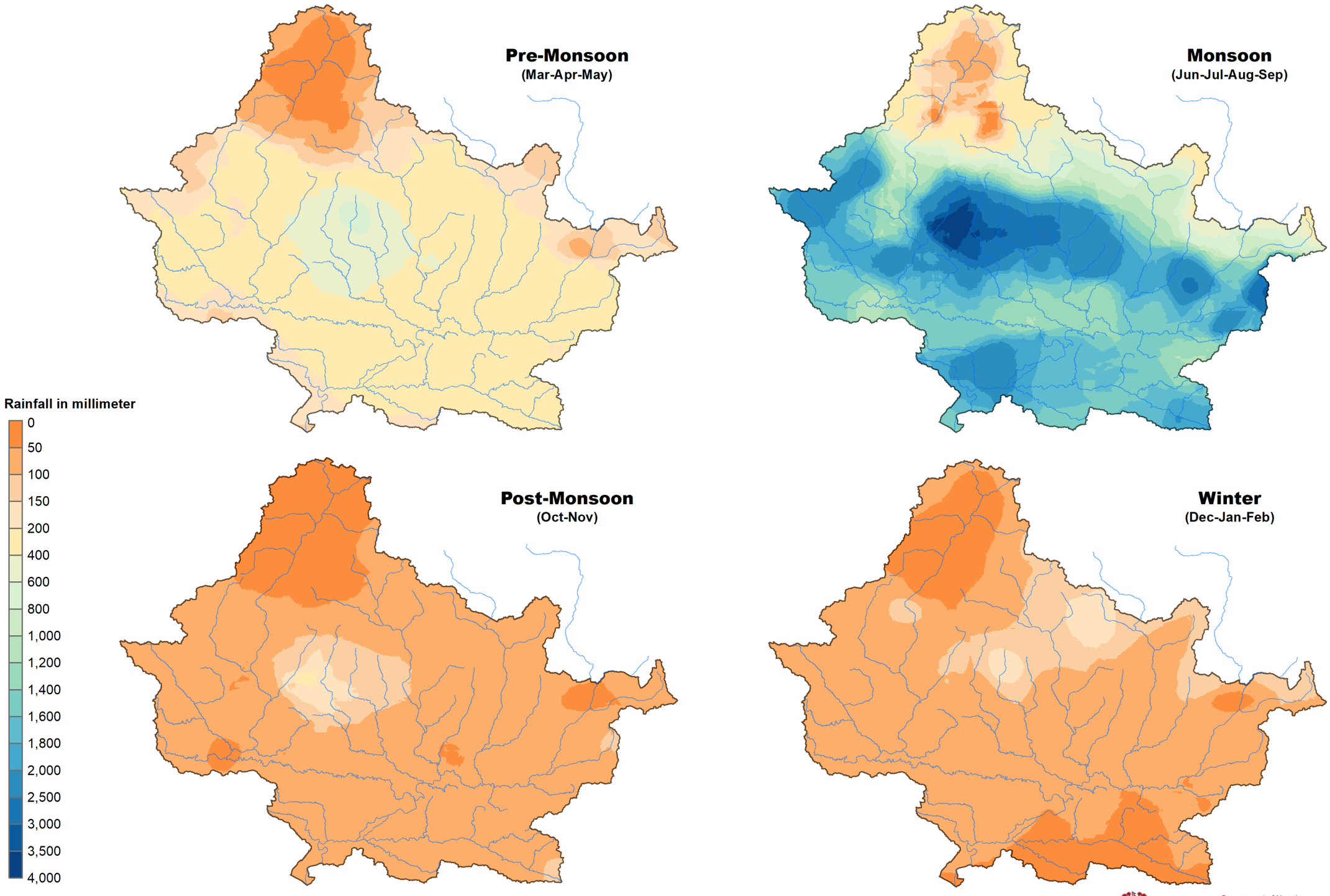
Seasonal Average Rainfall Distribution



Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

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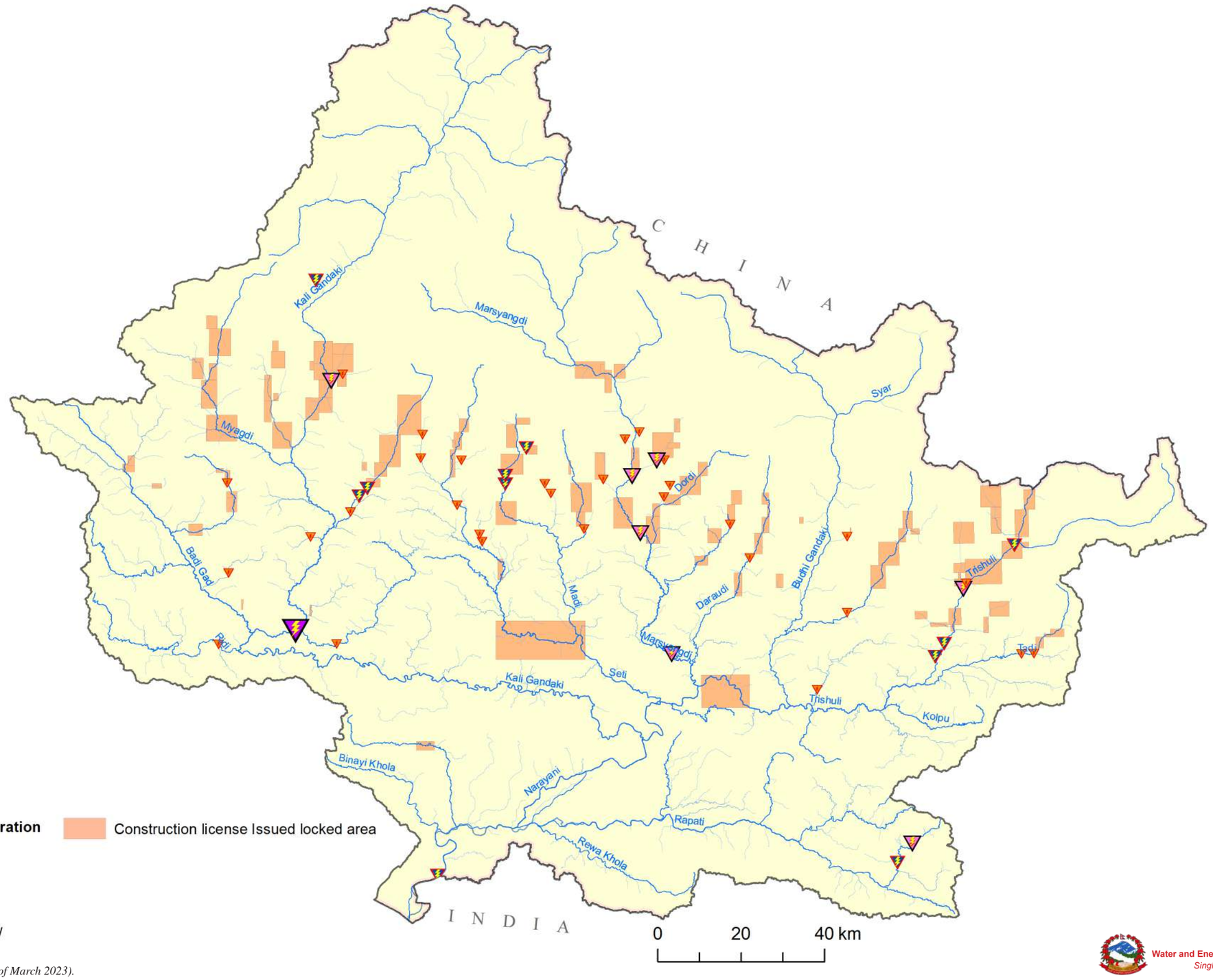
Irrigation Projects

Hydropower Projects



Data Source: DOED, GoN (as of March 2023).

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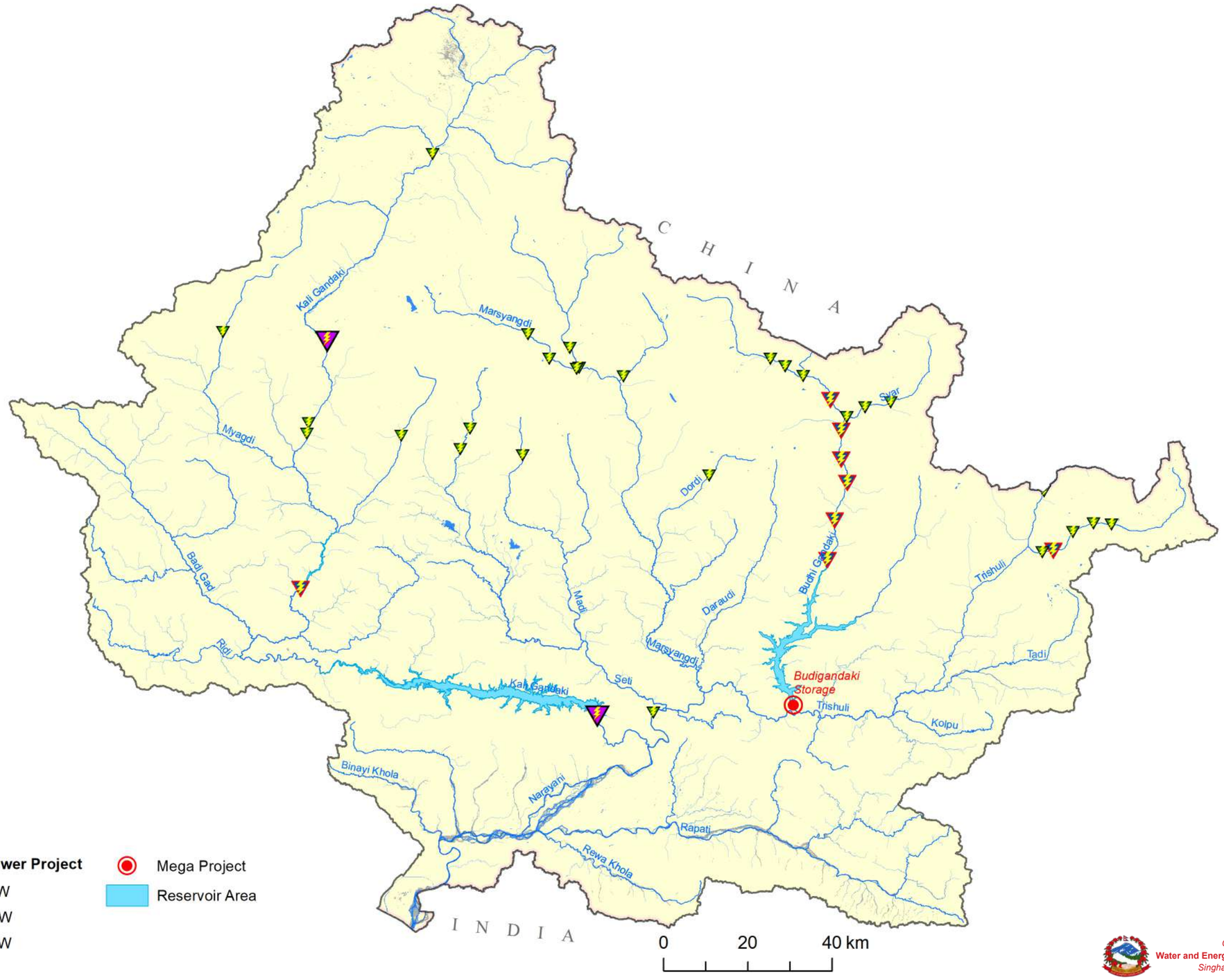
Greenfield Hydropower Projects



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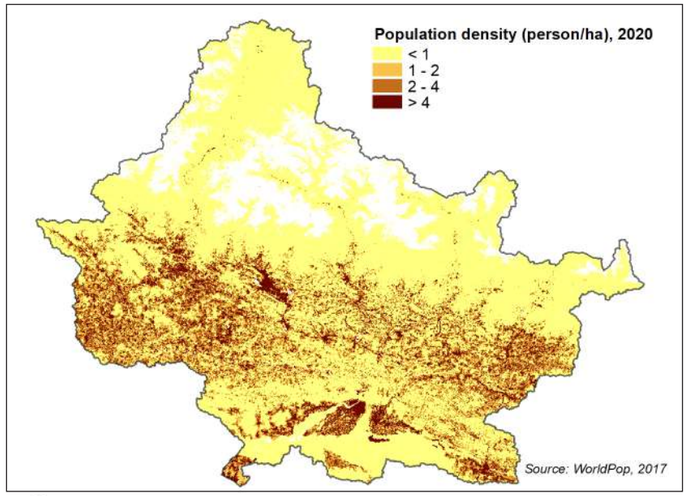
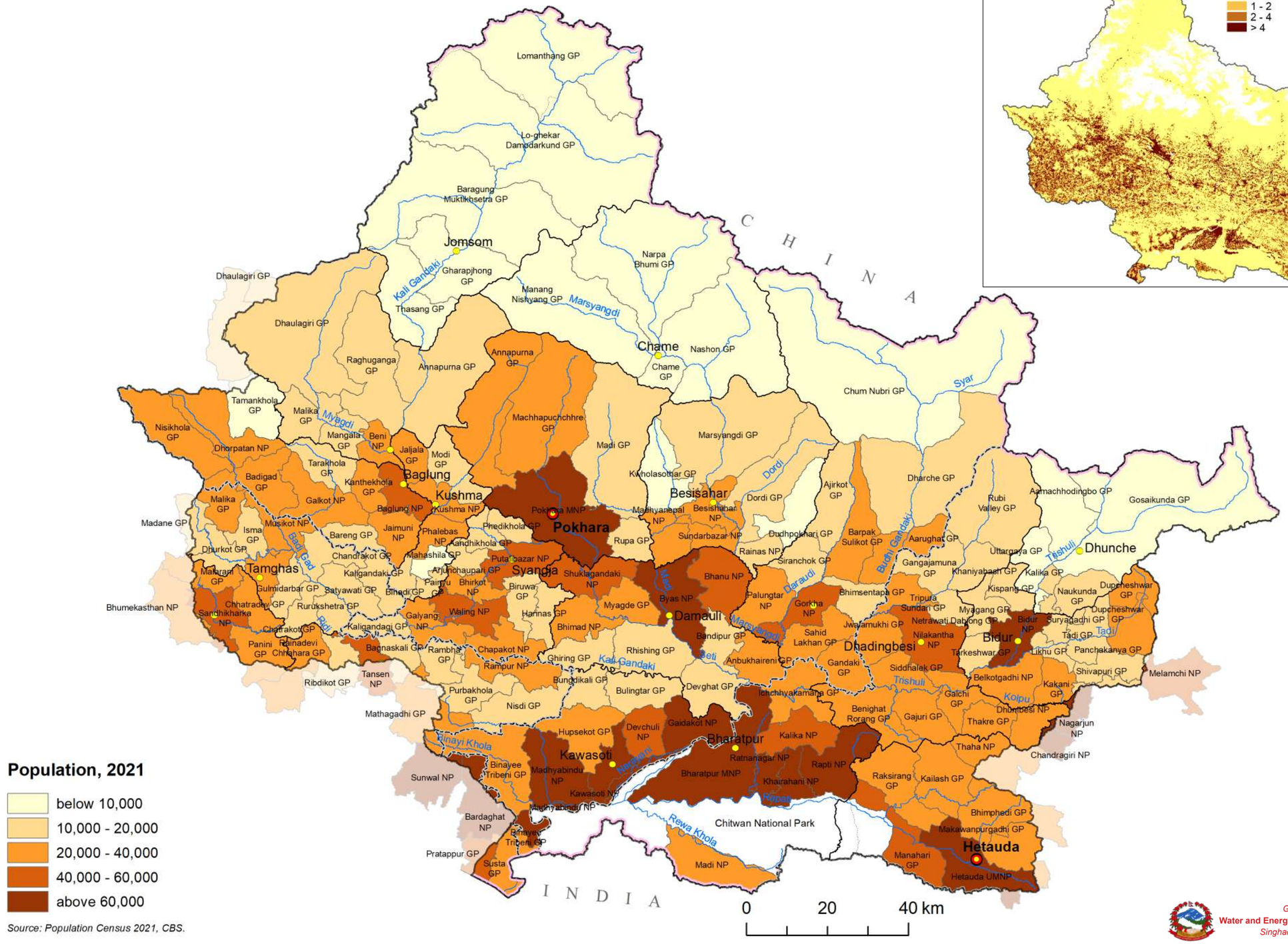
Population Distribution and Density





Population, 2021

- below 10,000
- 10,000 - 20,000
- 20,000 - 40,000
- 40,000 - 60,000
- above 60,000

Source: Population Census 2021, CBS.

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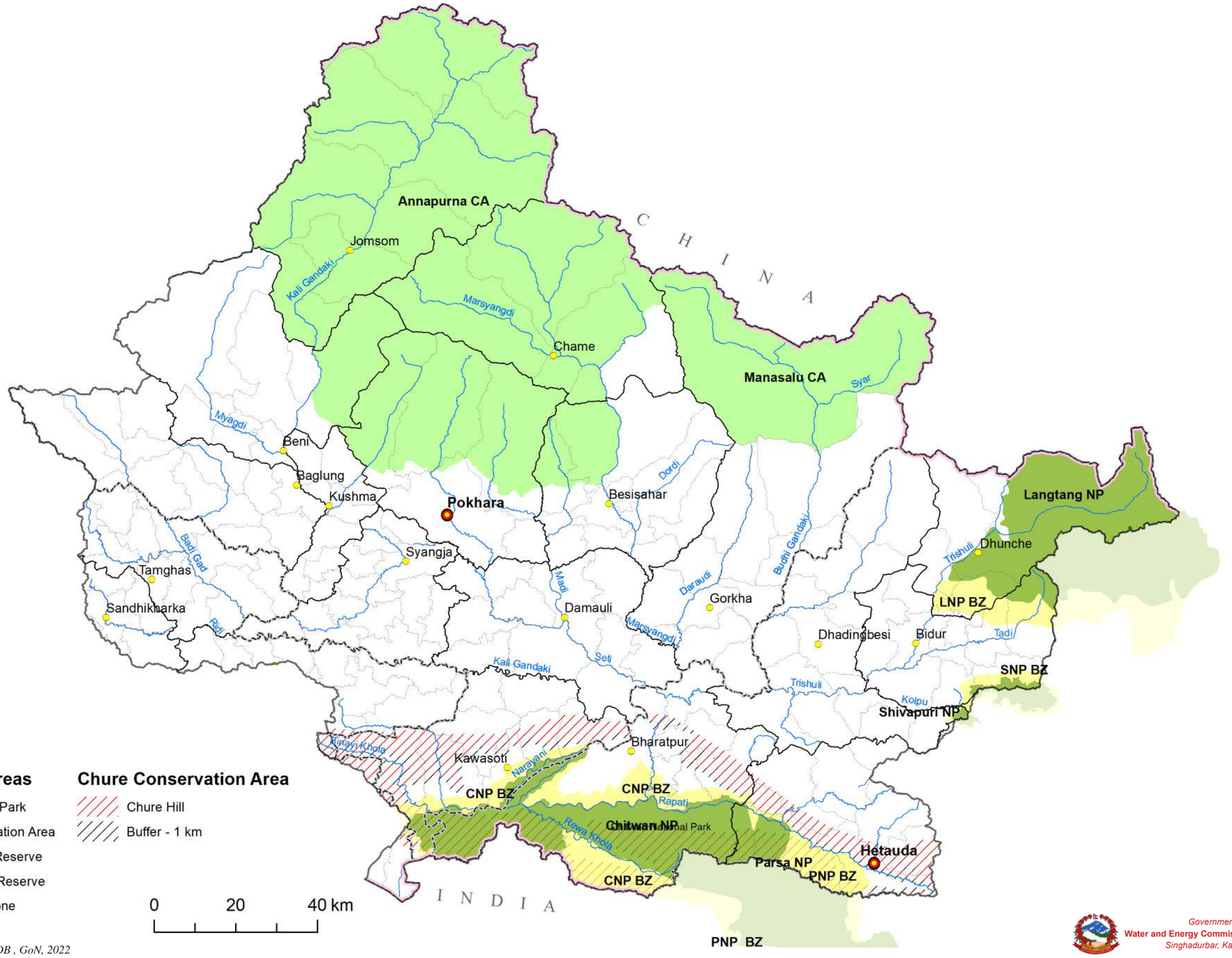
Protected Areas



Data Source: DNPWC & PCTMCDB , GoN, 2022

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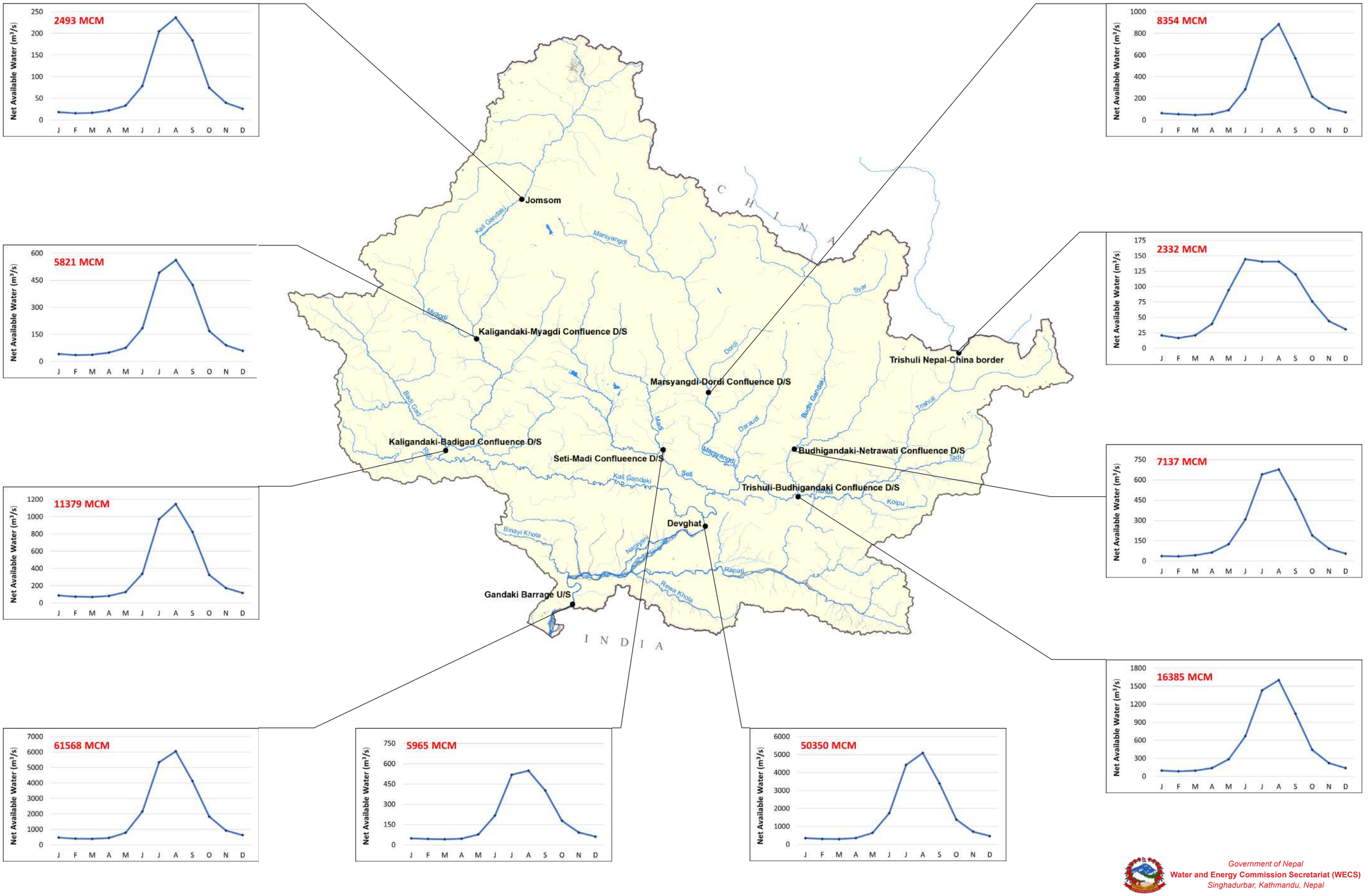
Hydrographs at Major River Nodes



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3. Karnali Basin

Karnali Basin

Karnali River Basin is one of the three major river basins in Nepal. The basin extends from 80° 33' 27" to 83° 40' 49" East longitudes and 28° 19' 28" to 30° 26' 50" North latitudes in Nepal. The basin lies in the western part of Nepal with Gandaki River Basin in the east and Mahakali River Basin in the west. The Karnali River is a transboundry river basin and it passes through Tibet China, Nepal and India. The Karnali River originates from Mapchachungo Glacier in Tibet, passes through Nepal and joins the Ganges River downstream of Chhapra, India after travelling 1,080 km. The Karnali Basin, with a catchment area of 3,040 km² in China and 43,153 km² in Nepal, covers areas of four provinces: Karnali, Sudurpaschim, Lumbini and Gandaki.

The Karnali River Basin has a long-term mean annual flow of 1,255.9 m³/s at Nepal-India border. The major tributaries of the basin are Bheri, Humla-Karnali, Mugu-Karnali, Tila, Seti (West) and Karnali.

There are 44 urban municipalities and 91 rural municipalities in the basin with a population of 2,660,036 as per estimated from the Population census, 2021.

The estimated irrigation systems covers 69,341 ha. of agricultural land for 2025 and 94,641 ha. for 2050.

With the highest potential for hydropower development in Nepal, the basin has many big hydropower projects studied and planned for development. The biggest hydropower Project studied in Nepal, Karnali-Chisapani storage project, with 10,800 MW capacity is situated in the basin.

Salient Features of Karnali Basin

Basin location	*Latitudes: 28°19'28" to 30°26'50" N* *Longitudes: 80°33'27" to 83°40'49" E*
Catchment area	*43,153 sq.km. (Nepal)* *3,040 sq.km. (China)*
Major rivers	*Humla Karnali (137 km), Mugukarnali (116 km), Tila (124 km), Karnali (345 km), West Seti (233 km), Bheri (296 km)*
River length	*603 km (Total from China to Nepal-India border), 491km (up to Nepal-India border)*
Elevation	*Maximum - 7,739 m.* *Minimum - 129 m.*
Hydro-meteorological stations	*39 Meteorological stations* *16 Hydrological stations*
Flood forecasting stations	*4*
Average annual rainfall	*1,225 mm*
Average river flow (Nepal - India border)	*1,255.9 cumec; 38,411 MCM (annual)*
Existing hydropower stations and Capacity (DOED, March 2023)	*4; 22.9 MW*
Agriculture land	*466,369 ha.*
Existing big irrigation systems	*2*
Total irrigated area in basin (as per inventory of IMP, 2019)	*69,341 ha.(2025)* *94,641 ha. (2050)*
Total population (extimated from Population Census, 2021)	*2,660,036*
Forest land	*1,677,900 ha.*
Total water demand (2025)	*Irrigation demand:1424 MCM* *Domestic demand: 230 MLD*
Administrative units	*Pradesh: Karnali, Sudurpaschim, Gandaki, and Lumbini* *Districts: 22* *Local Bodies:* *(91 Gaupalika; 44 Nagarpalika)*

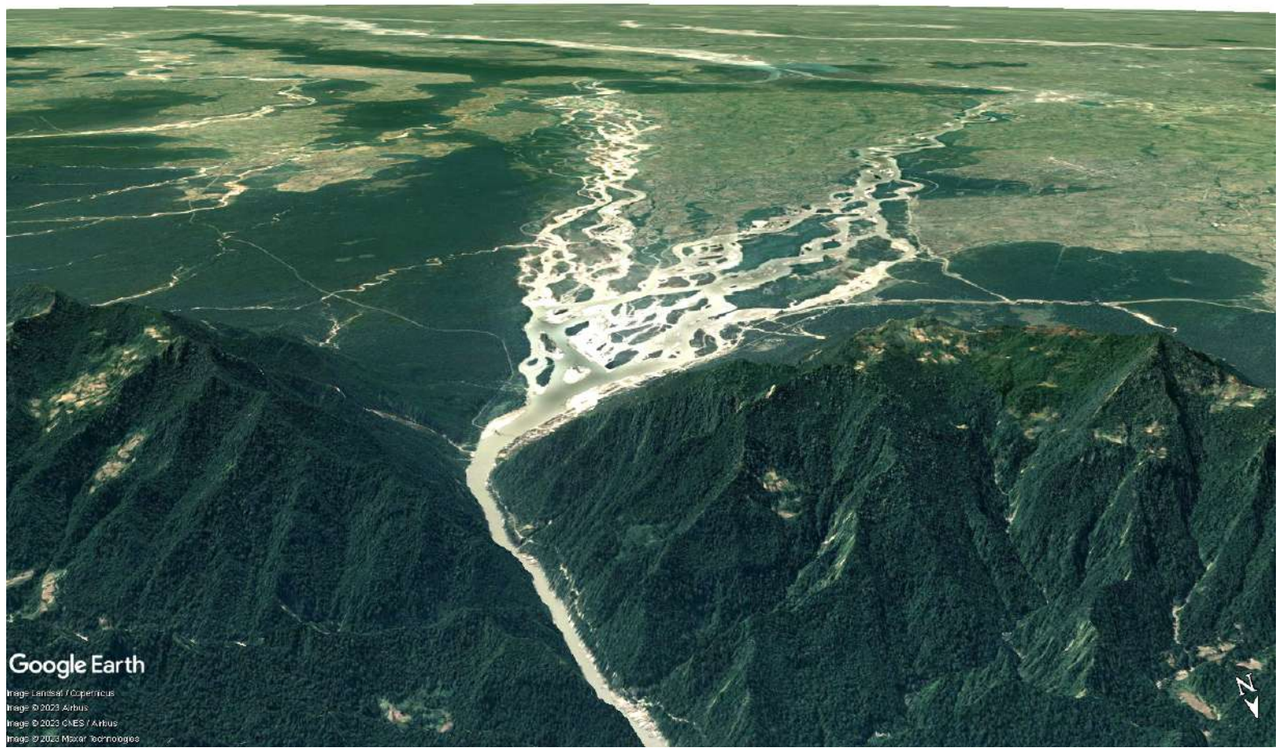


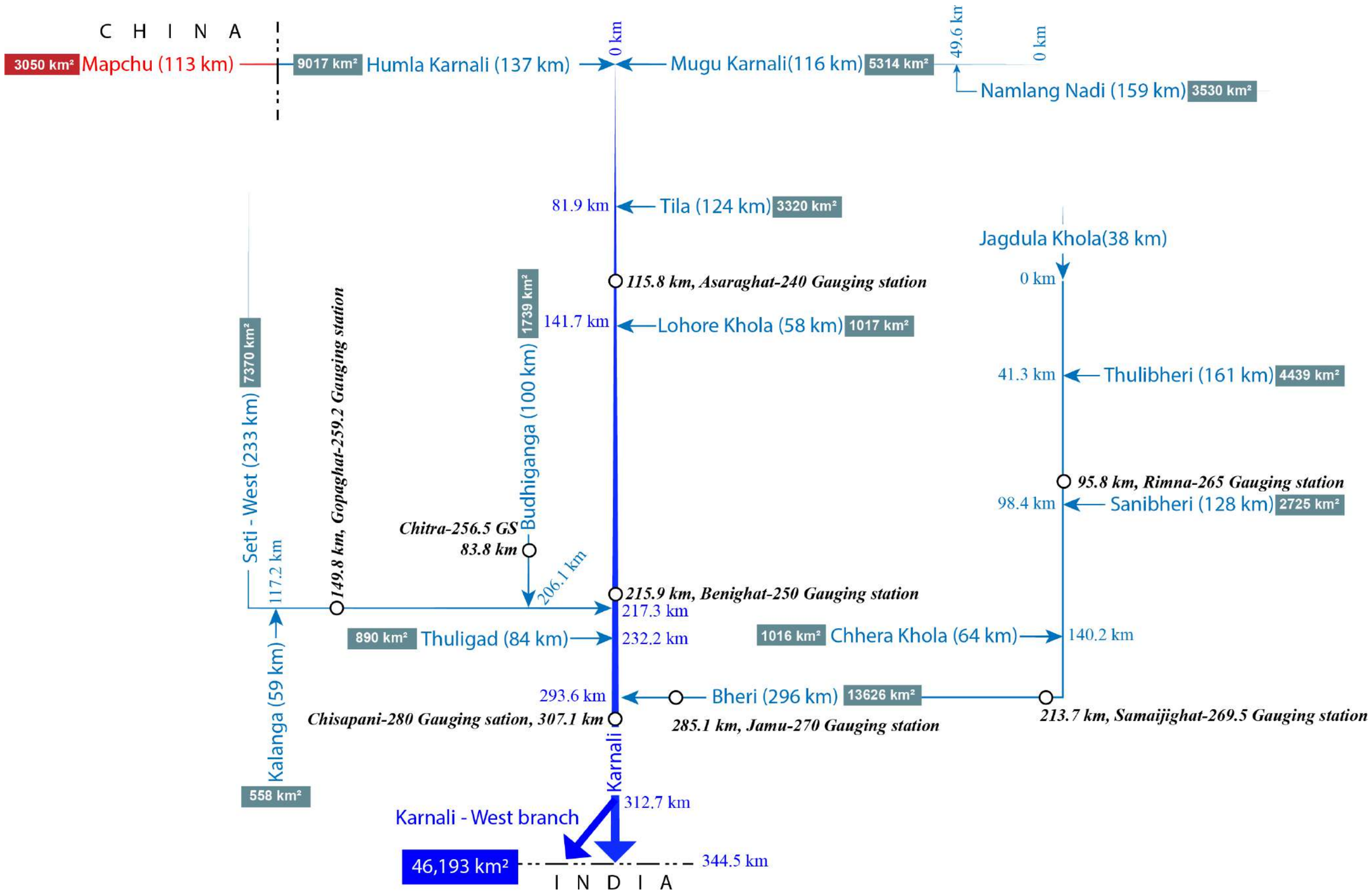
Figure 2.3: Karnali River flows down to Terai plain land

Administrative Division of Karnali Basin

Table 2.3 List of Local Bodies in Karnali Basin

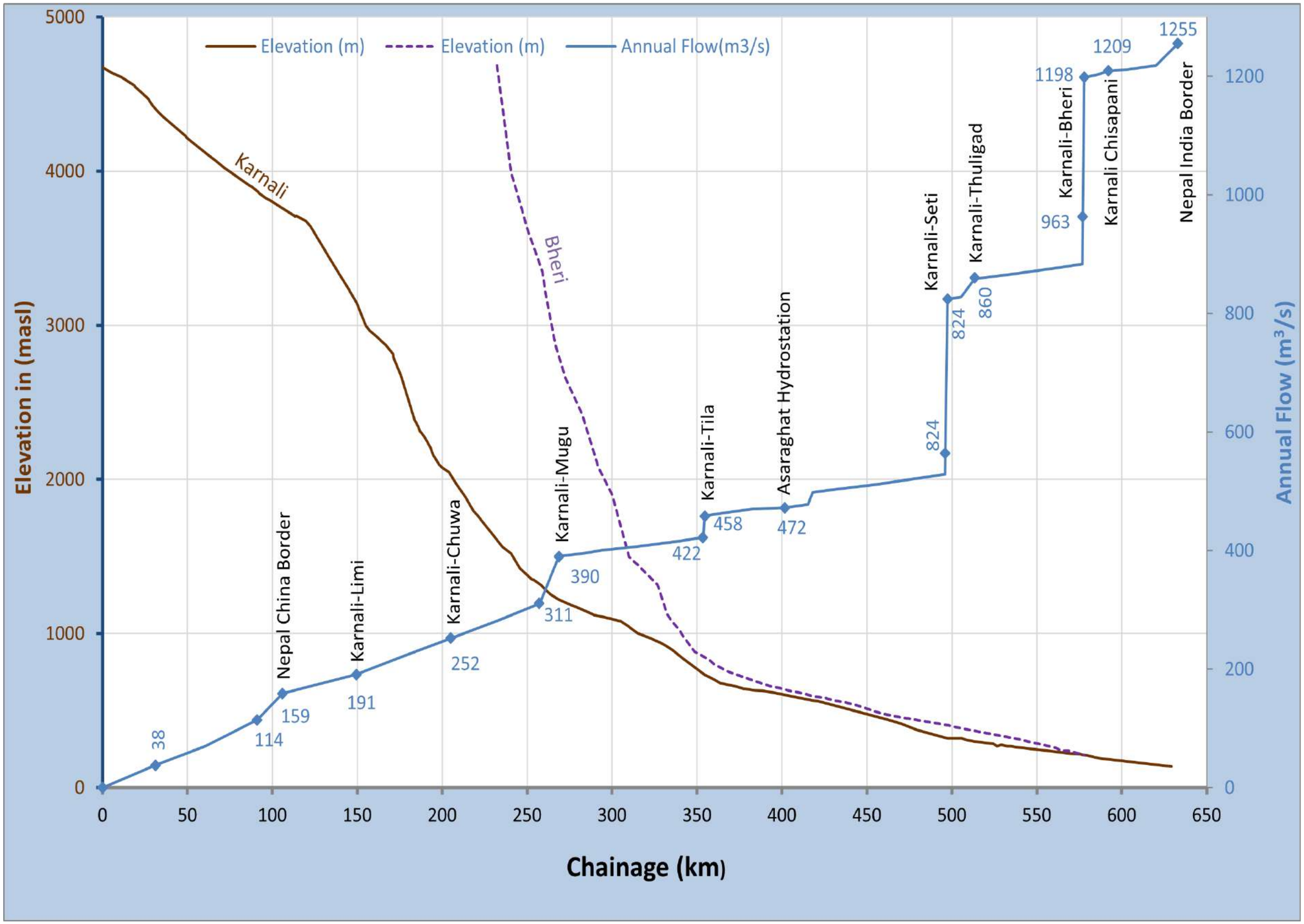
SN	Province	District	Name of Local Body	% of Area
1	Gandaki	Baglung	Tamankhola GP	8
2		Myagdi	Dhaulagiri GP	6
3	Karnali	Dailekh	Aathabis NP	100
4			Bhagawatimai GP	100
5			Bhairabi GP	100
6			Chamunda Bindrasaini NP	100
7			Dullu NP	100
8			Dungeshwor GP	100
9			Gurans GP	100
10			Mahabu GP	100
11			Narayan NP	100
12			Naumule GP	100
13			Thantikandh GP	100
14		Dolpa	Chharka Tangsong GP	100
15			Dolpo Buddha GP	100
16			Jagadulla GP	100
17			Kaike GP	100
18			Mudkechula GP	100
19			Shey Phoksundo GP	100
20			Thuli Bheri NP	100
21			Tripurasundari NP	100
22		Humla	Adanchuli GP	100
23			Chankheli GP	100
24			Kharpunath GP	100
25			Namkha GP	100
26			Sarkegad GP	100
27			Simkot GP	100
28			Tanjakot GP	100
29		Jajarkot	Barekot GP	100
30			Bheri NP	100
31			Chhedagad NP	100
32			Junichande GP	100
33			Kuse GP	100
35			Nalagad NP	100
34			Shiwalaya GP	100
36	Karnali	Jumla	Chandannath NP	100
37			Guthichaur GP	100
38			Hima GP	100
39			Kanakasundari GP	100
40			Patrasi GP	100
41			Sinja GP	100
42			Tatopani GP	100
43			Tila GP	100
45		Kalikot	Khandachakra NP	100
46			Mahawai GP	100
47			Naraharinath GP	100
48			Pachaljharana GP	100
49			Palata GP	100
50			Raskot NP	100
51			Sanni Tribeni GP	100
44			Shubha Kalika GP	100
52			Tilagufa NP	100
53		Mugu	Chhayanath Rara NP	100
54			Khatyad GP	100
55			Mugum Karmarong GP	100
56			Soru GP	100
57		Rukum West	Aathbiskot NP	100
58			Banfikot GP	100
59			Chaurjahari NP	100
60			Musikot NP	100
61			Sani Bheri GP	100
62			Tribeni GP	100
63		Salyan	Bagchaur NP	12
64			Bangad Kupinde NP	96
65			Darma GP	100
67			Kumakh GP	100
68			Sharada NP	2
66			Siddha Kumakh GP	45
69		Surkhet	Barahtal GP	100
70			Bheriganga NP	100
71	Karnali	Surkhet	Birendranagar NP	100
72			Chaukune GP	100
73			Chingad GP	100
74			Gurbhakot NP	100
75			Lekbeshi NP	100
76			Panchpuri NP	100
77			Simta GP	100
78	Lumbini	Bardiya	Geruwa GP	100
79			Madhuwan NP	38
80			Rajapur NP	100
81			Thakurbaba NP	71
82		Rolpa	Thawang GP	26
83		Rukum East	Bhume GP	85
84			Putha Uttarganga GP	100
85			Sisne GP	100
86	Sudur-pashchim	Achham	Bannigadhi Jayagadh GP	100
87			Chaurpati GP	100
88			Dhakari GP	100
89			Kamalbazar NP	100
90			Mangalsen NP	100
91			Mellekh GP	100
92			Panchadewal Binayak NP	100
93			Ramaroshan GP	100
94			Sanphebagar NP	100
95			Turmakhad GP	100
96		Baitadi	Dilasaini GP	1
97			Patan NP	21
98			Purchaudi NP	1
99			Sigas GP	100
100		Bajhang	Bithadchir GP	99
101			Bungal NP	100
102			Chabispathivera GP	100
103			Durgathali GP	100
104			JayaPrithivi NP	100
106			Kedarseu GP	100
107	Sudur-pashchim	Bajhang	Khaptadchhanna GP	100
108			Masta GP	100
105			Saipal GP	100
109			Surma GP	100
110			Talkot GP	100
111			Thalara GP	100
112		Bajura	Badimalika NP	100
113			Budhiganga NP	100
114			Budhinanda NP	100
116			Gaumul GP	100
117			Himali GP	100
118			Jagannath GP	100
115			Khaptad Chhededaha GP	100
119			Swami Kartik Khapar GP	100
120			Tribeni NP	100
121		Dadeldhura	Amargadhi NP	25
122			Ganayapdhura GP	98
123			Nawadurga GP	100
124		Doti	Adharsha GP	100
125			Badikedar GP	100
126			Bogtan GP	100
127			Dipayal Silgadi NP	100
128			Jorayal GP	95
129			K I Singh GP	100
130			Purbichauki GP	100
131			Sayal GP	100
132			Shikhar NP	100
133		Kailali	Chure GP	34
134			Janaki GP	31
135			Lamkichuha NP	11
136			Mohanyal GP	72
137			Tikapur NP	39

River Flow Line Diagram of Karnali River

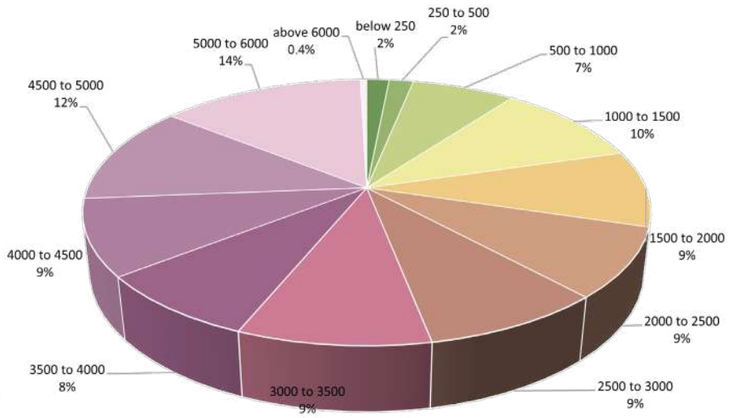


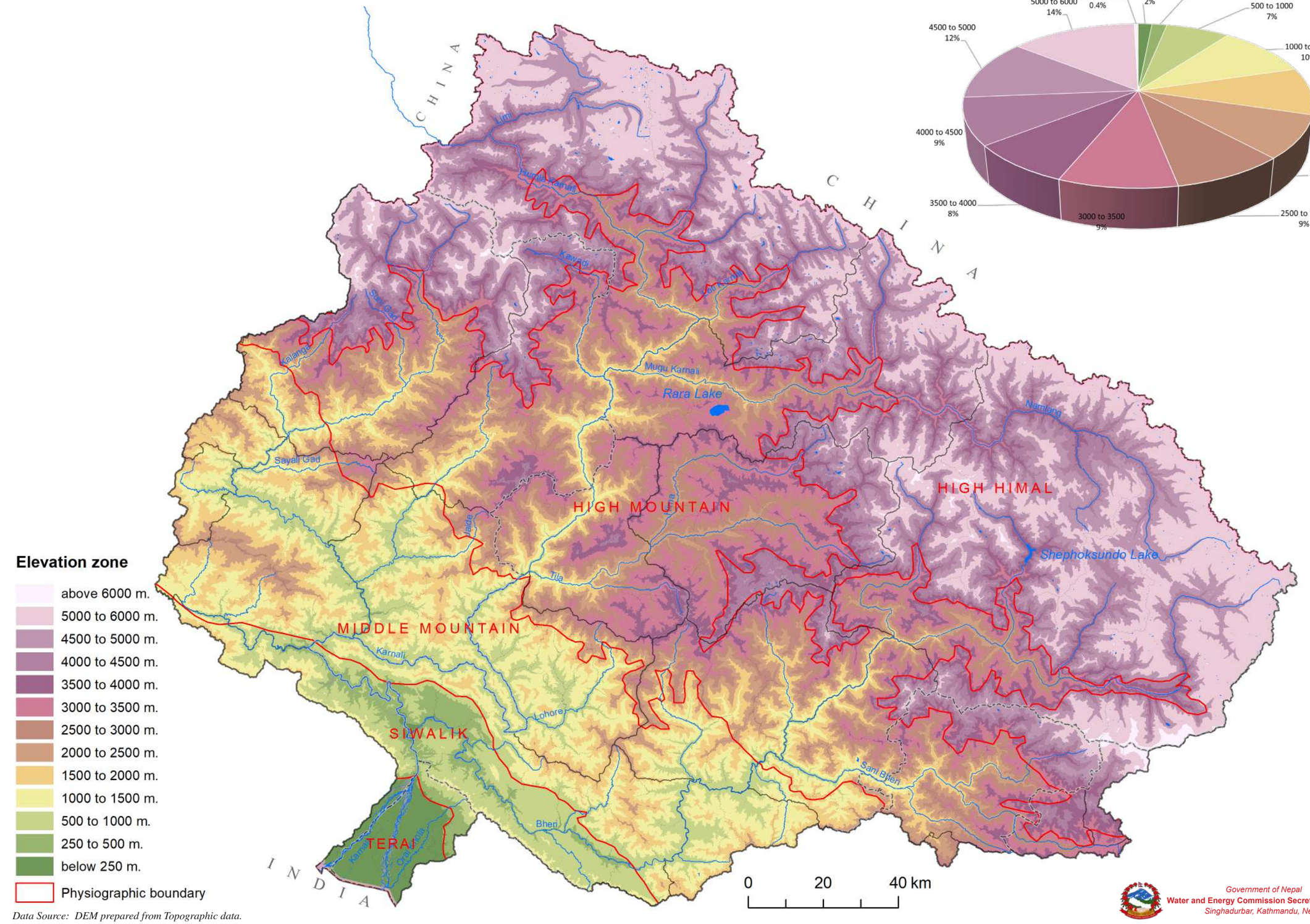
River System

River Profile and Annual Flow



Elevation Zone





Data Source: DEM prepared from Topographic data.

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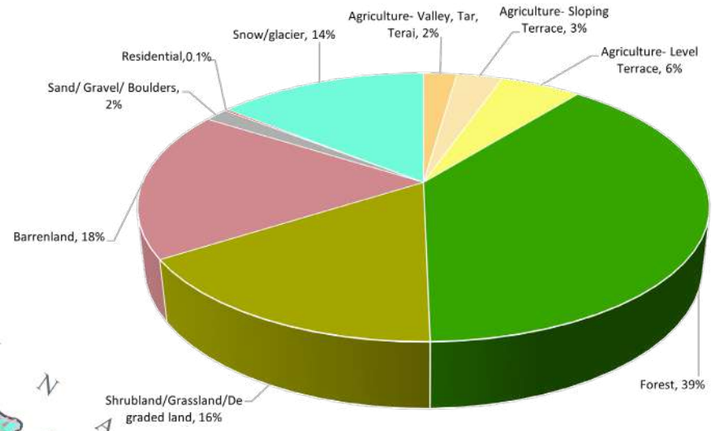
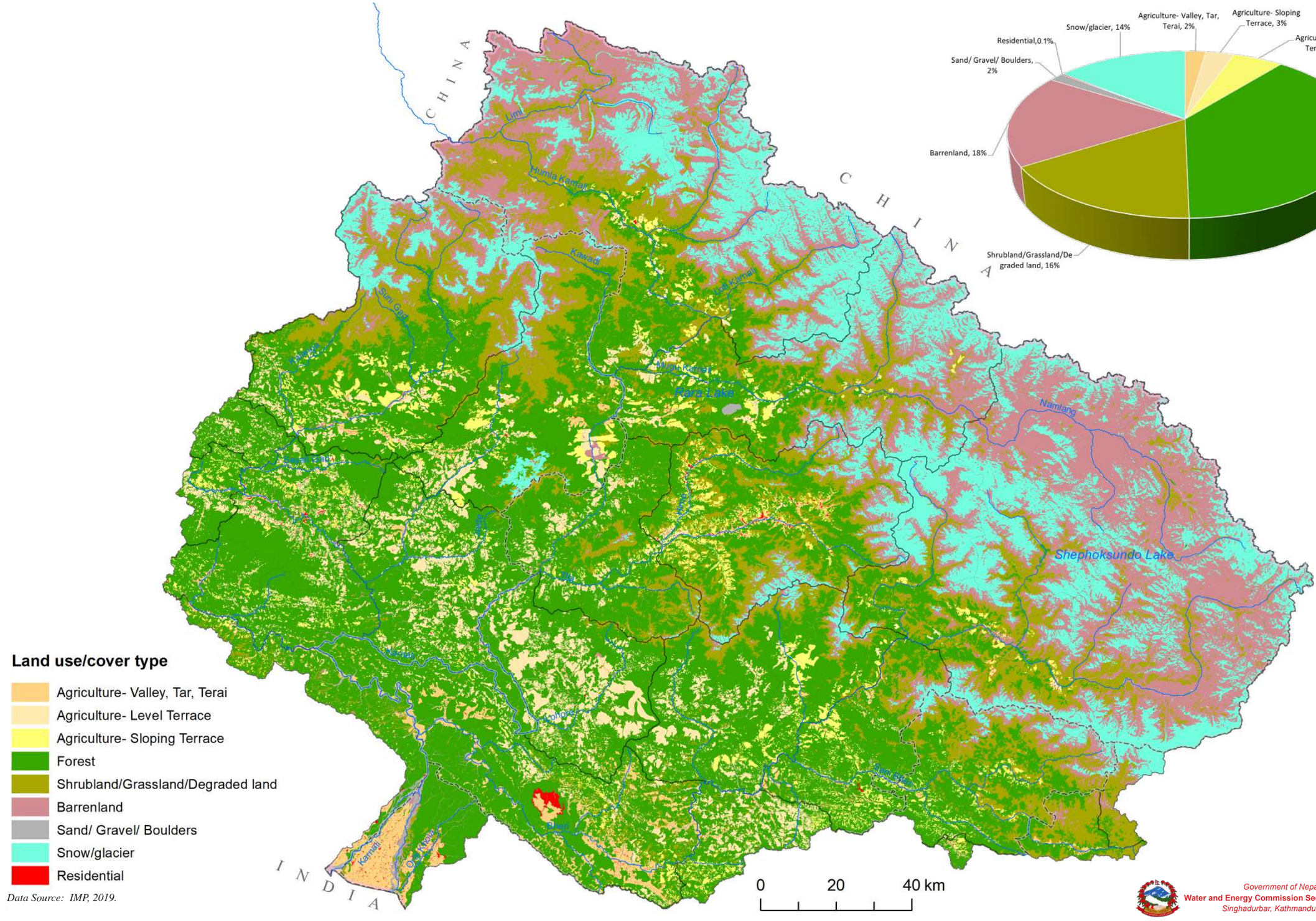
Land Use/Cover





Data Source: IMP, 2019.

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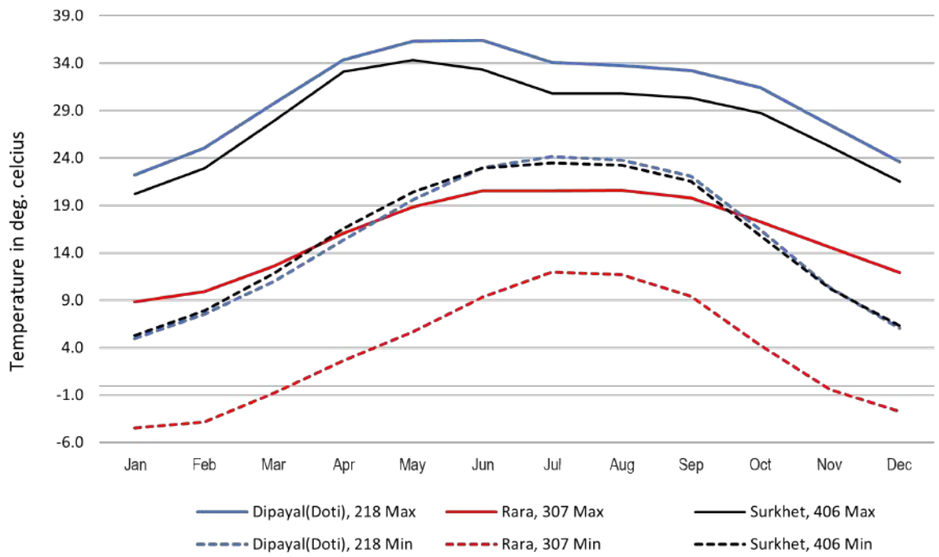
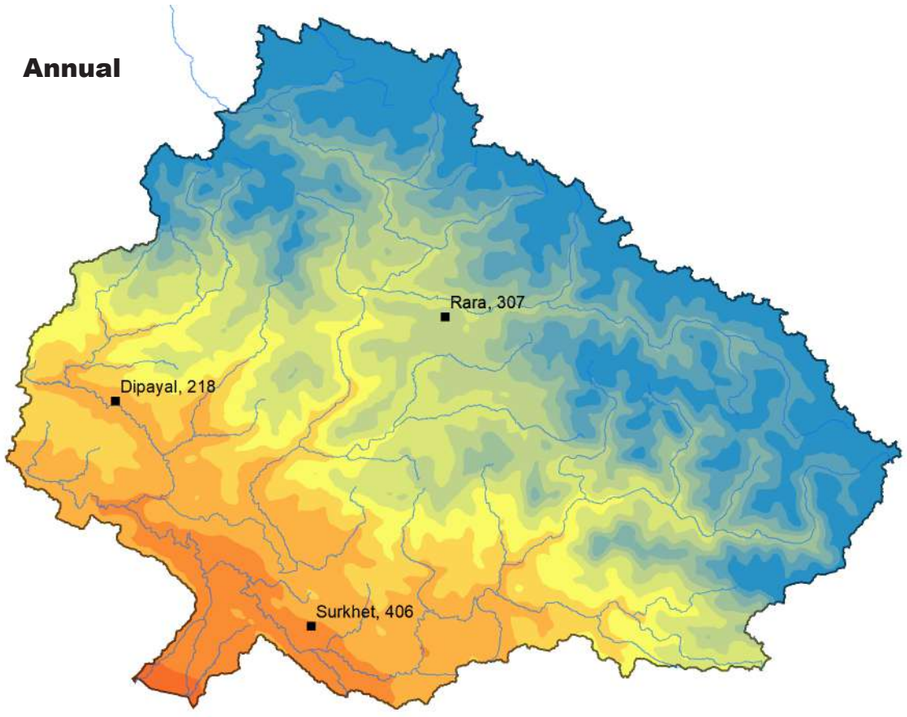
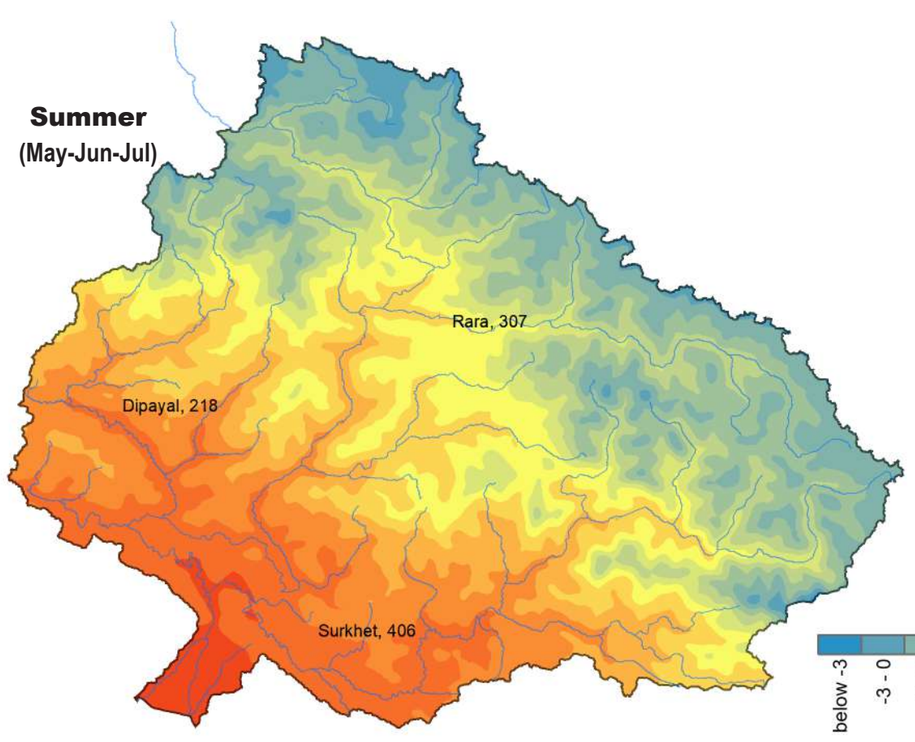
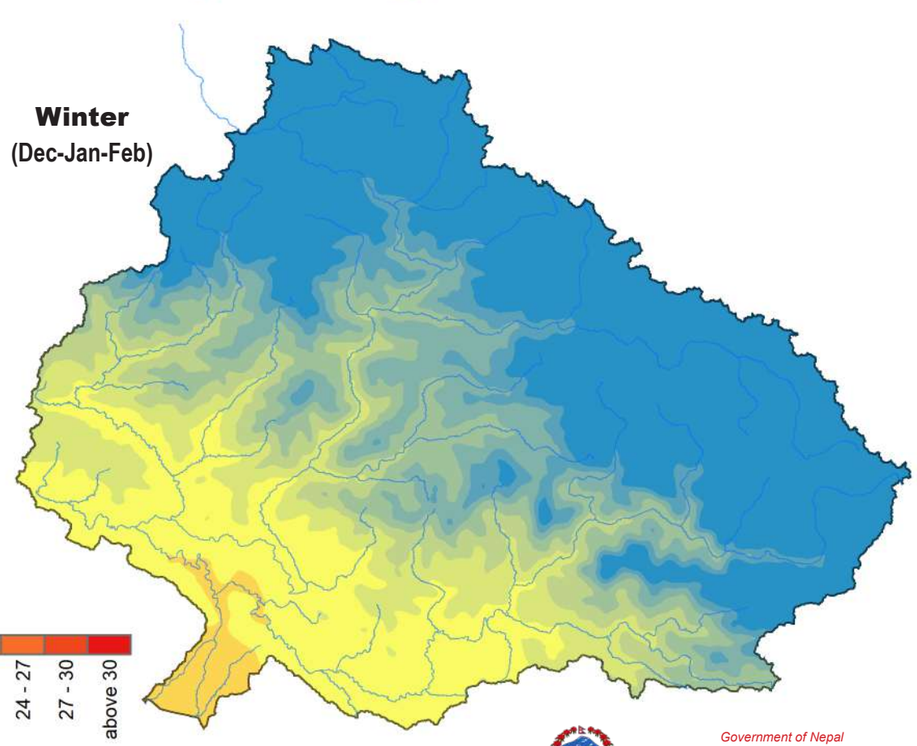
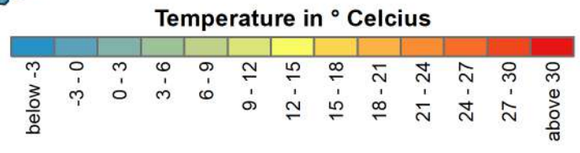
Average Temperature Distribution











Data Source: Surface generated from DHM Temperature Data - 1985-2015.

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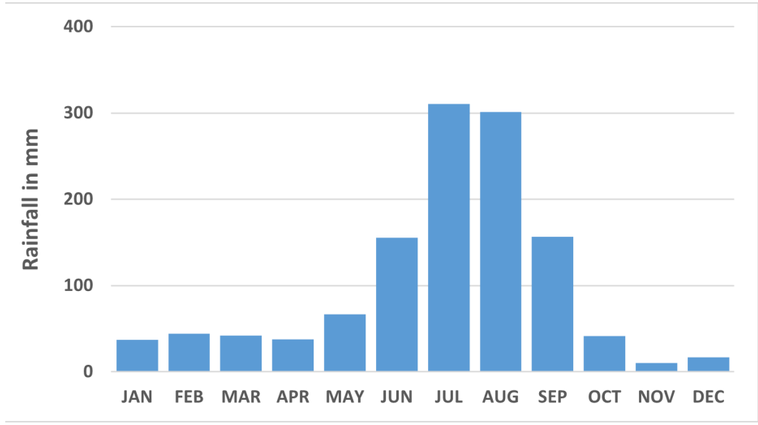
Annual Average Rainfall Distribution



CHINA
CHINA
INDIA
Limi
Humla Karnali
Simikot
Kawadi
Loti Karnali
Suni Gad
Kalanga
Chainpur
Martadi
Mugu Karnali
Rara Lake
Gamgadhi
Namlang
Sayali Gad
Silgadhi
Jaldo
Mangalsen
Manma
Tila
Hima
Jumla
Shephoksundo Lake
Karnali
Dunai
Dailekh
Lohore
Jajarkot
Sani Bheri
Musikot
Rukumkot
Birendranagar
Bheri
Karnali
Orai Khola

Rainfall in millimeter

- below 250
- 250 - 500
- 500 - 750
- 750 - 1,000
- 1,000 - 1,500
- 1,500 - 2,000
- 2,000 - 2,500
- 2,500 - 3,000

0 20 40 km

Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

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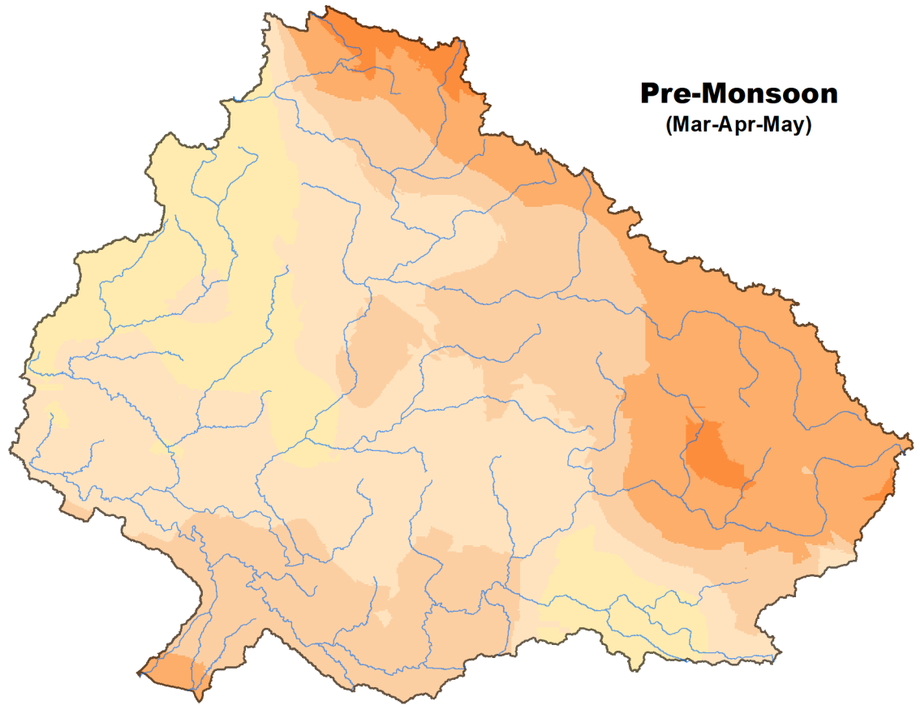
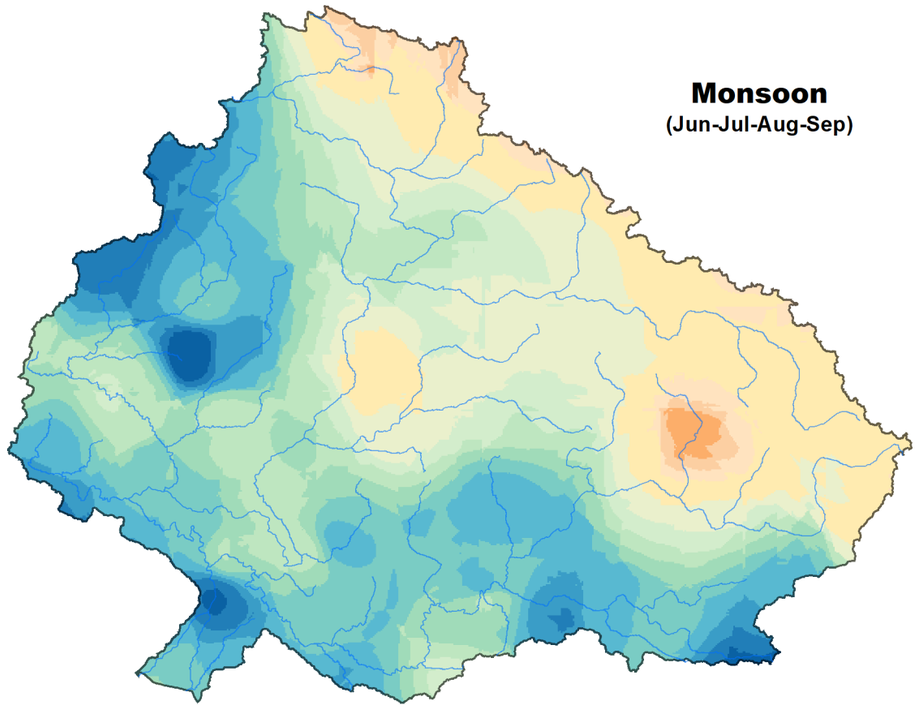
Seasonal Average Rainfall Distribution



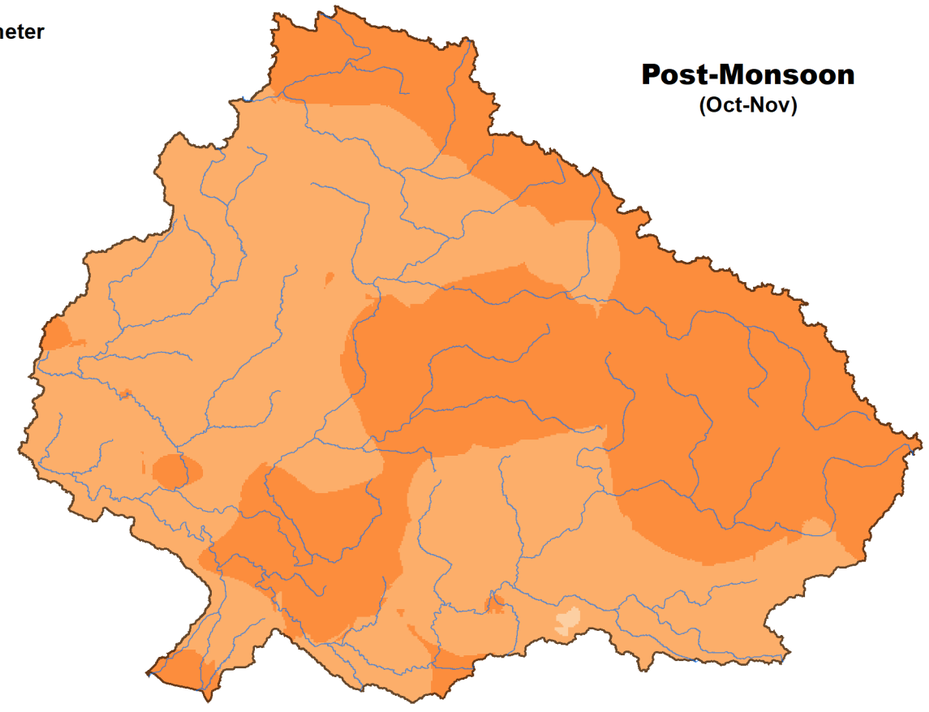
Pre-Monsoon
(Mar-Apr-May)



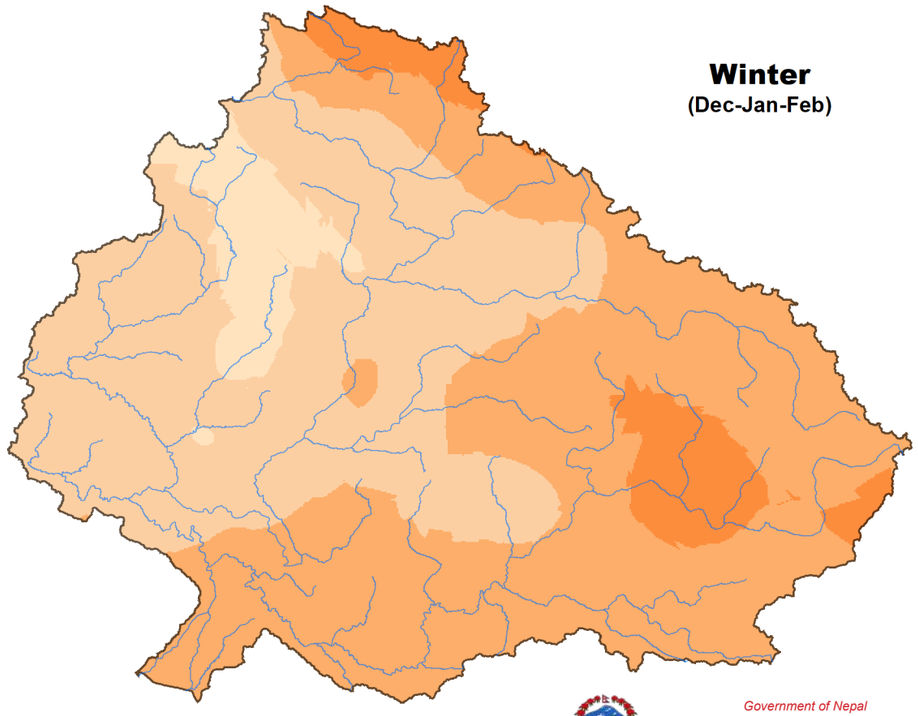
Monsoon
(Jun-Jul-Aug-Sep)

Rainfall in millimeter

0
50
100
150
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000
2,500
3,000



Post-Monsoon
(Oct-Nov)



Winter
(Dec-Jan-Feb)

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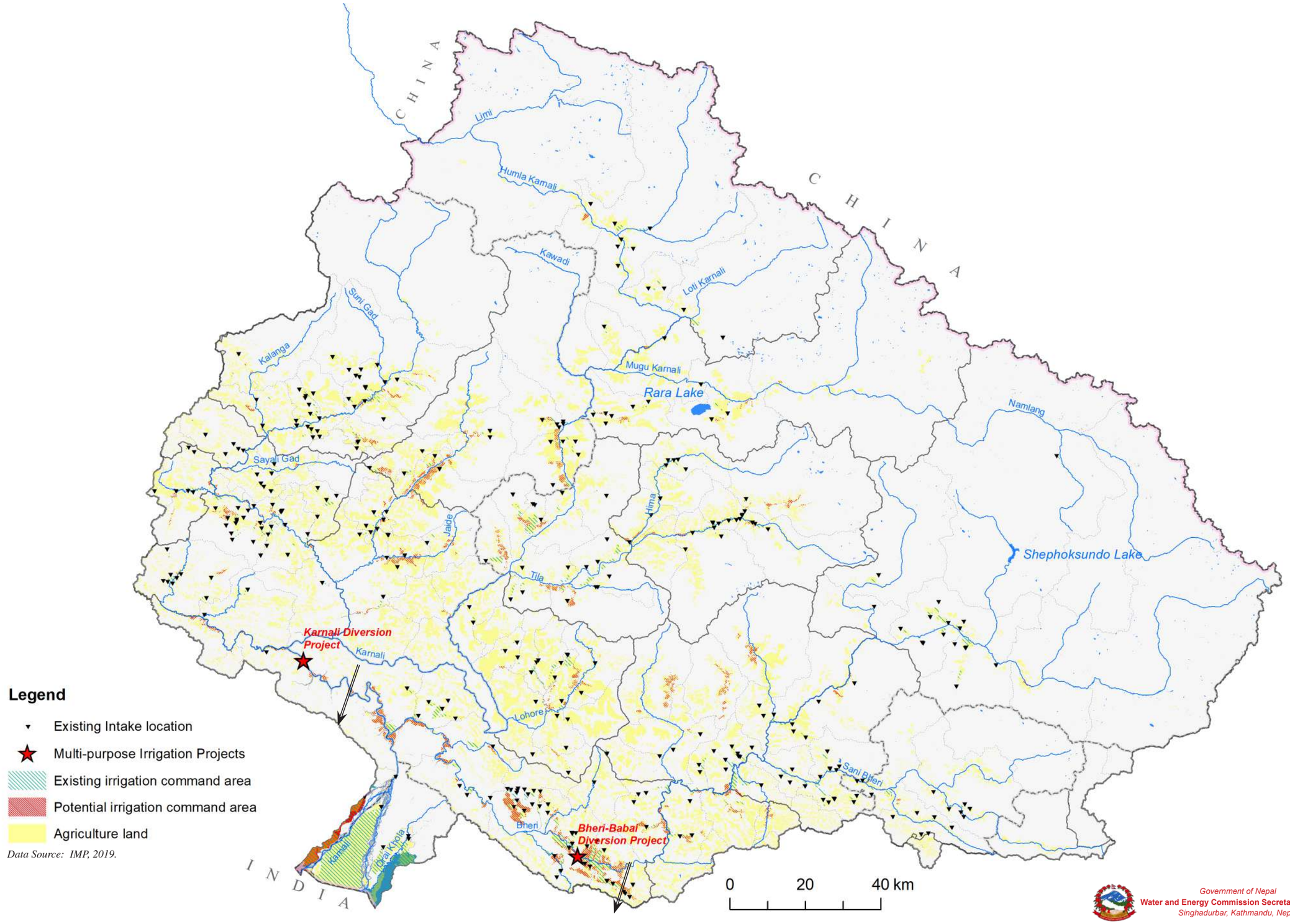
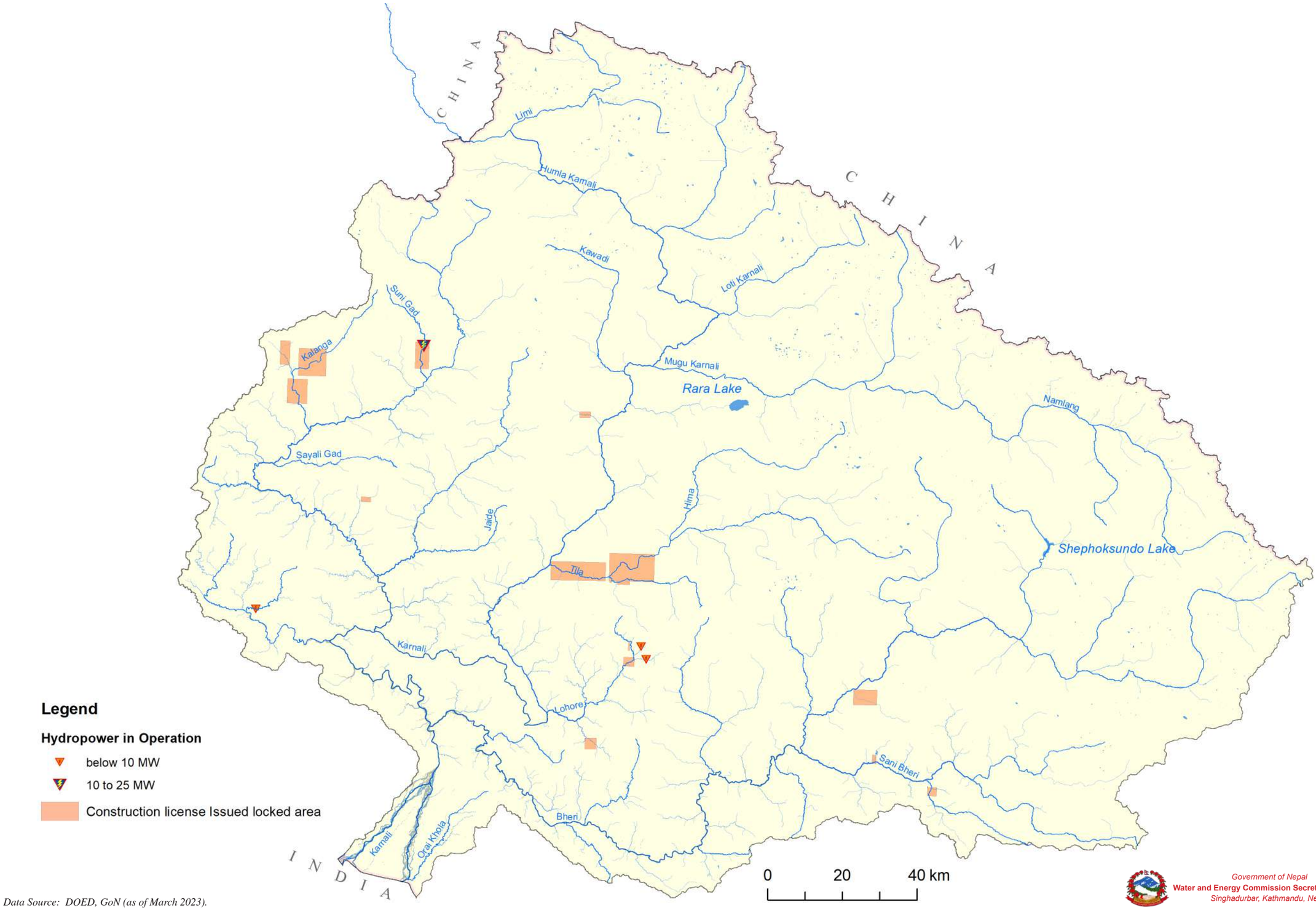
Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

Irrigation Projects



Hydropower Projects



Data Source: DOED, GoN (as of March 2023).

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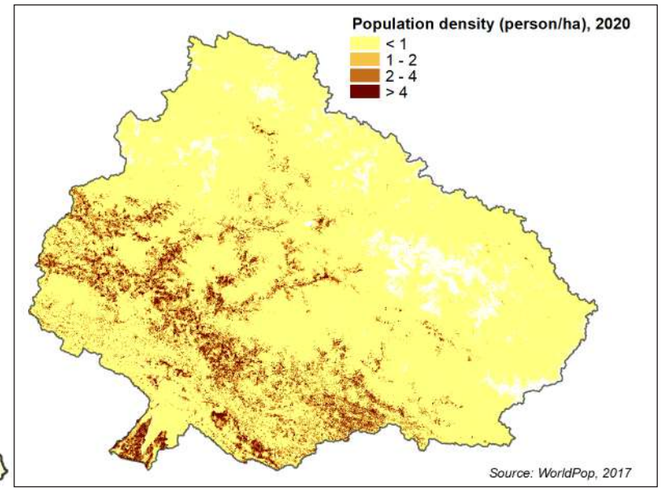
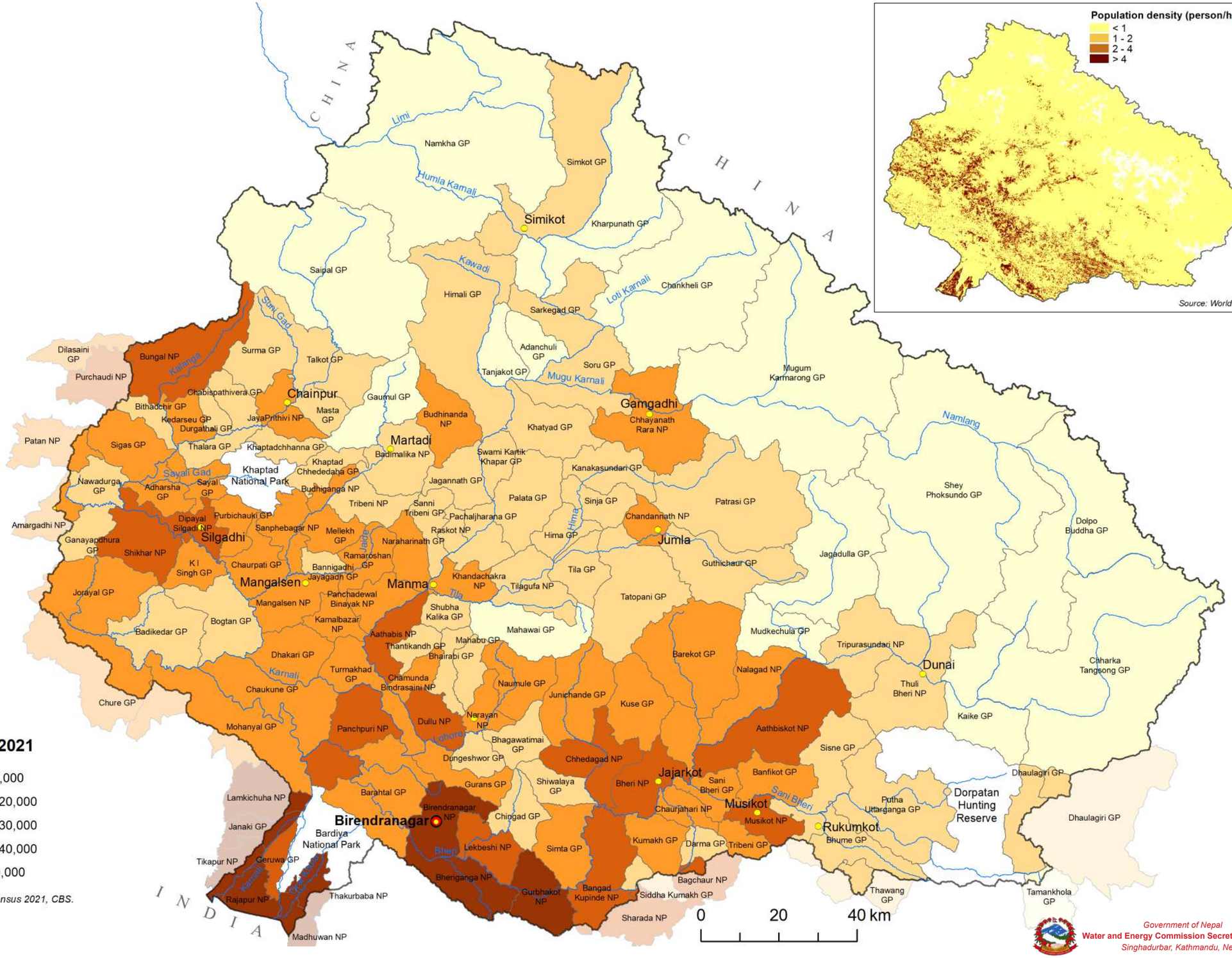
Greenfield Hydropower Projects

Population Distribution and Density





Population, 2021

- below 10,000
- 10,000 - 20,000
- 20,000 - 30,000
- 30,000 - 40,000
- above 40,000

Source: Population Census 2021, CBS.

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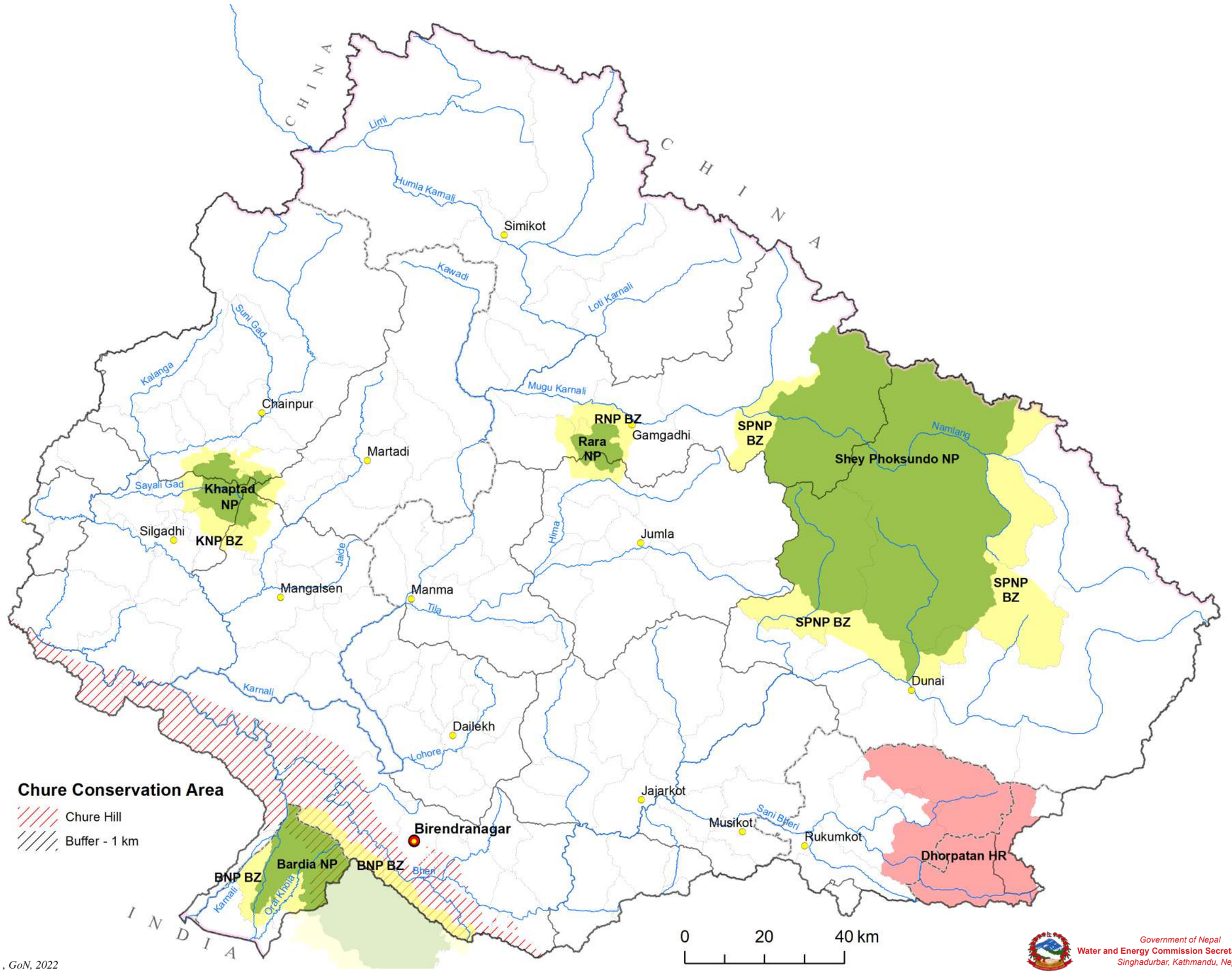
Protected Areas



Data Source: DNPWC & PCTMCDB , GoN, 2022

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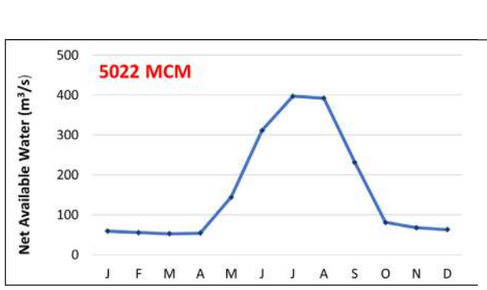
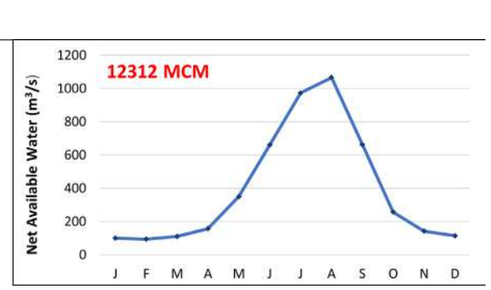
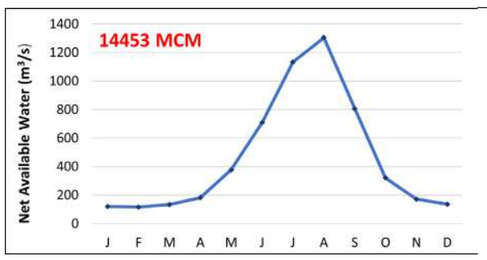
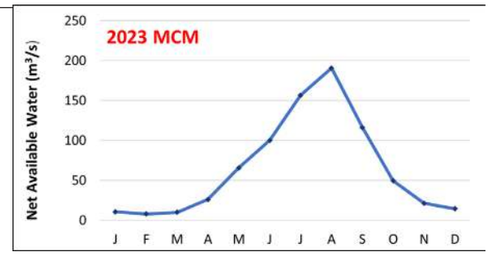
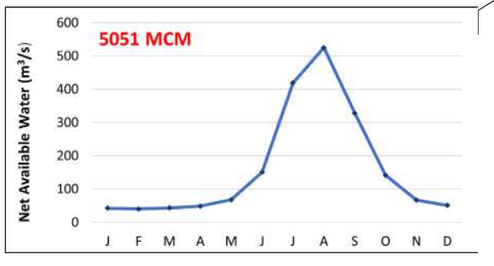
Hydrographs at Major River Nodes

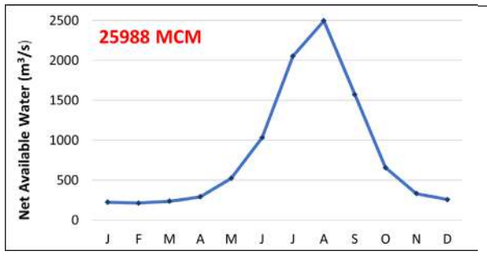


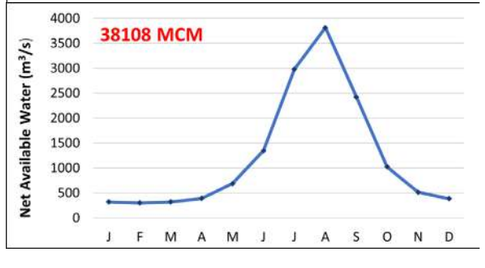


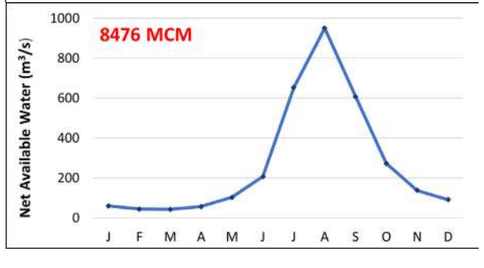


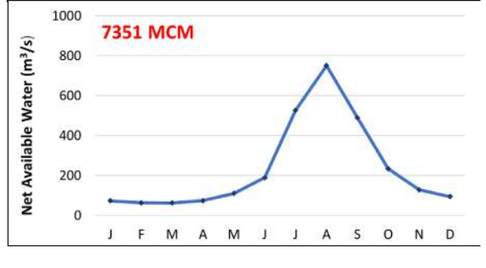












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4. Mahakali Basin

Mahakali Basin

The Mahakali River is a border river between Nepal and India in the western border of Nepal. Geographically, the basin in Nepal extends from 80° 03' 30.59" to 81° 06' 30.95" East longitudes and 28° 48' 51.83" to 30° 14' 47.76" North latitudes . Most of the major rivers of the basin originate from the Himalaya range and drain south to the Gangetic plain. The total area of the basin up to Nepal-India Border is about 15,769 km². The long-term mean annual discharge of Mahakali River is 719.8 m³/s at Nepal-India southern border. The elevation of the river basin in Nepal ranges from 155 meter to 7132 meter (Mt. Api).

There are three major tributaries meeting on the left bank of the Mahakali River in Nepal, namely, Chamelia, Surnaygad and Rangoon. On the right side, in India, the major rivers meeting Mahakali River are Darma, Gauri Ganga and Saryu.

The Mahakali River reaches the Terai plains at Brahmadev Mandi, where it is called the Sharda River in India. The river then flows southward lying entirely within India from Tanakpur Barrage to Sharada Barrage. From then, it flows entirely within Nepal in the Dodhara Chadini area. After exiting Nepal, it flows towards southeast direction in Uttar Pradesh in India and meets Karnali (Ghaghara) River downstream of Girijapur Barrage in Uttar Pradesh near Amritpur village.

Mahakali Basin has a high potential for hydropower. Pancheswar storage project with a 315 m high dam and 5600 MW installed capacity is under study by Nepal and India. At present there are three operating hydropower projects in the basin with the total installed capacity of 46.5 MW.

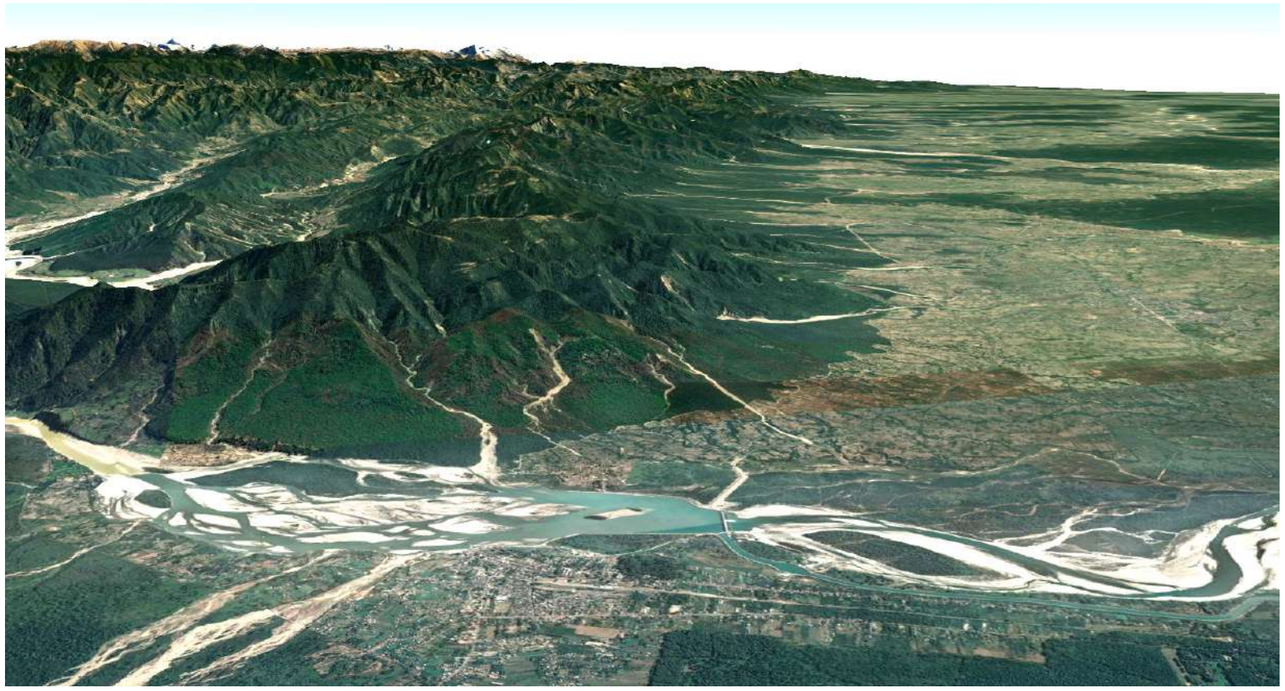


Figure 2.4: Mahakali River

Salient Features of Mahakali Basin

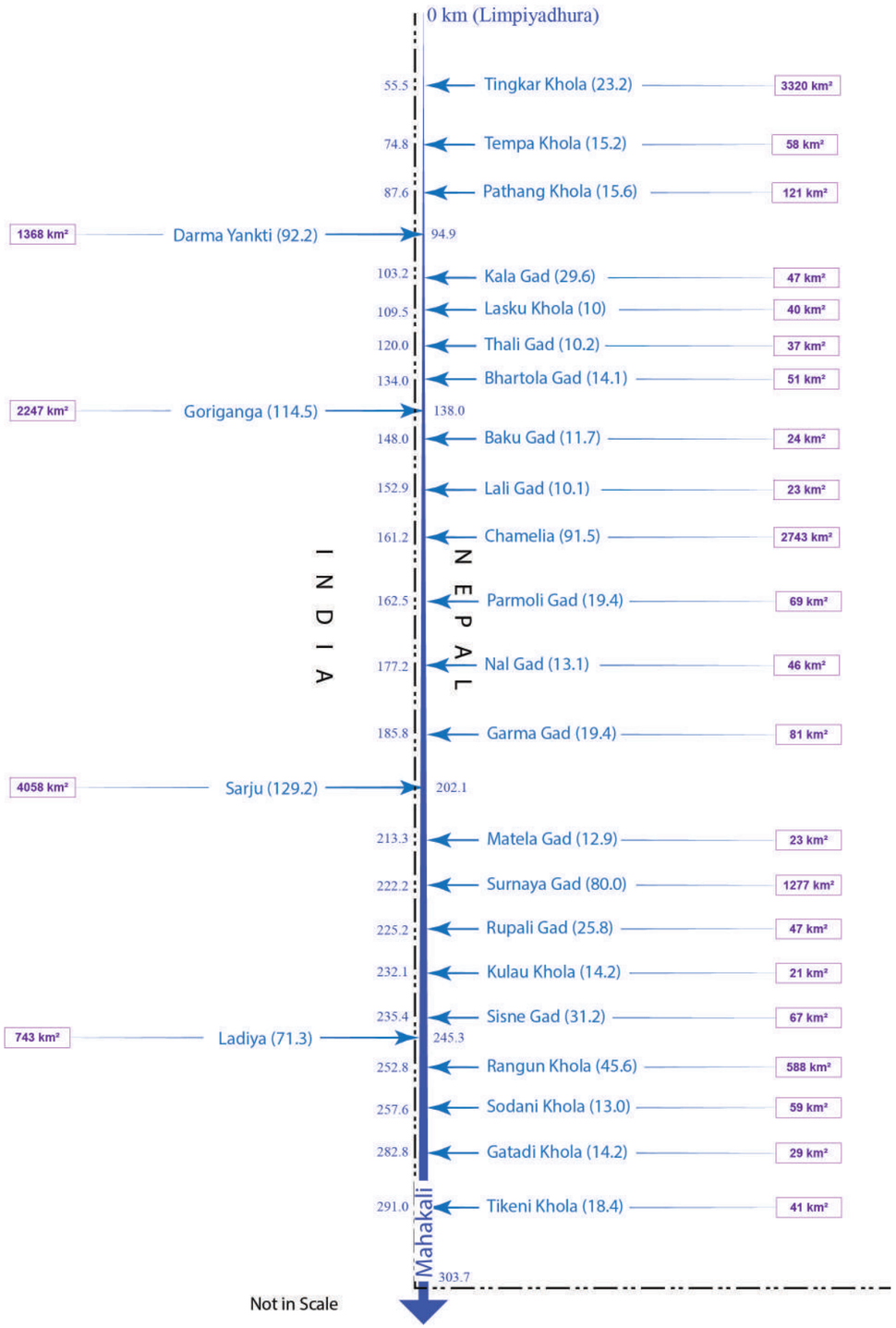
Basin location	*Latitudes: 28°48'51" to 30°28'23" N* *Longitudes: 80°03'30" to 81°06'31" E*
Catchment area	*15,769 sq.km. (Nepal and India)*
Major rivers	*Chameliya (92 km), Rangun (46 km), Surnayagad (80 km)*
River length	*351 km (up to Nepal-India border)*
Elevation	*Maximum - 7,112 m.; Minimum - 154 m.*
Hydro-meteorological stations	*6 Meteorological stations* *4 Hydrological stations*
Flood forecasting stations	*0*
Average annual rainfall	*1,925 mm*
Average river flow (Nepal - India border)	*719.8 cumec; 22,700 MCM*
Existing hydropower stations and Capacity (DOED, March 2023)	*3; 46.5 MW*
Agriculture land	*81,986 ha.*
Existing big irrigation systems	*1*
Total irrigated area in basin (as per inventory of IMP, 2019)	*3,178 ha. (2025)* *22,391 ha. (2050)*
Total population (extimated from Population Census, 2021)	*562,928*
Forest land	*282,900 ha.*
Total water demand (for 2025)	*Irrigation demand: 762 MCM* *Domestic demand: 38 MLD*
Administrative units	*Pradesh: Sudurpashchim* *Districts: 5* *Local Bodies:* *(17 Gaupalika; 10 Nagarpalika)*

Administrative Division of Mahakali Basin

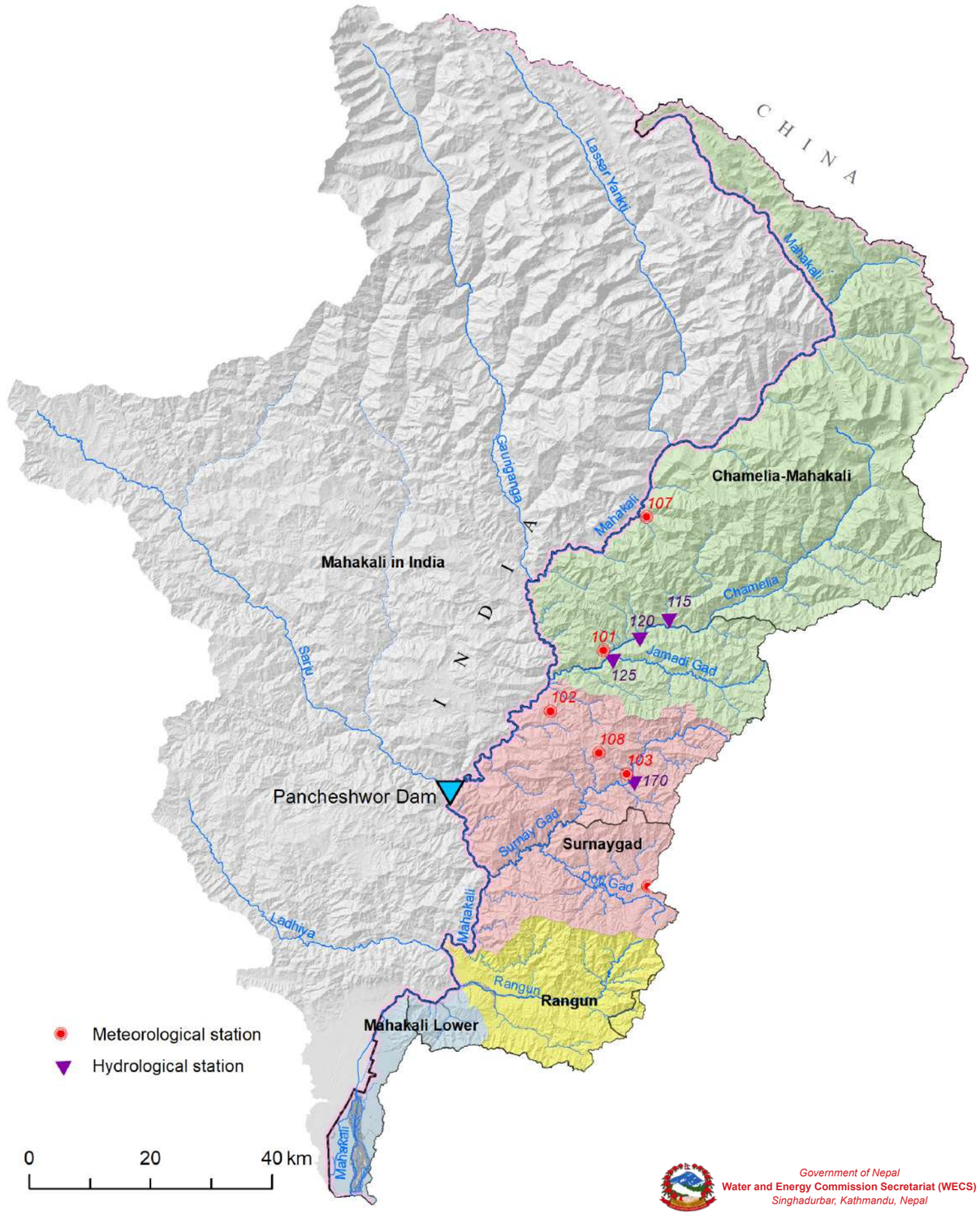
Table 2.4 List of Local Bodies in Mahakali Basin

SN	Province	District	Name of Local Body	% of Area
1	Sudur Pashchim	Doti	Jorayal GP	5
2		Kanchanpur	Bhimdatta NP	57
3			Dodhara Chandani NP	100
4		Dadeldhura	Ajaymeru GP	100
5			Alital GP	88
6			Amargadhi NP	75
7			Bhageshwar GP	100
8			Ganayapdhura GP	2
9			Parashuram NP	100
10		Baitadi	Dasharathchanda NP	100
11			Dilasaini GP	100
12			Dogadakedar GP	100
13			Melauli NP	100
14			Pancheshwar GP	100
15			Patan NP	79
16			Purchaudi NP	100
17			Shivanath GP	100
18			Surnaya GP	100
19		Darchula	Apihimal GP	100
20			Byas GP	100
21			Dunhu GP	100
22			Lekam GP	100
23			Mahakali NP	100
24			Malikaarjun GP	100
25			Marma GP	100
26			Naugad GP	100
27			Shailyashikhar NP	100
28		Bajhang	Bithadchir GP	1

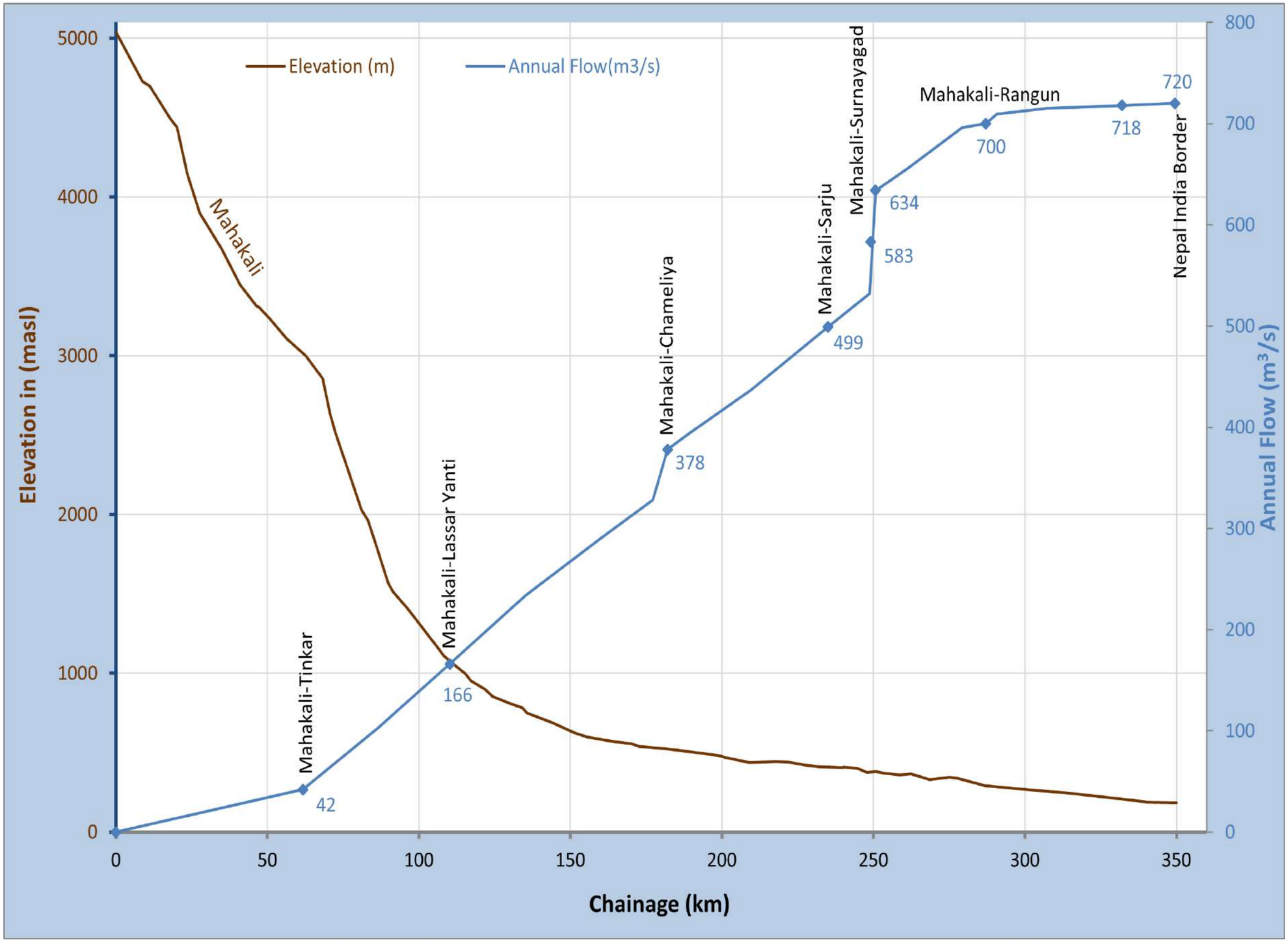
River Flow Line Diagram of Mahakali River



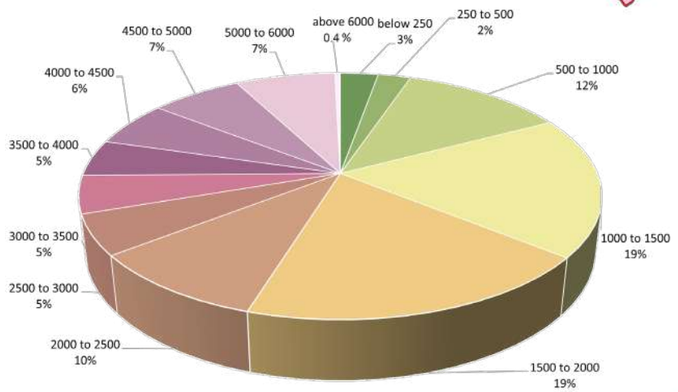
River System

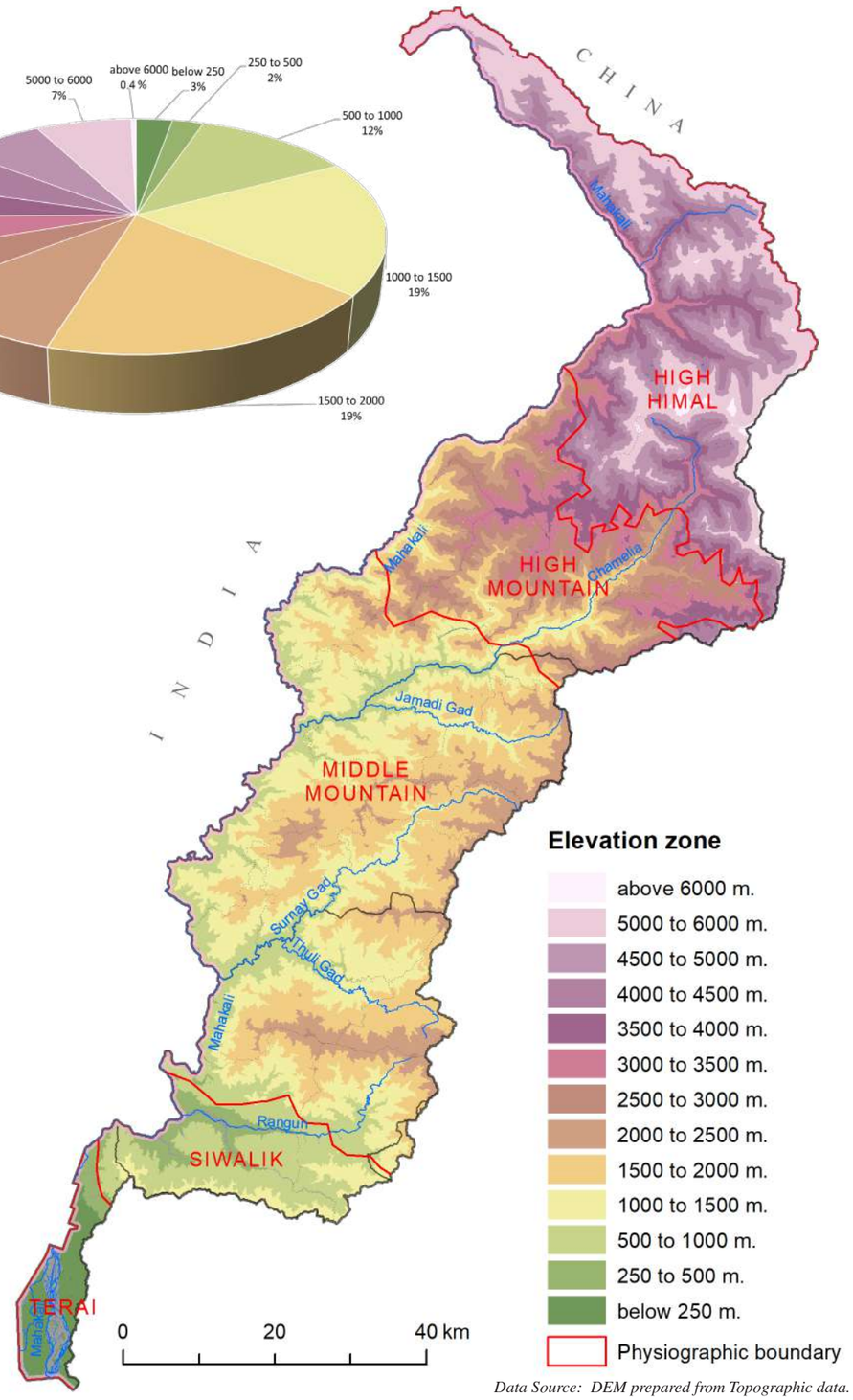


River Profile and Annual Flow



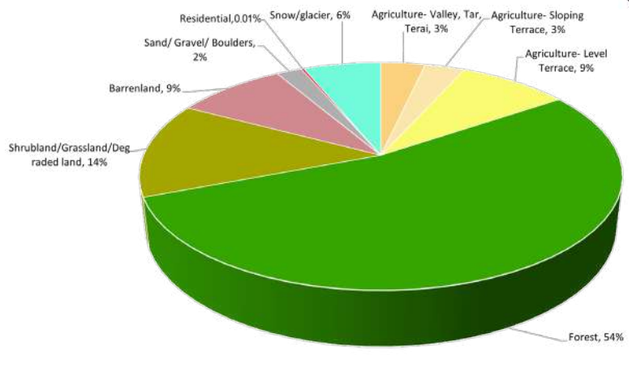
Elevation Zone

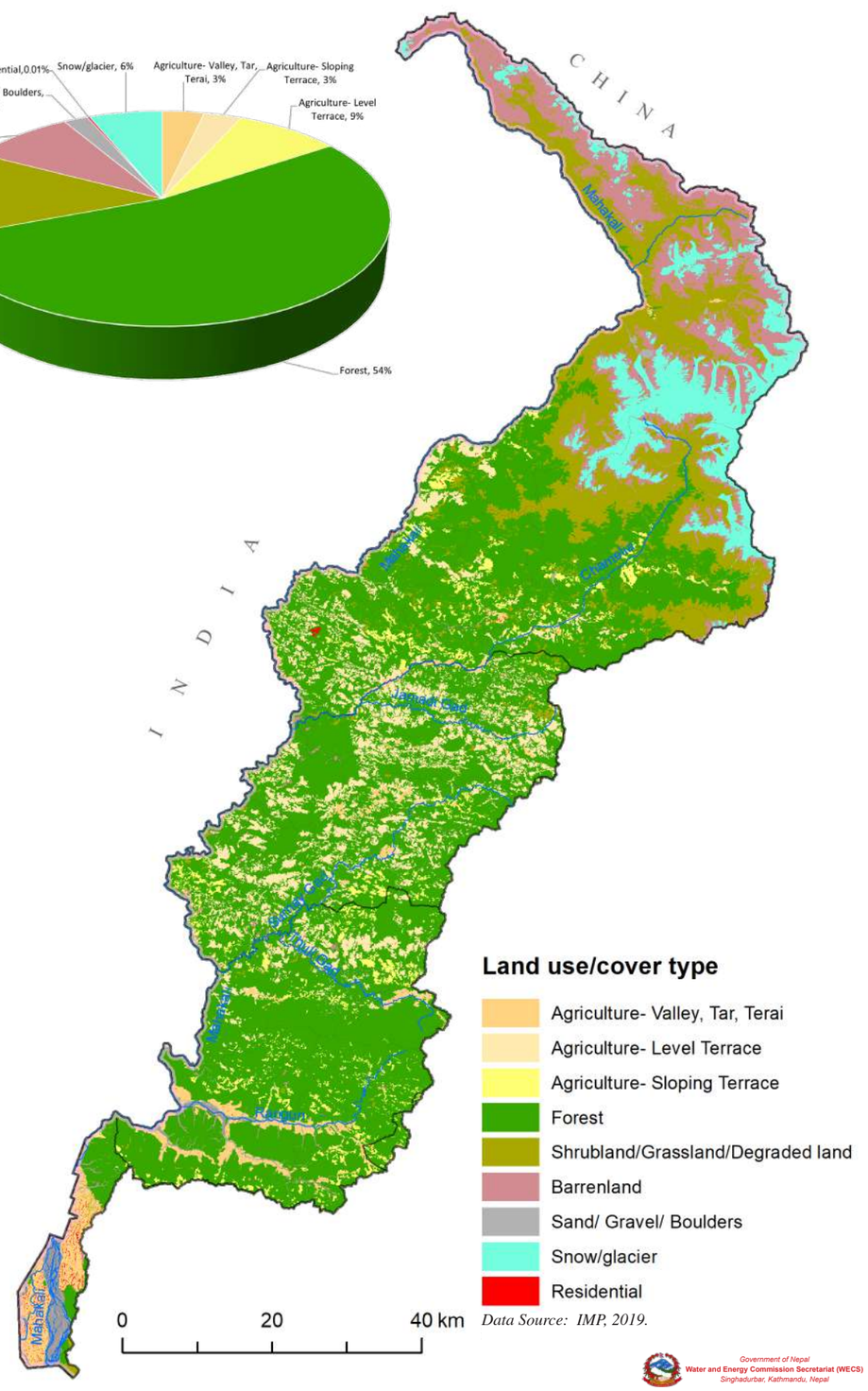




Data Source: DEM prepared from Topographic data.

Land Use/Cover





Data Source: IMP, 2019.

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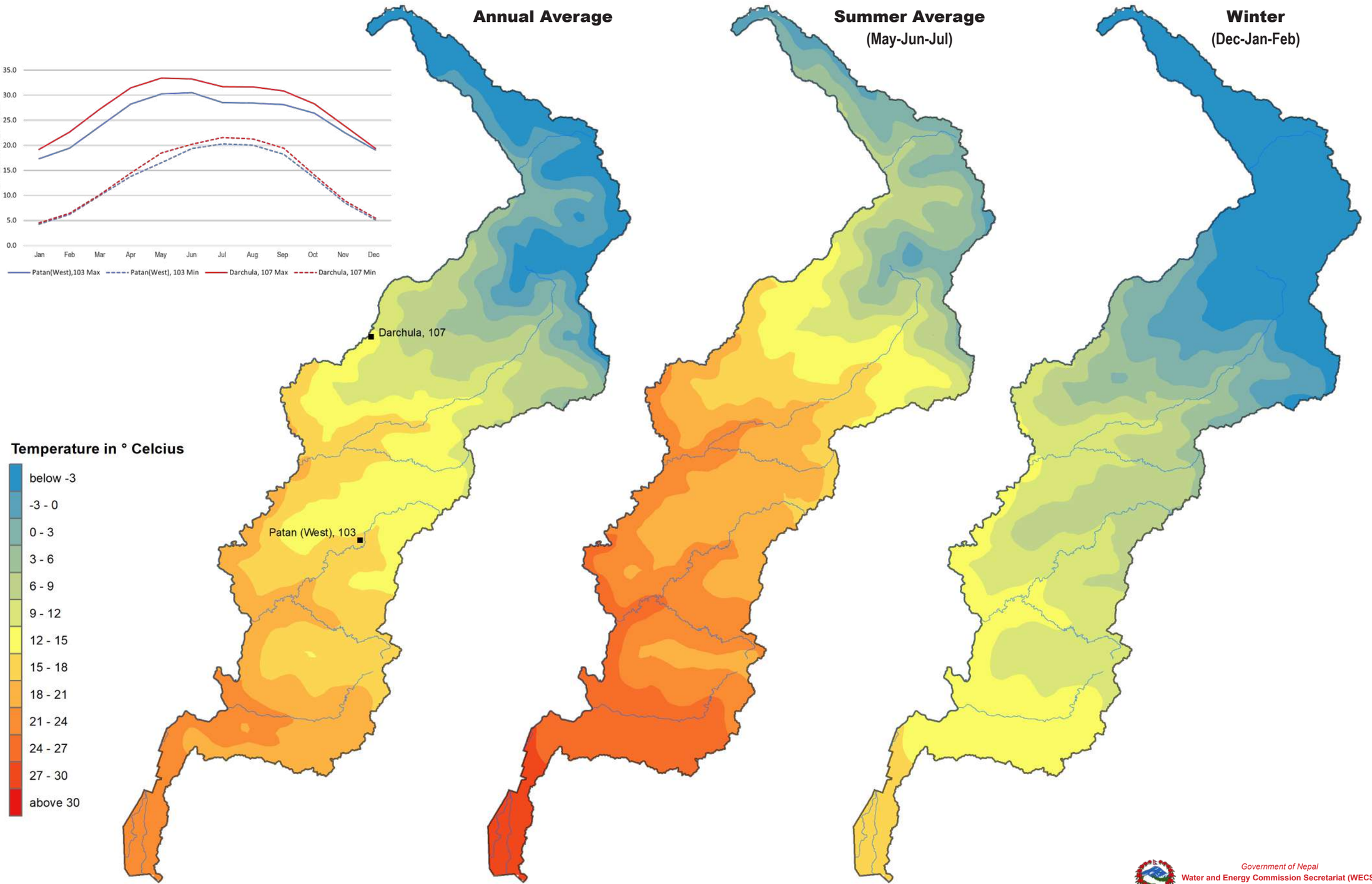
Average Temperature Distribution



Data Source: Surface generated from DHM Temperature Data - 1985-2015.

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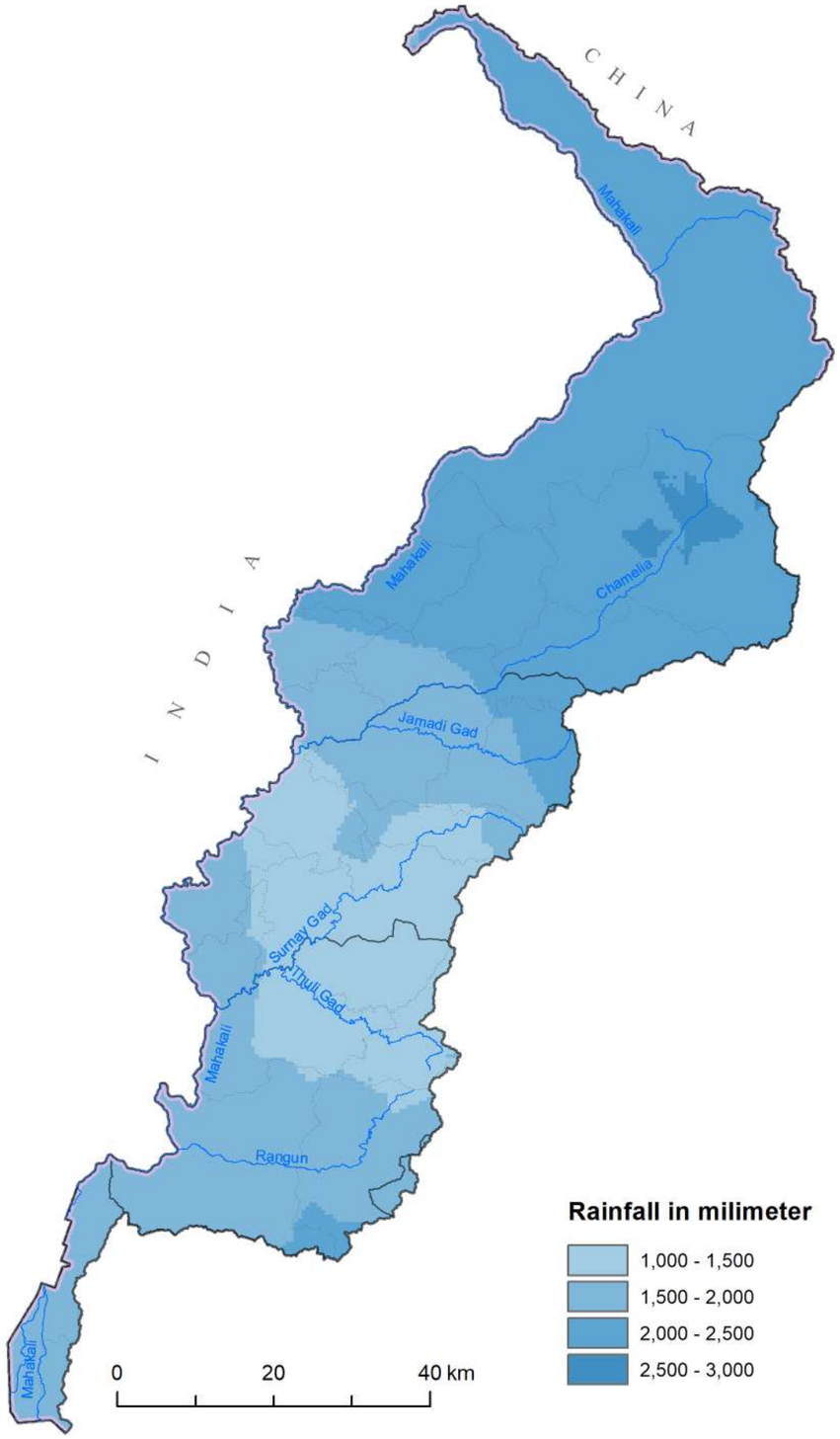
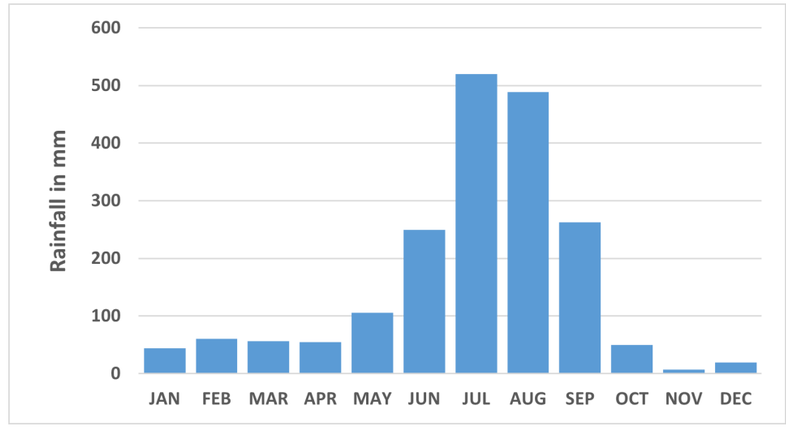
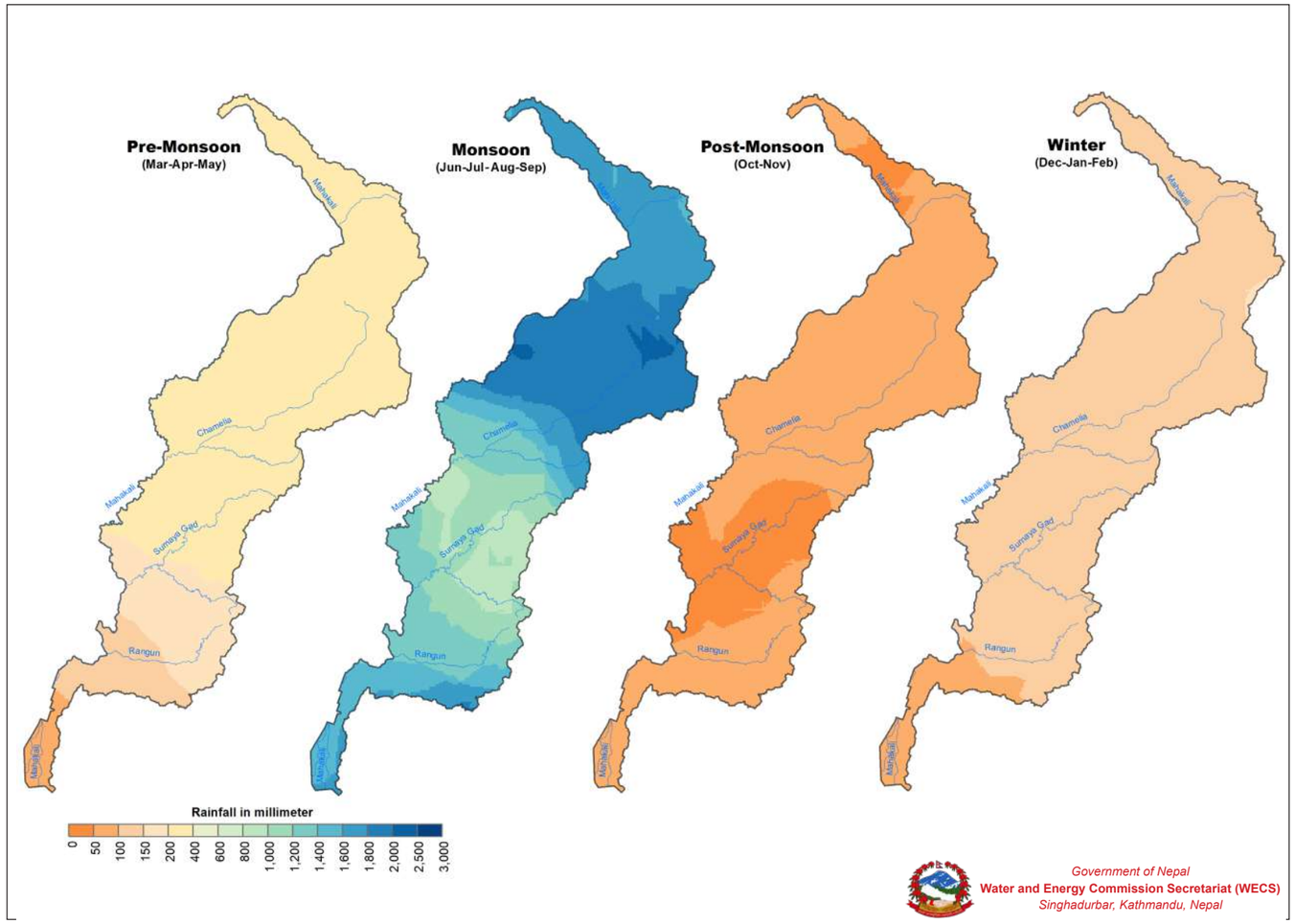
Annual Average Rainfall Distribution



Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.





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Irrigation Projects

Data Source: IMP, 2019.

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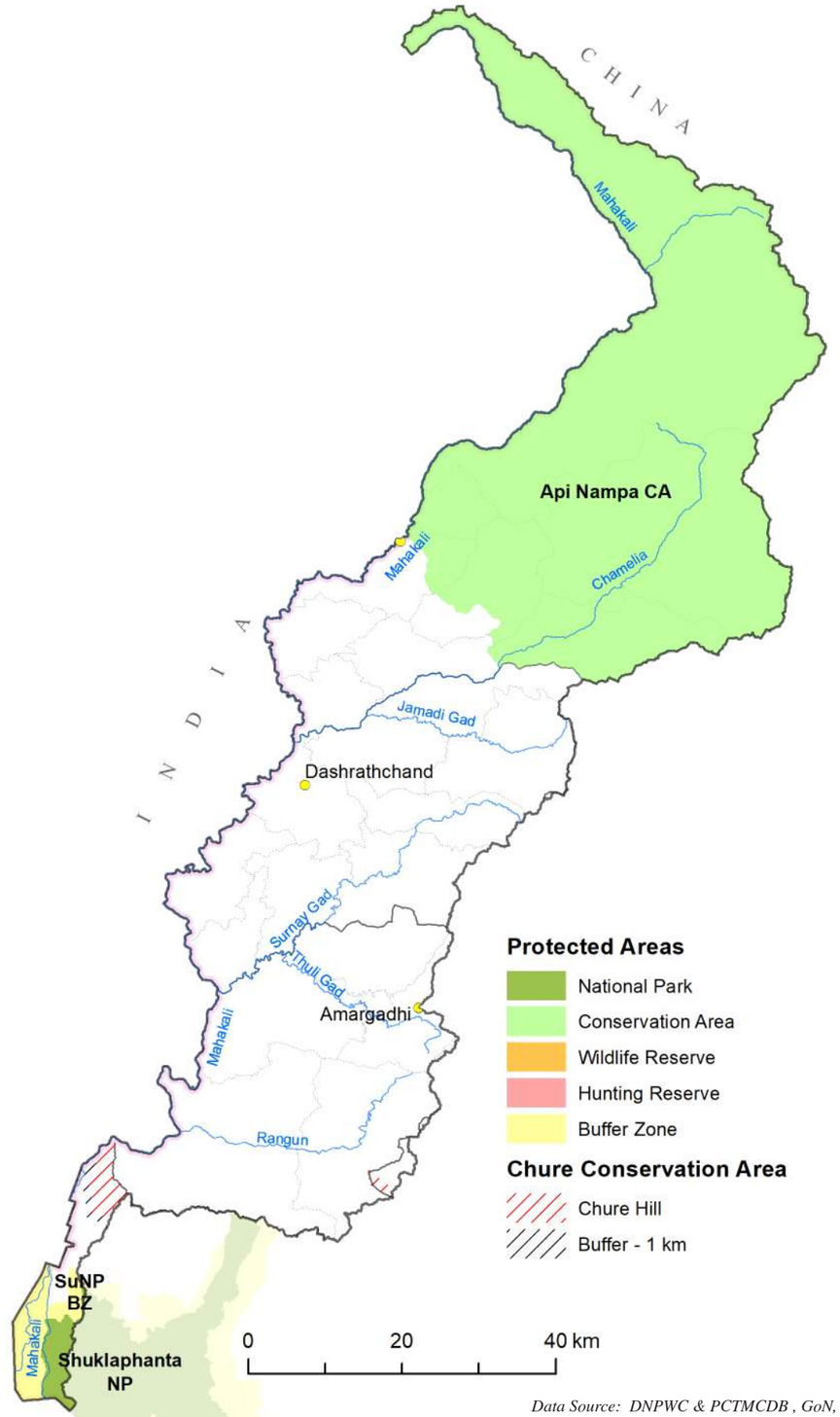
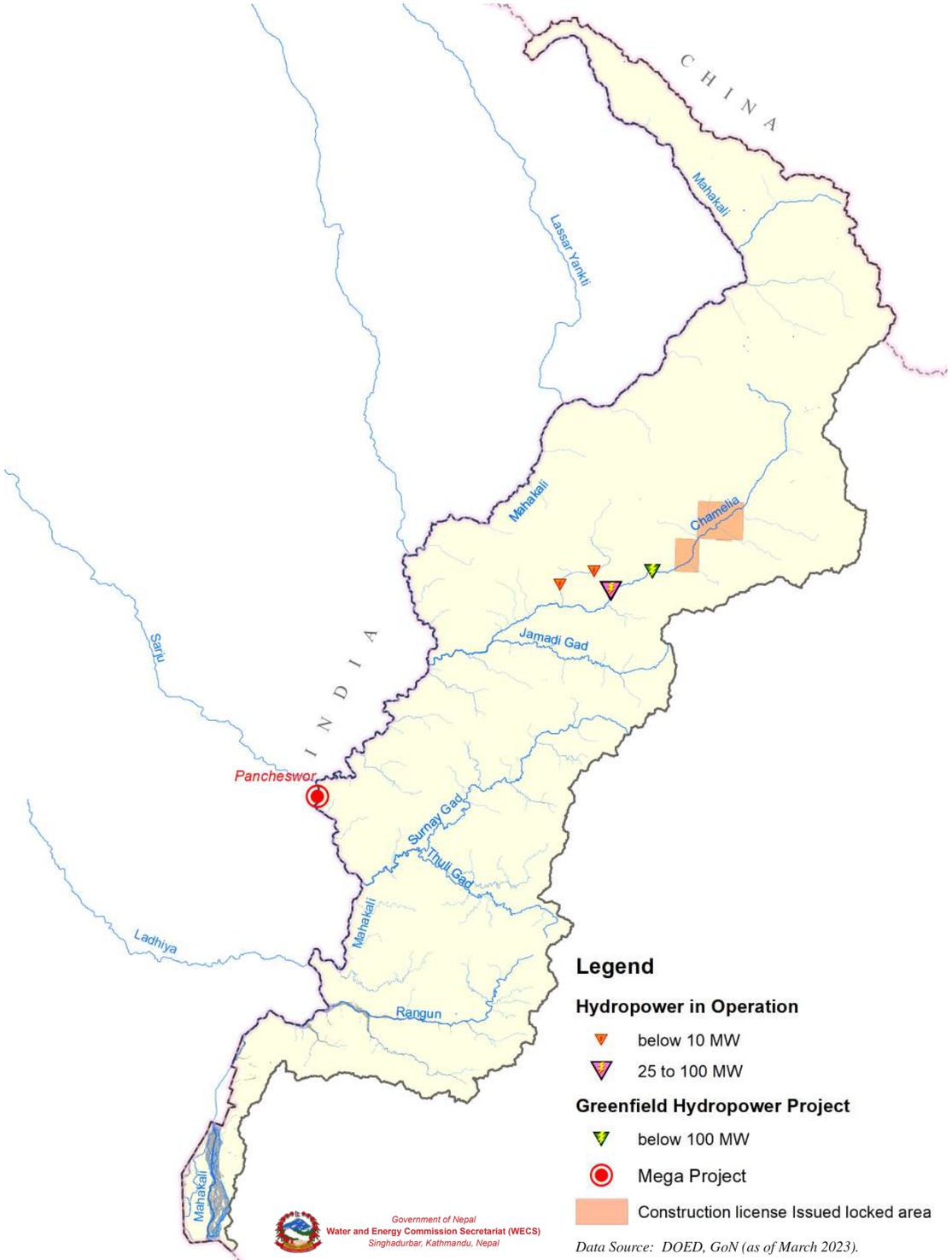
Protected Areas



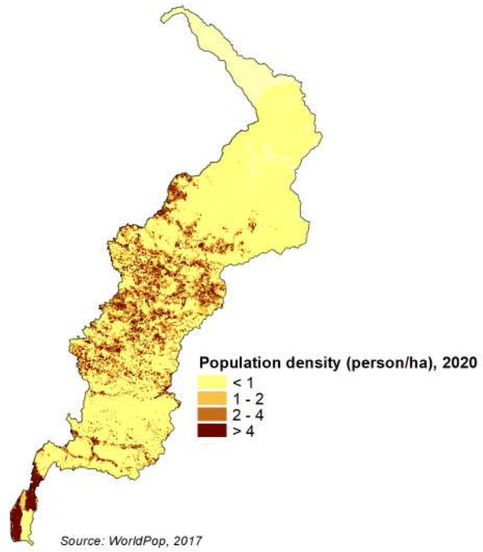
Data Source: DNPWC & PCTMCDB , GoN, 2022

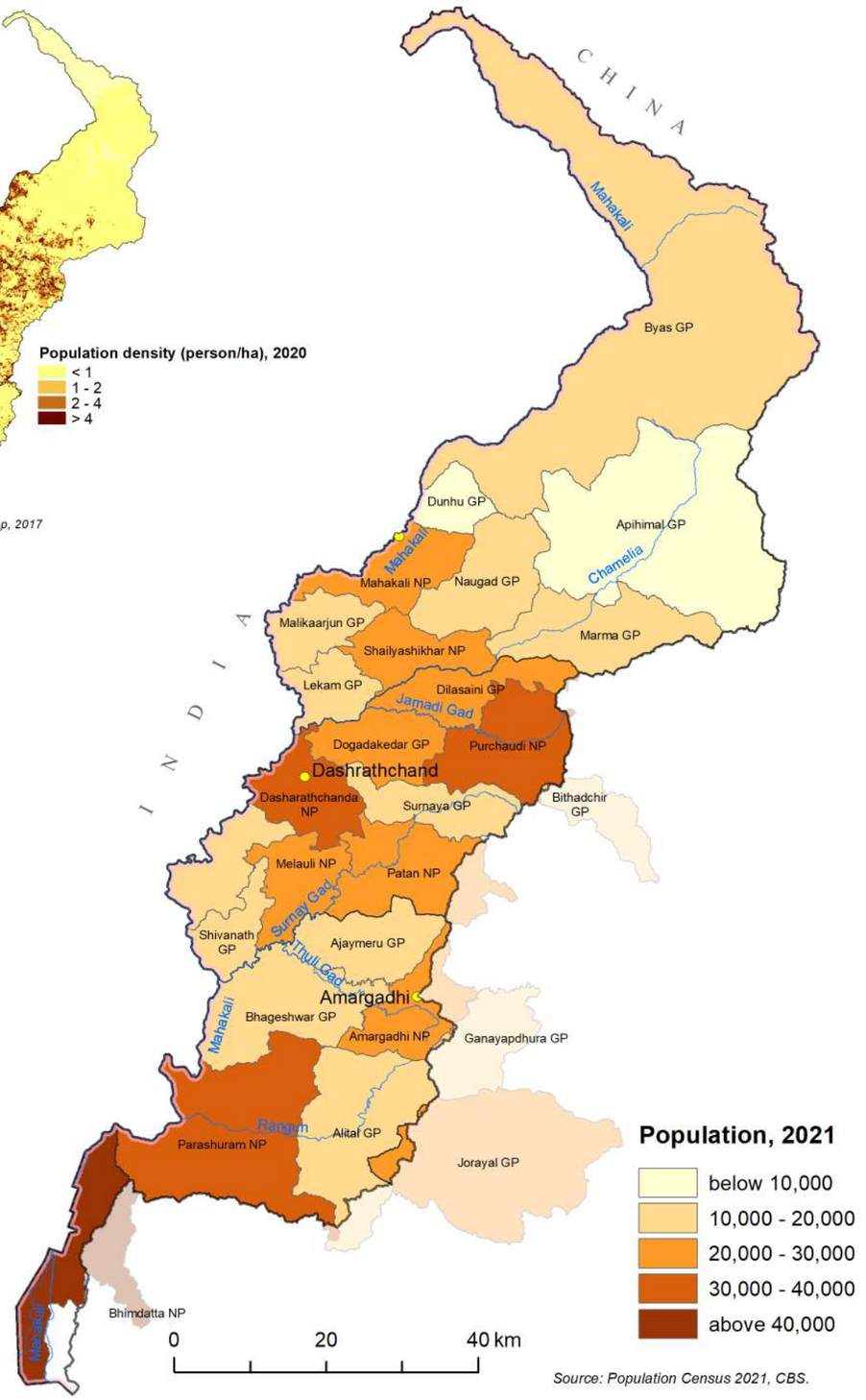
Hydropower Projects



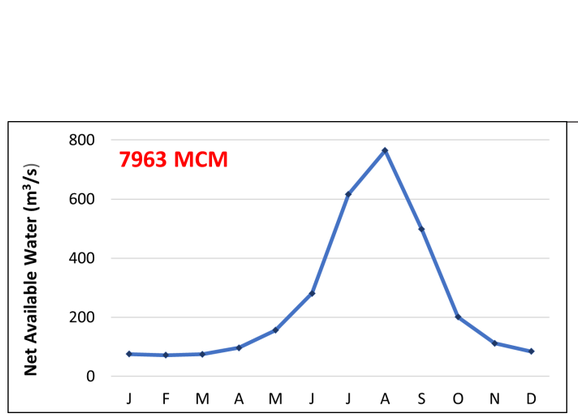
Data Source: DOED, GoN (as of March 2023).

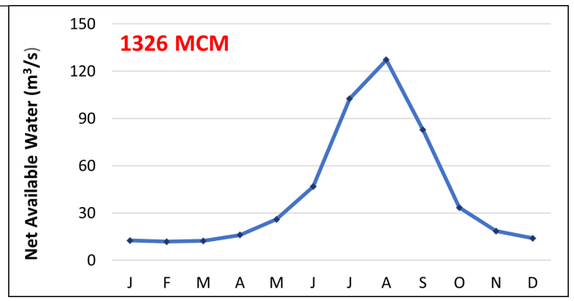
Population Distribution and Density

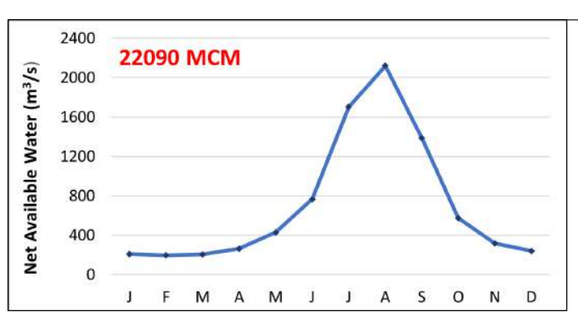


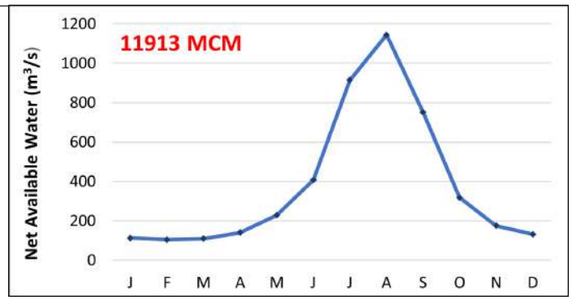


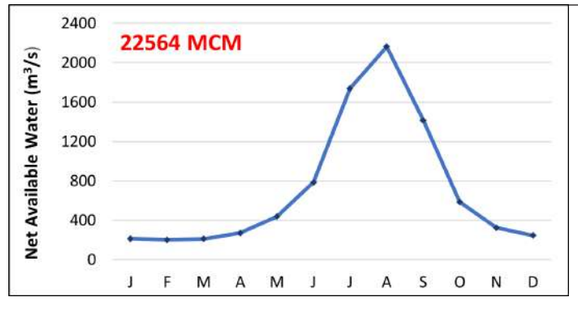
Hydrographs at Major River Nodes

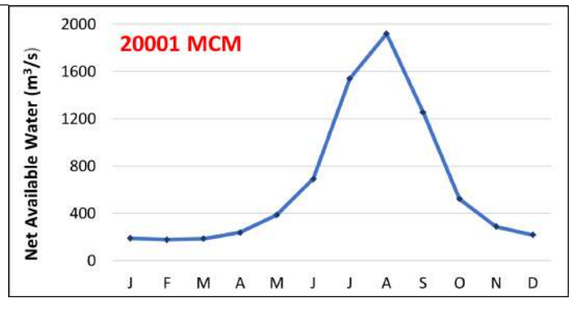


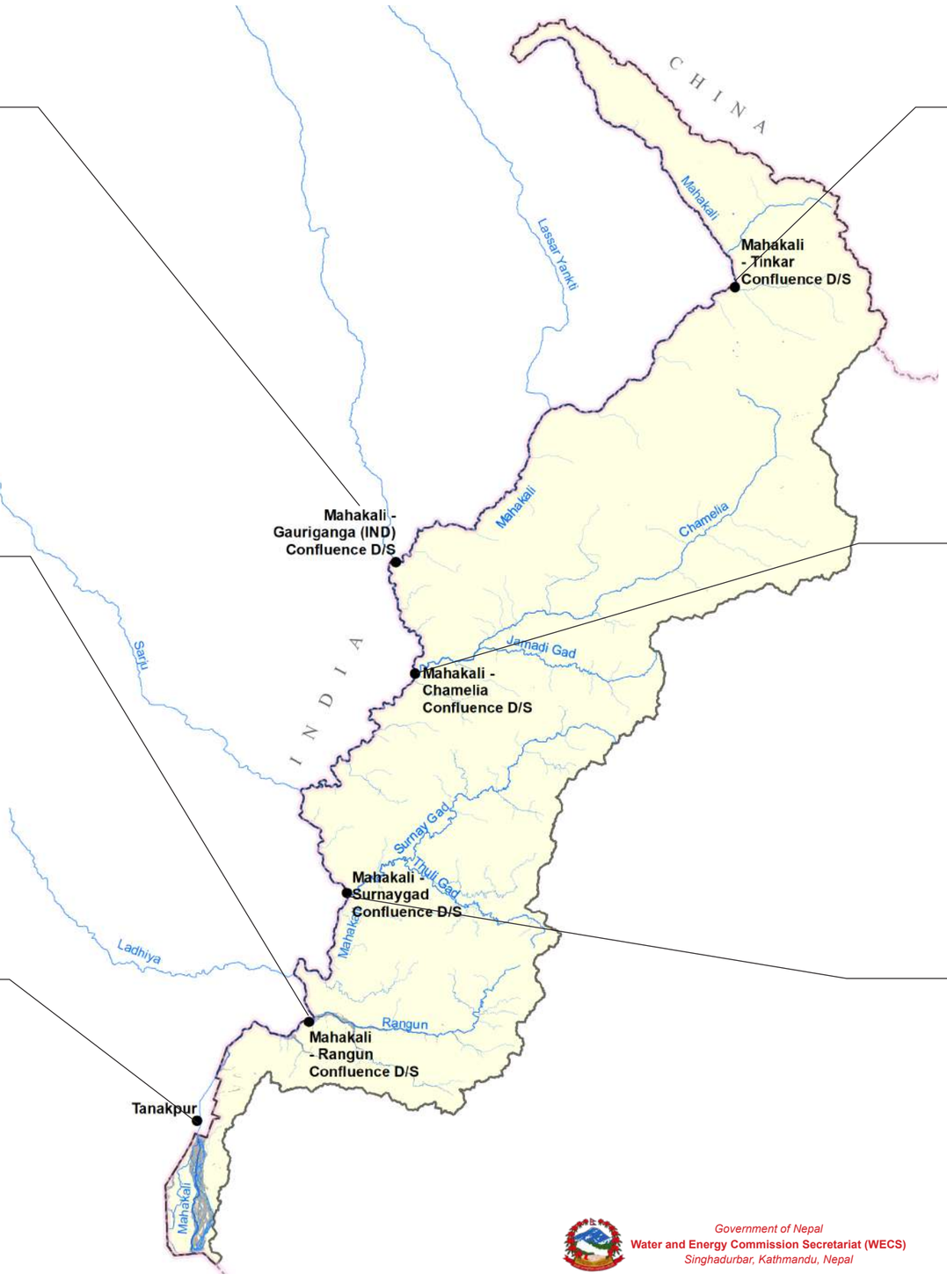












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5. Babai Basin

Babai Basin

The Babai River Basin is situated in Karnali Province and Lumbini Province in western Nepal. The basin extends from 81° 13' 57" to 82° 26' 08" East longitudes and 27° 56' 39" to 28° 33' 15" North latitudes in Nepal. The basin has an area of 3,579 km² in Nepal draining parts of Rolpa, Salyan, Dang and Bardiya districts. The Babai River originates from the Mahabharat range and flows westwards in the inner Terai Valley of Dang formed between the Mahabharat range and the Siwaliks.

The Babai River flows along west-northwest axis of the valley through Dang and Salyan district. The Sharada Khola, meets Babai at Bardiya, draining the southern slopes of the Mahabharat region of Salyan and parts of Rolpa district. The combined river then flows westwards and then makes a left turn in Bardiya itself cutting across the Siwalik and emerging into the Terai. The major tributaries of Babai River are Katuwa khola, Jangawa Khola, Guhar Khola, Patu Khola, Sharada Khola in the hill region and Bhada Khola in the Terai.

The Babai River flows southwards after it enters the Terai, flowing through Bardiya and exiting the Nepal-India Border before merging into Ghagra River (Karnali in Nepal) in further south in Uttar Pradesh, India. The elevation of the river basin in Nepal ranges from 132 meter to 2816 meter and is a rain-fed river basin.

The average annual rainfall of Babai Basin is 1,514 mm. The average annual flow of the basin is estimated to be 79.9 m³/s at Nepal-India border.

The existing irrigation systems cover an area of 61,662 ha (2025), for which round the year irrigation demand cannot be met. Therefore, the Bheri-Babai interbasin diversion project is being implemented to provide adequate supply to meet the irrigation demand of the Babai Irrigation System.

Figure 2.5: Babai River flows down to Terai plain land

Salient Features of Babai Basin

Basin location	*Latitudes: 27°56'39" to 28°33'15" N* *Longitudes: 81°13'57" to 82°36'08" E*
Catchment area	*3,579 sq.km.*
Major rivers	*Sharada (110 km), Guhar (25 km)*
River length	*241 km (up to Nepal-India border)*
Elevation	*Maximum - 2,809 m.* *Minimum - 132 m.*
Hydro-meteorological stations	*10 Meteorological stations* *3 Hydrological stations*
Flood forecasting stations	*2*
Average annual rainfall	*1,514 mm*
Average river flow (Nepal - India border)	*79.9 cumec;* *2,520 MCM (annual)*
Existing hydropower stations and Capacity (DOED, March 2023)	*0*
Agriculture land	*123,945 ha.*
Existing big irrigation systems	*1*
Total irrigated area in basin (as per inventory of IMP, 2019)	*61,662 ha. (2025)* *67,686 ha. (2050)*
Total population (extimated from Population Census, 2021)	*791,543*
Forest land	*203,500 ha.*
Total water demand (for 2025)	*Irrigation demand: 1,616 MCM* *Domestic demand: 77 MLD*
Administrative units	*Pradesh: Karnali, and Lumbini* *Districts: 4* *Local Bodies:* *(11 Gaupalika; 8 Nagarpalika, 2 Upa-mahanagarpalika)*

Administrative Division of Babai Basin

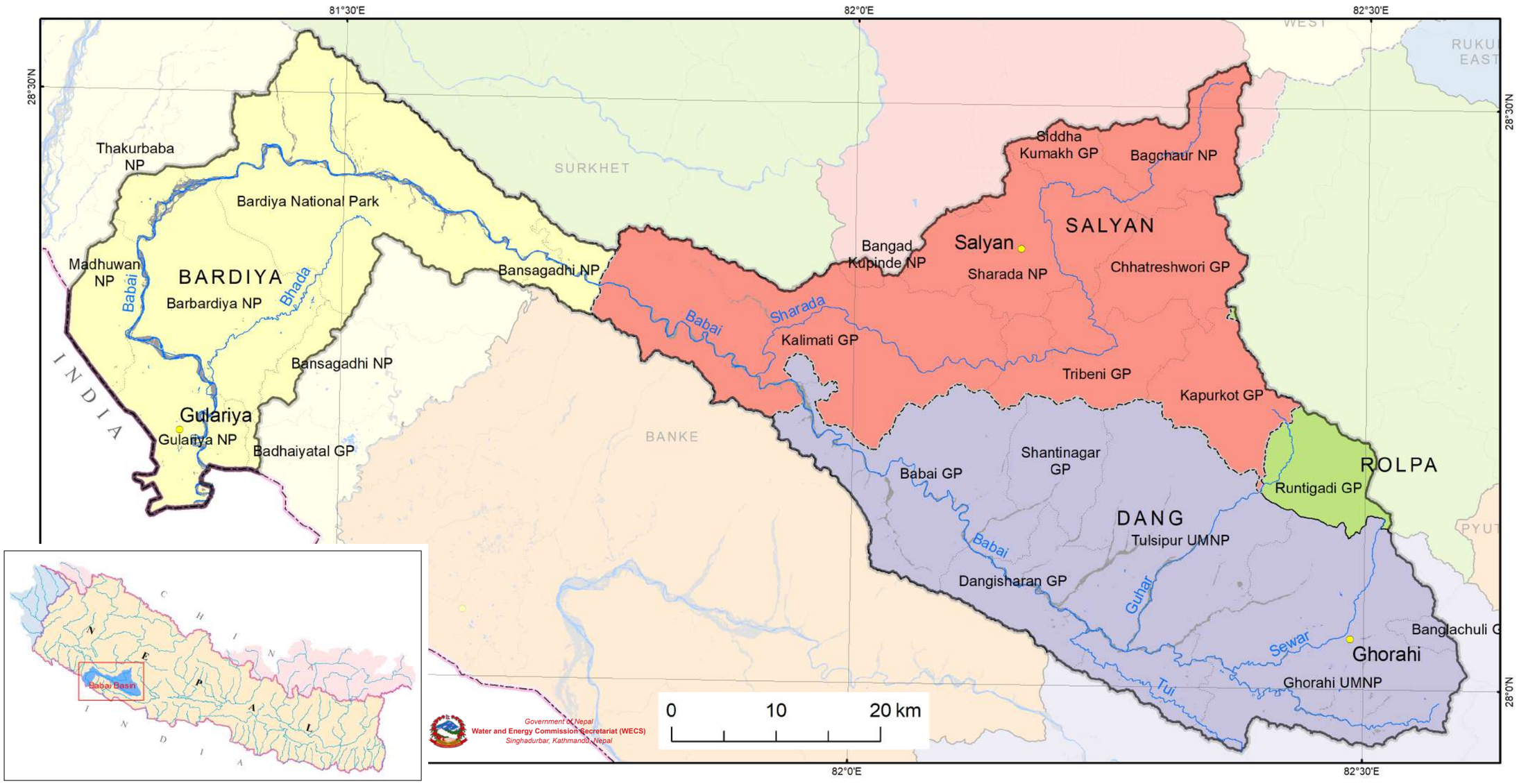


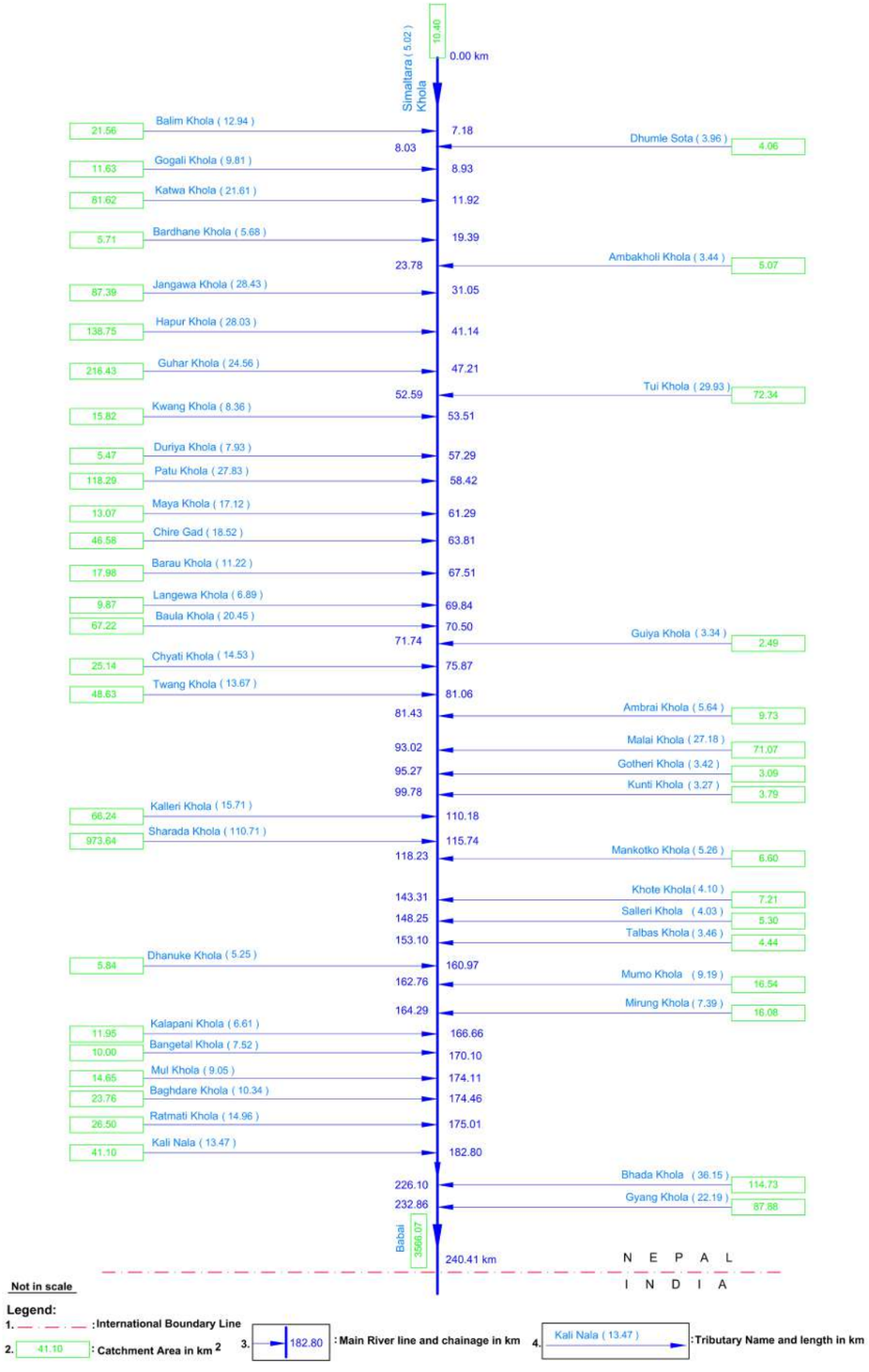
Table 2.5 List of Local Bodies in Babai Basin

SN	Province	District	Name of Local Body	% of Area
1	Lumbini	Rolpa	Runtigadi GP	41
2			Tribeni GP	1
3		Dang	Babai GP	100
4			Banglachuli GP	6
5			Dangisharan GP	100
6			Ghorahi UMNP	75
7			Shantinagar GP	100
8			Tulsipur UMNP	100

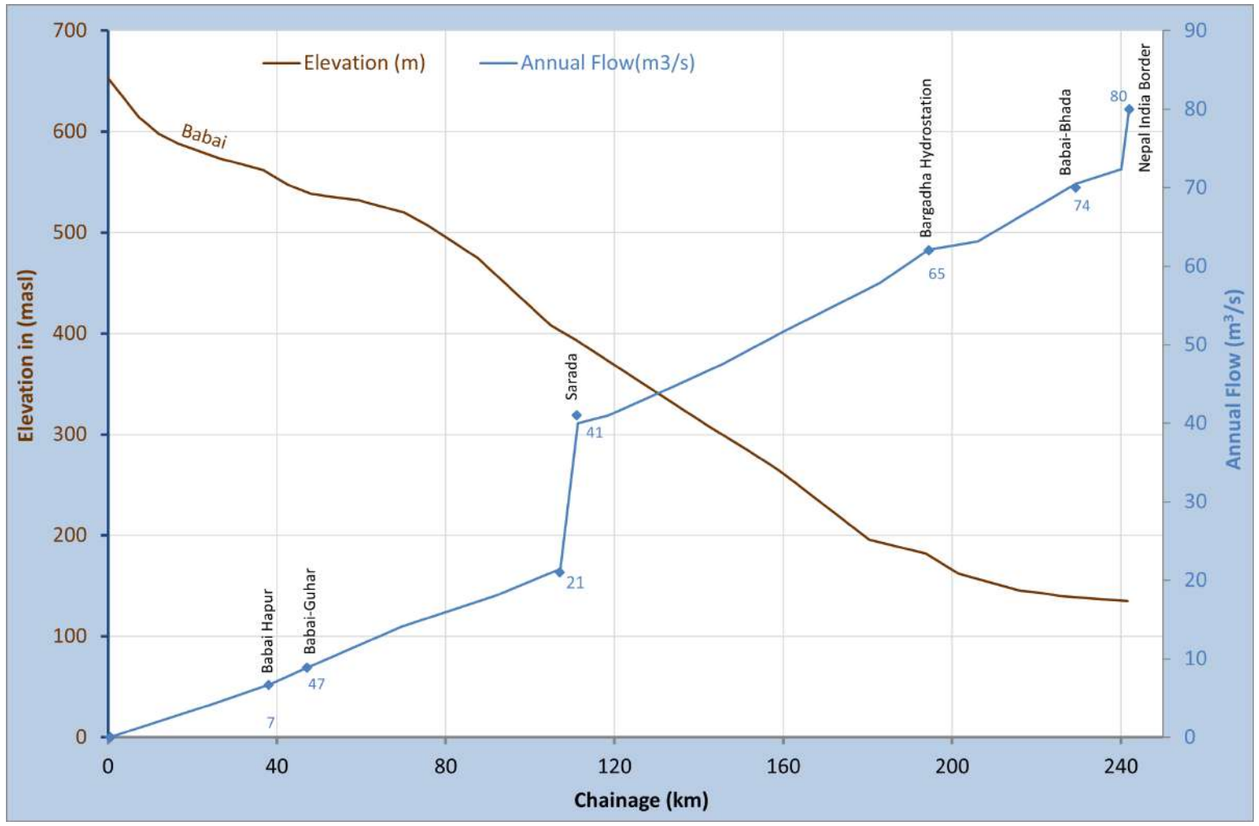
SN	Province	District	Name of Local Body	% of Area
9	Lumbini	Bardiya	Badhaiyatal GP	8
10			Bansagadhi NP	33
11			Barbardiya NP	100
12			Gulariya NP	100
13			Madhuwan NP	62
14			Thakurbaba NP	29
15	Karnali	Salyan	Bagchaur NP	71
16			Bangad Kupinde NP	4

SN	Province	District	Name of Local Body	% of Area
17	Karnali	Salyan	Chhatreshwori GP	100
18			Siddha Kumakh GP	55
19			Kalimati GP	100
20			Kapurkot GP	100
21			Sharada NP	98
22			Tribeni GP	100

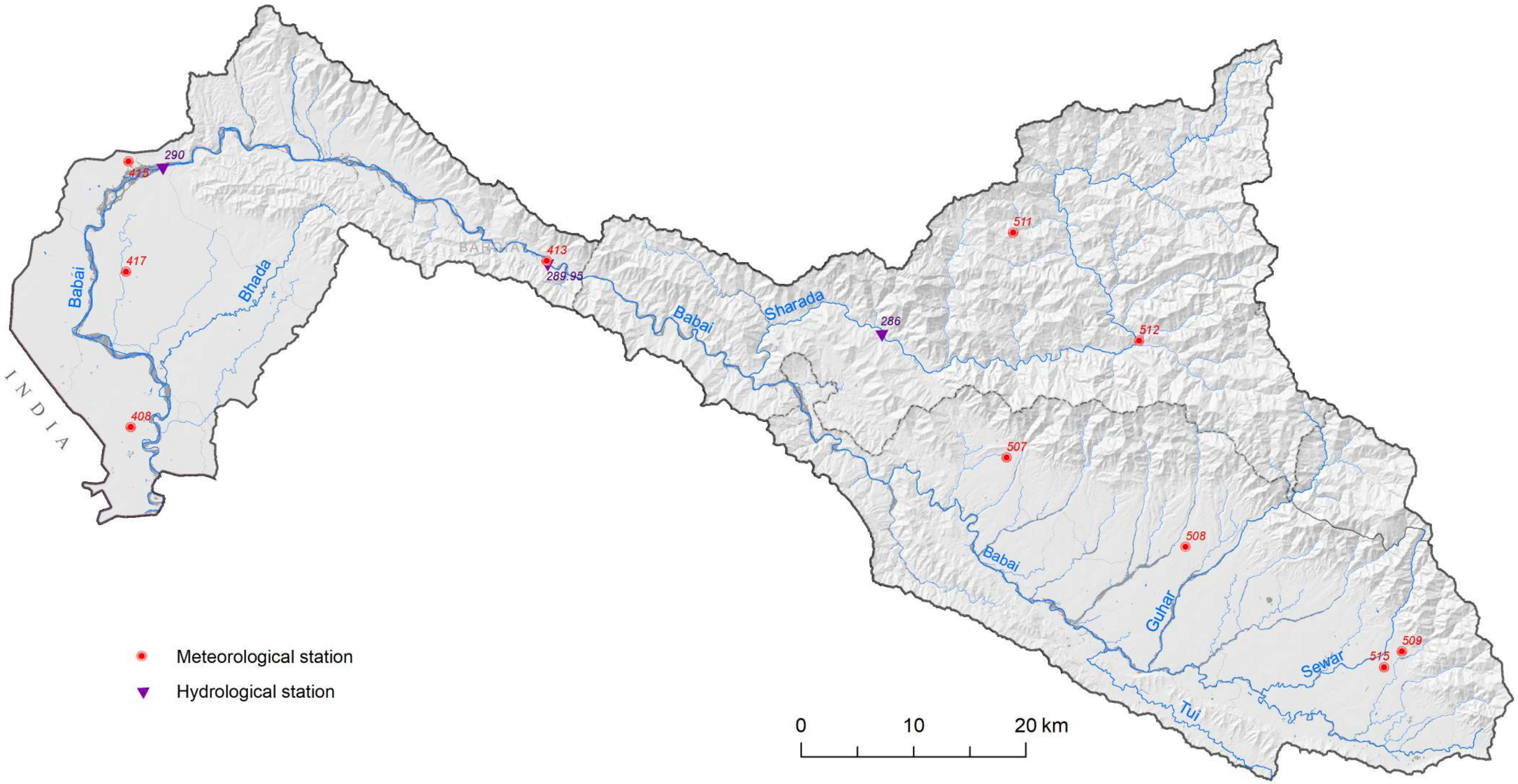
River Flow Line Diagram of Babai River



River Profile and Annual Flow



River System



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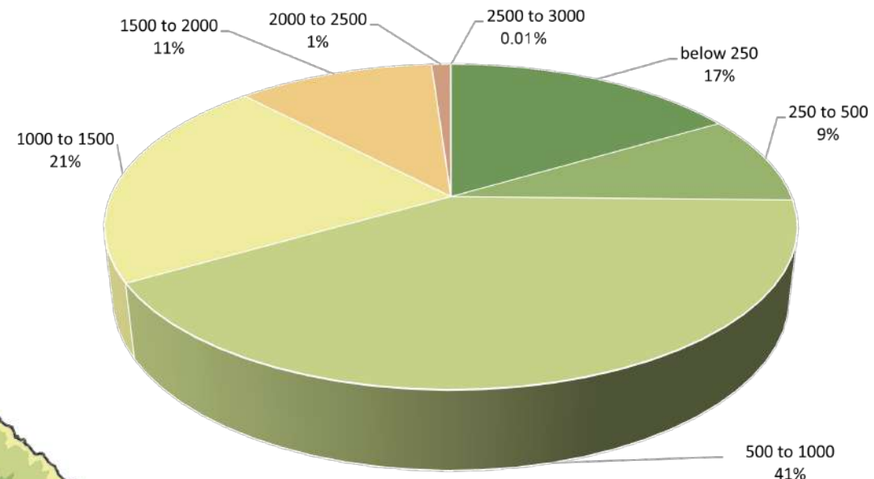
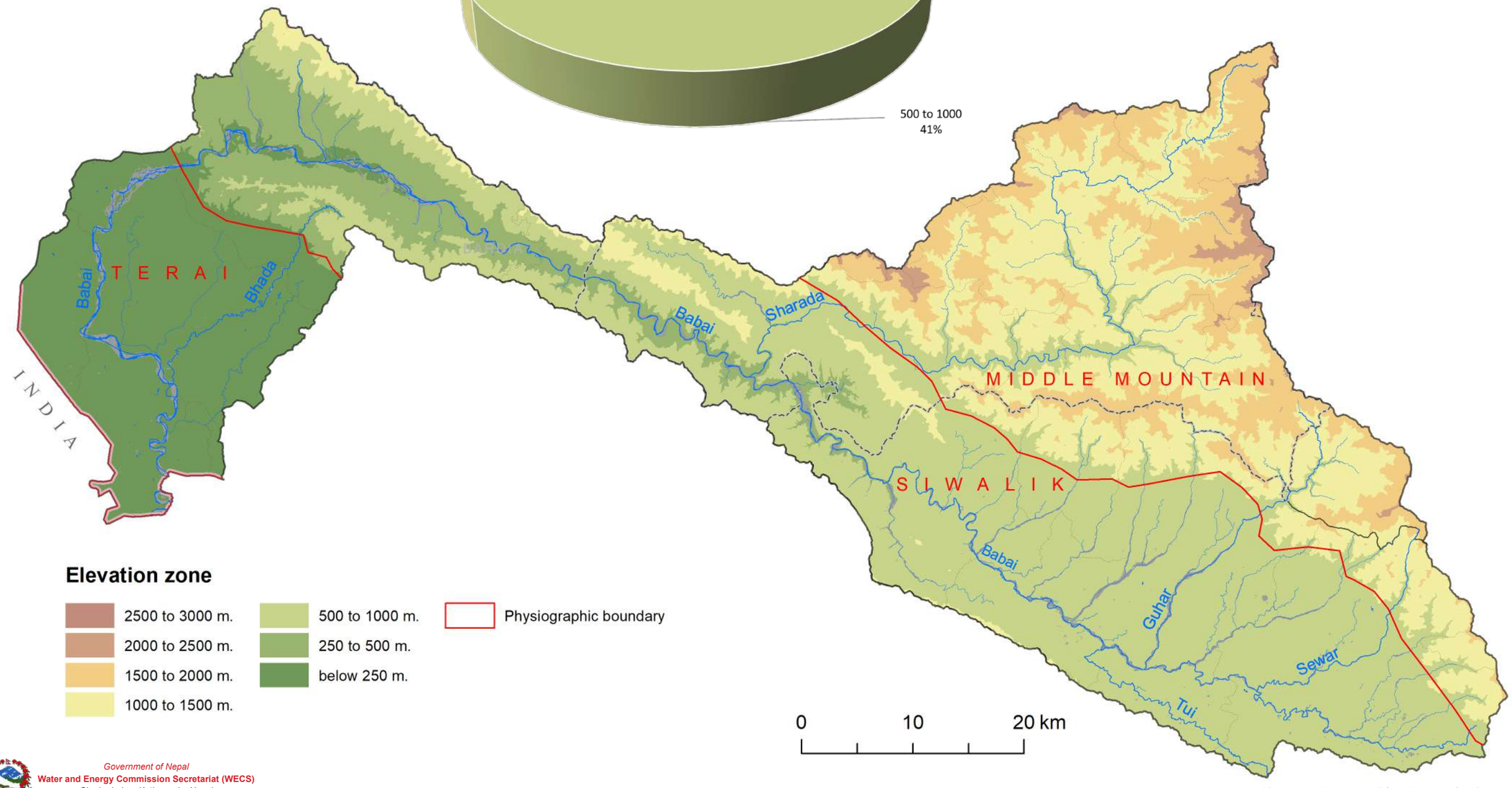
Elevation Zone





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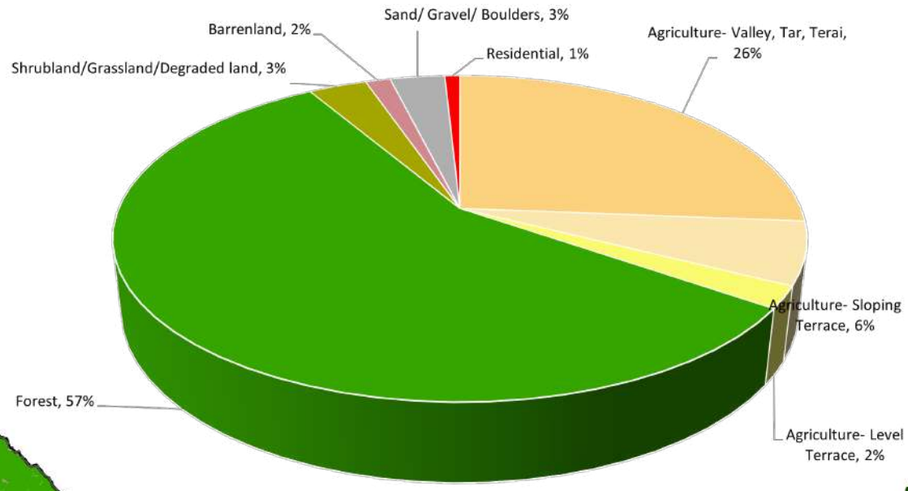
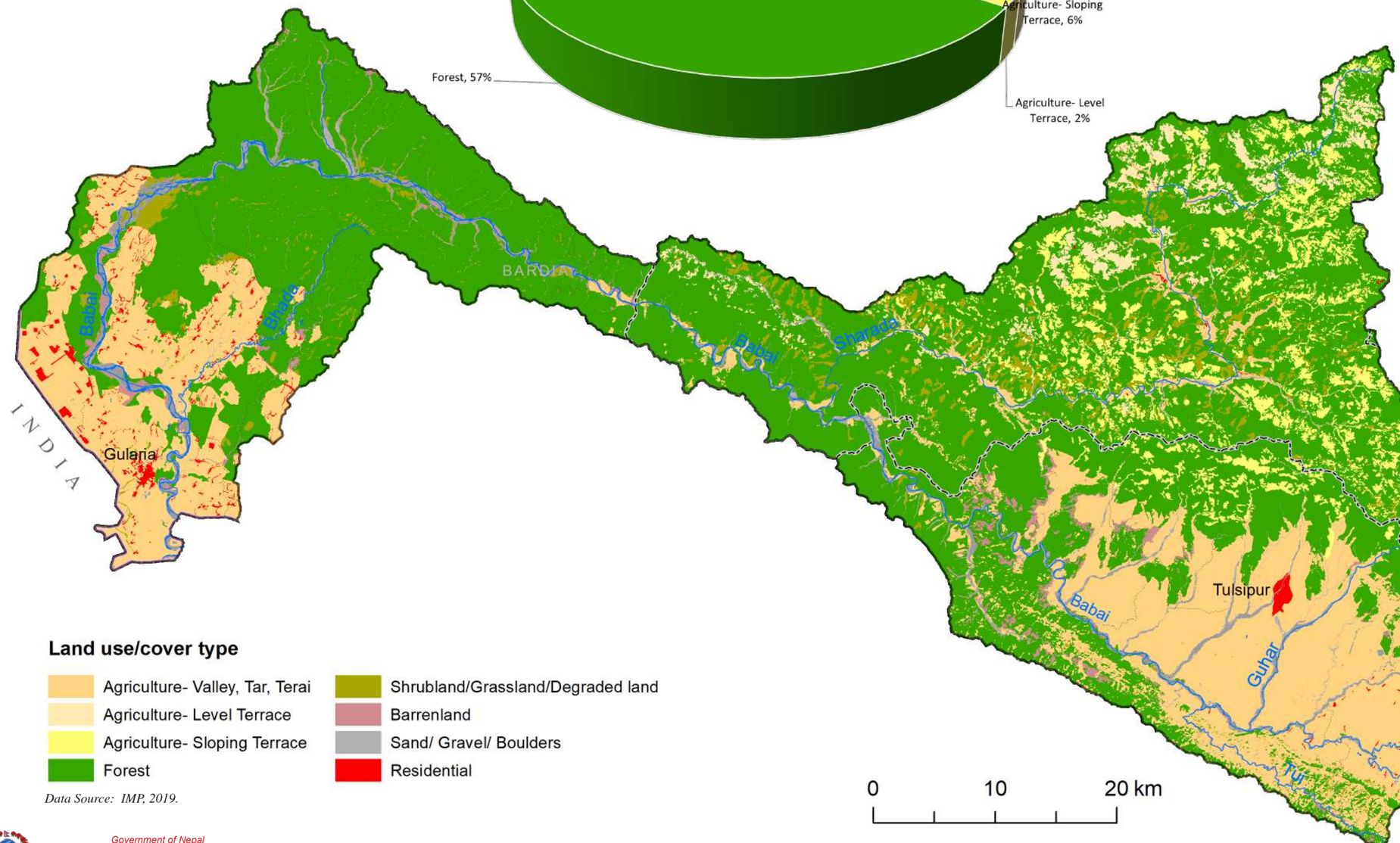
Data Source: DEM prepared from Topographic data.

Land Use/Cover





Land use/cover type

- Agriculture- Valley, Tar, Terai
- Agriculture- Level Terrace
- Agriculture- Sloping Terrace
- Forest
- Shrubland/Grassland/Degraded land
- Barrenland
- Sand/ Gravel/ Boulders
- Residential

Data Source: IMP, 2019.

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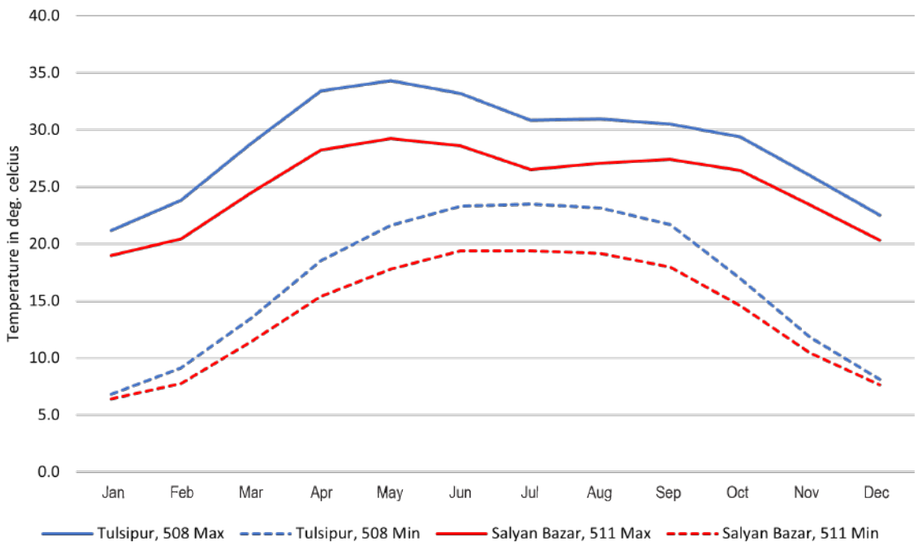
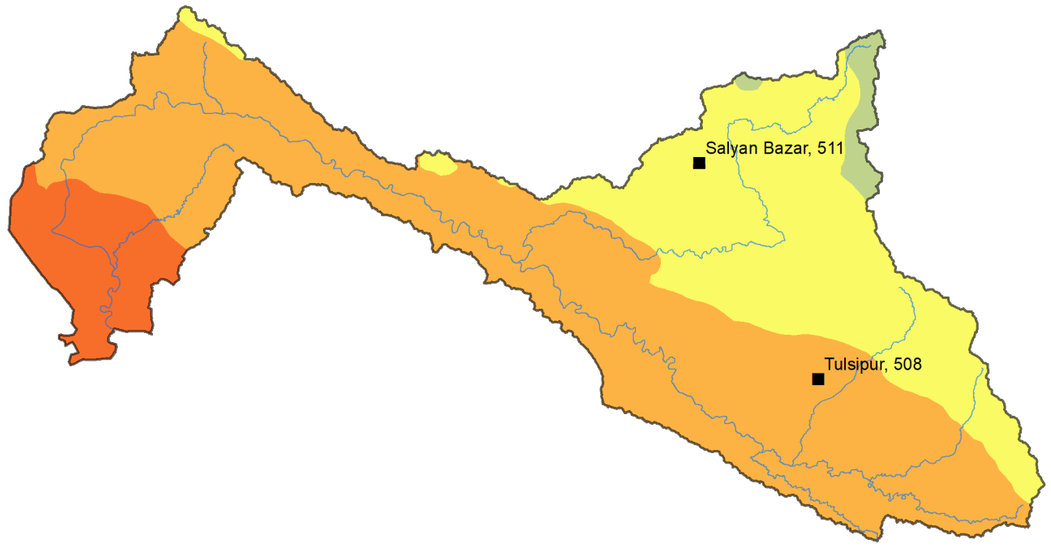
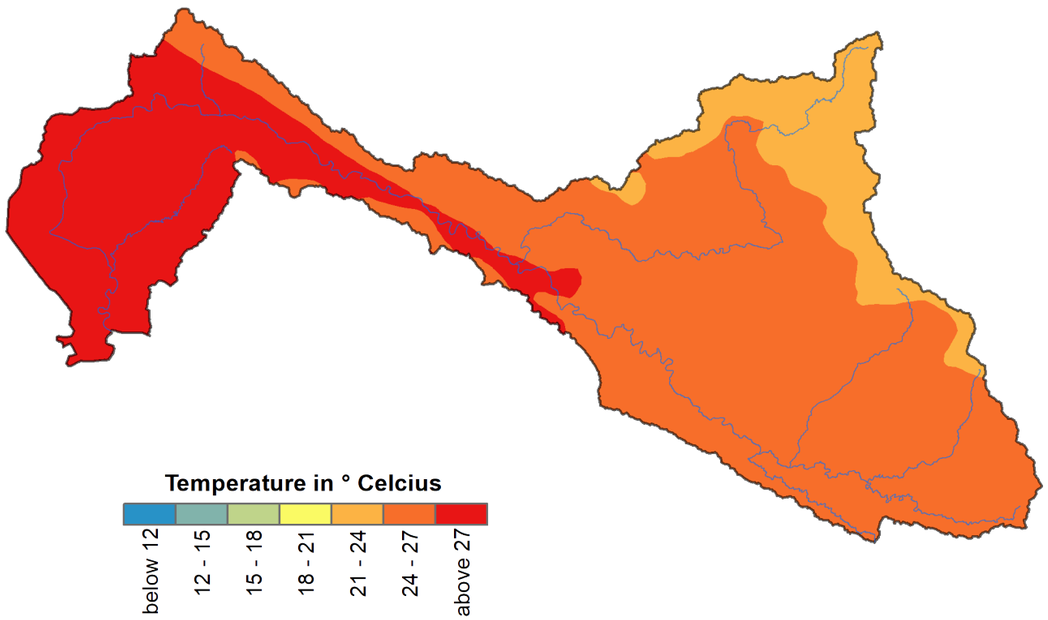
Average Temperature Distribution



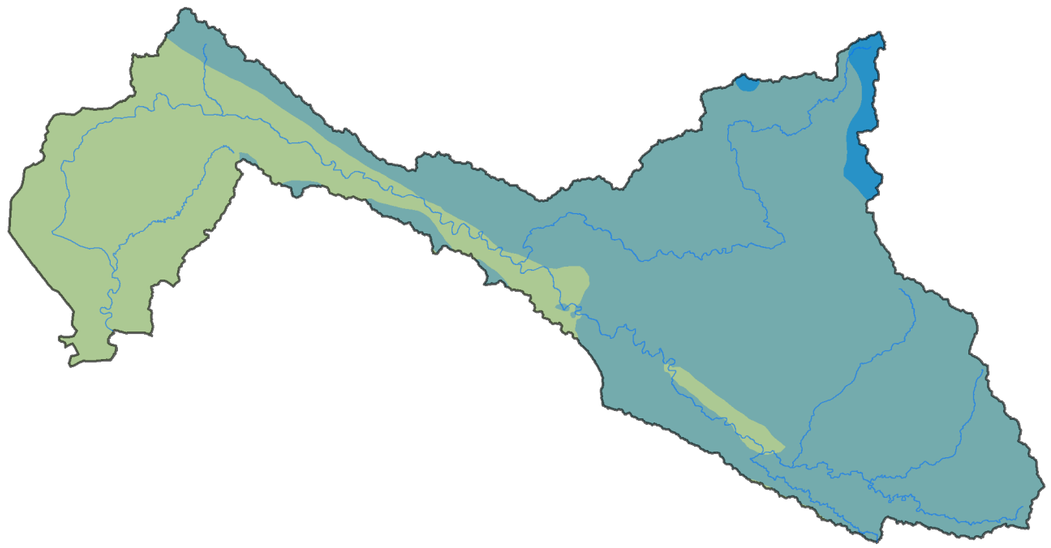
Annual Average



Summer Average
(May-Jun-Jul)



Winter Average
(Dec-Jan-Feb)



Data Source: Surface generated from DHM Temperature Data - 1985-2015.

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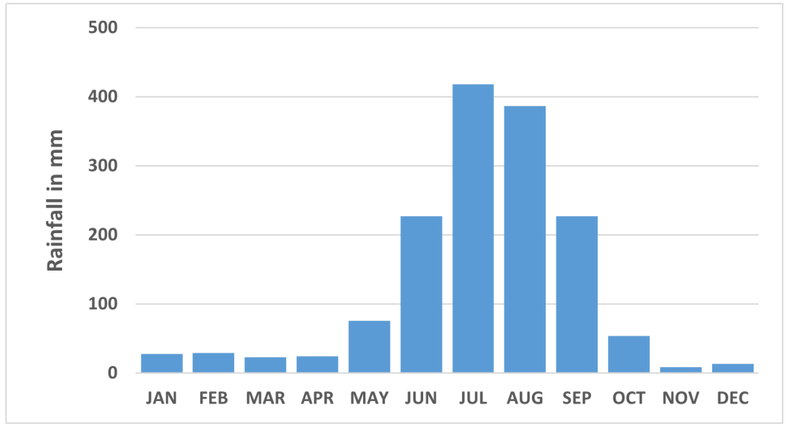
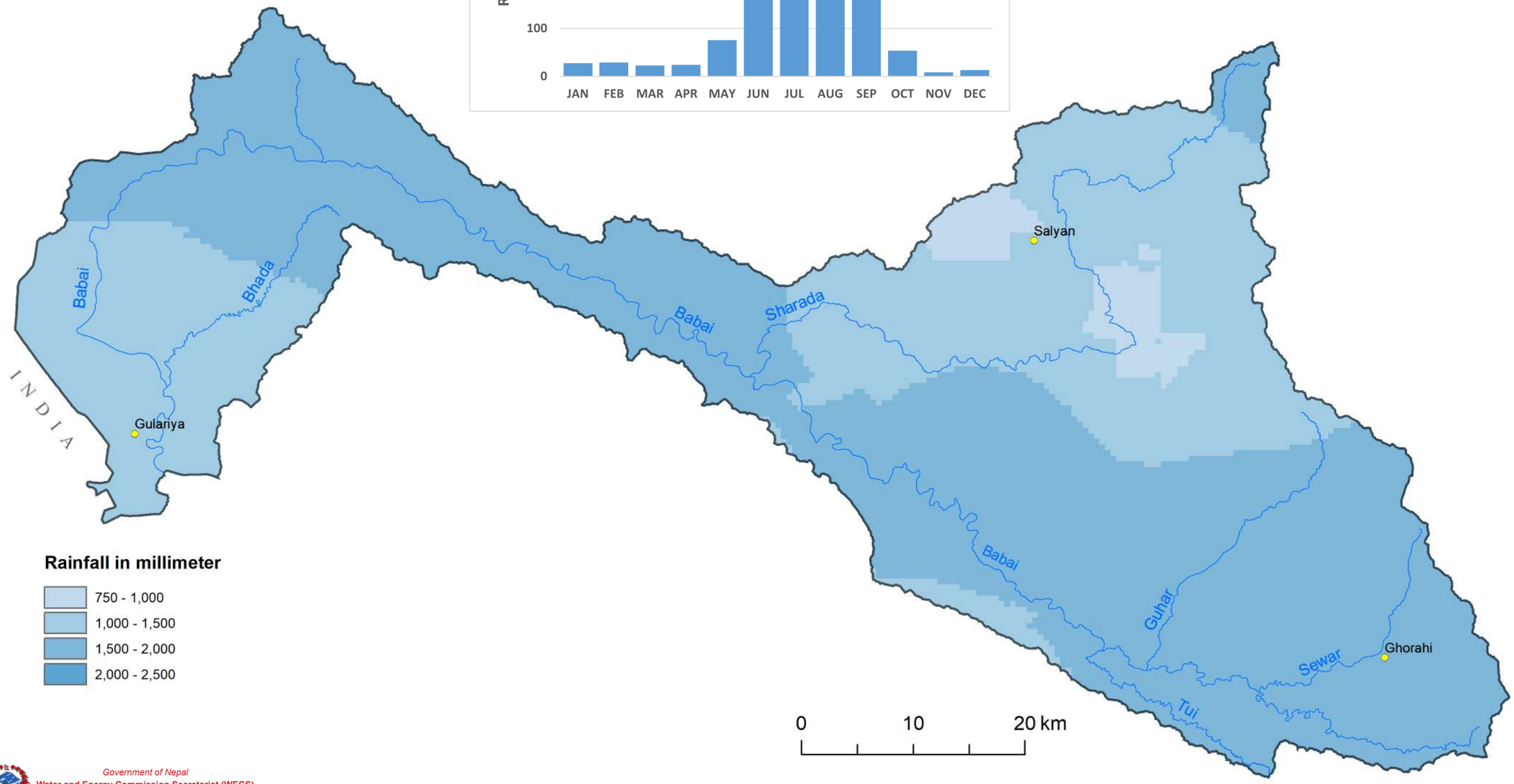
Annual Average Rainfall Distribution





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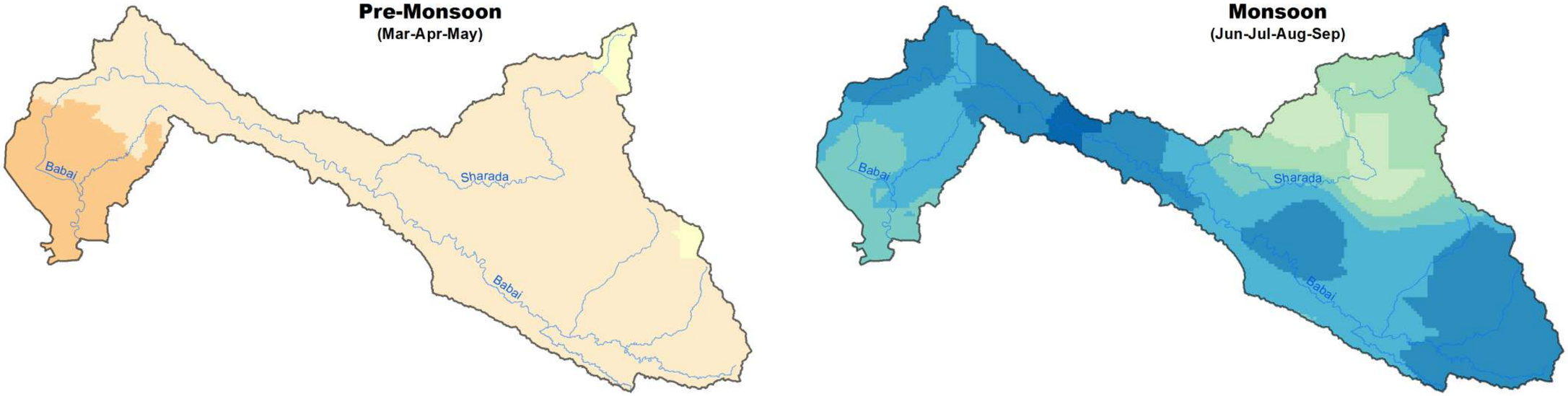
Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

Seasonal Average Rainfall Distribution



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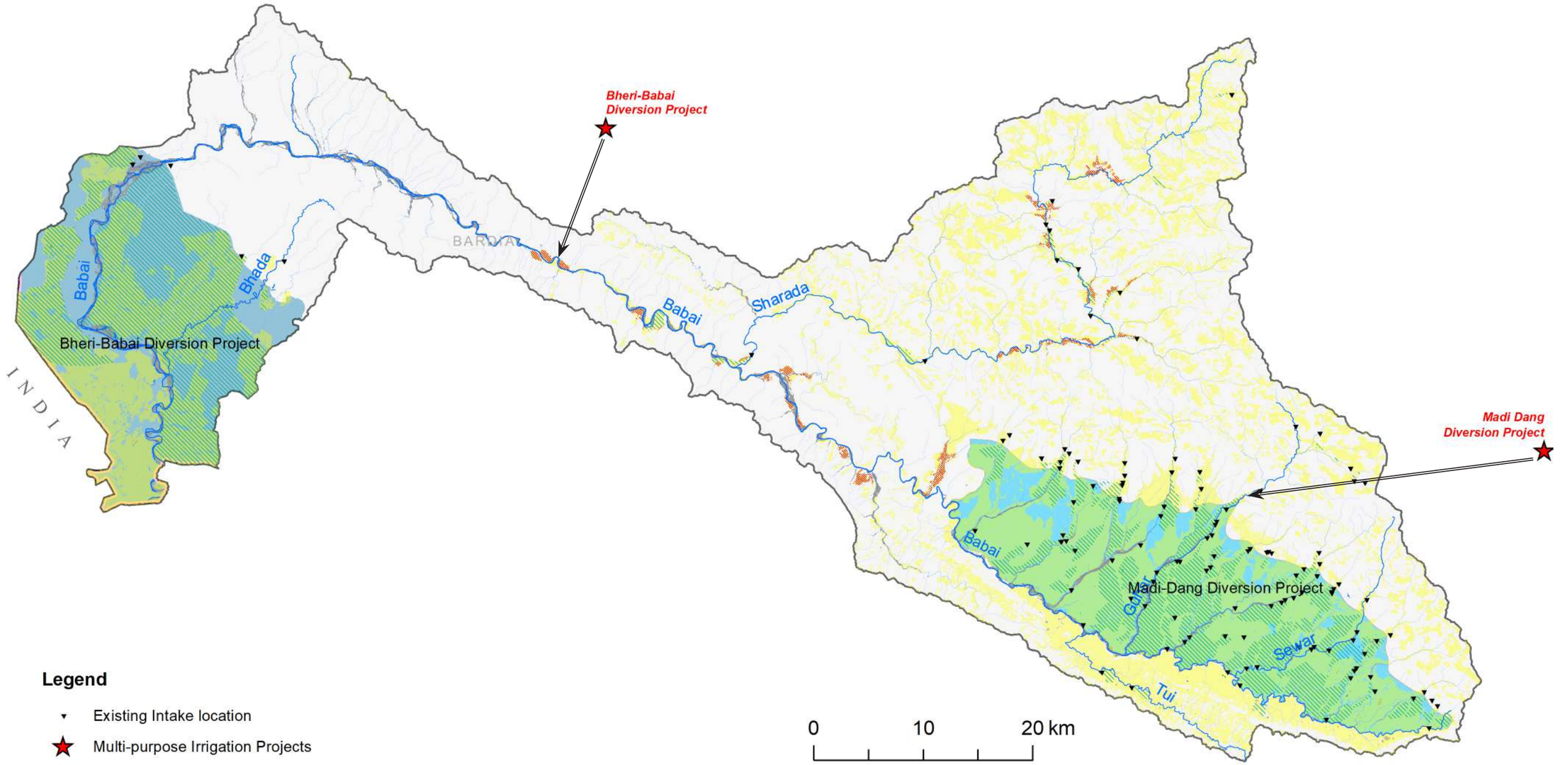
Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

Irrigation Projects



Data Source: IMP, 2019.

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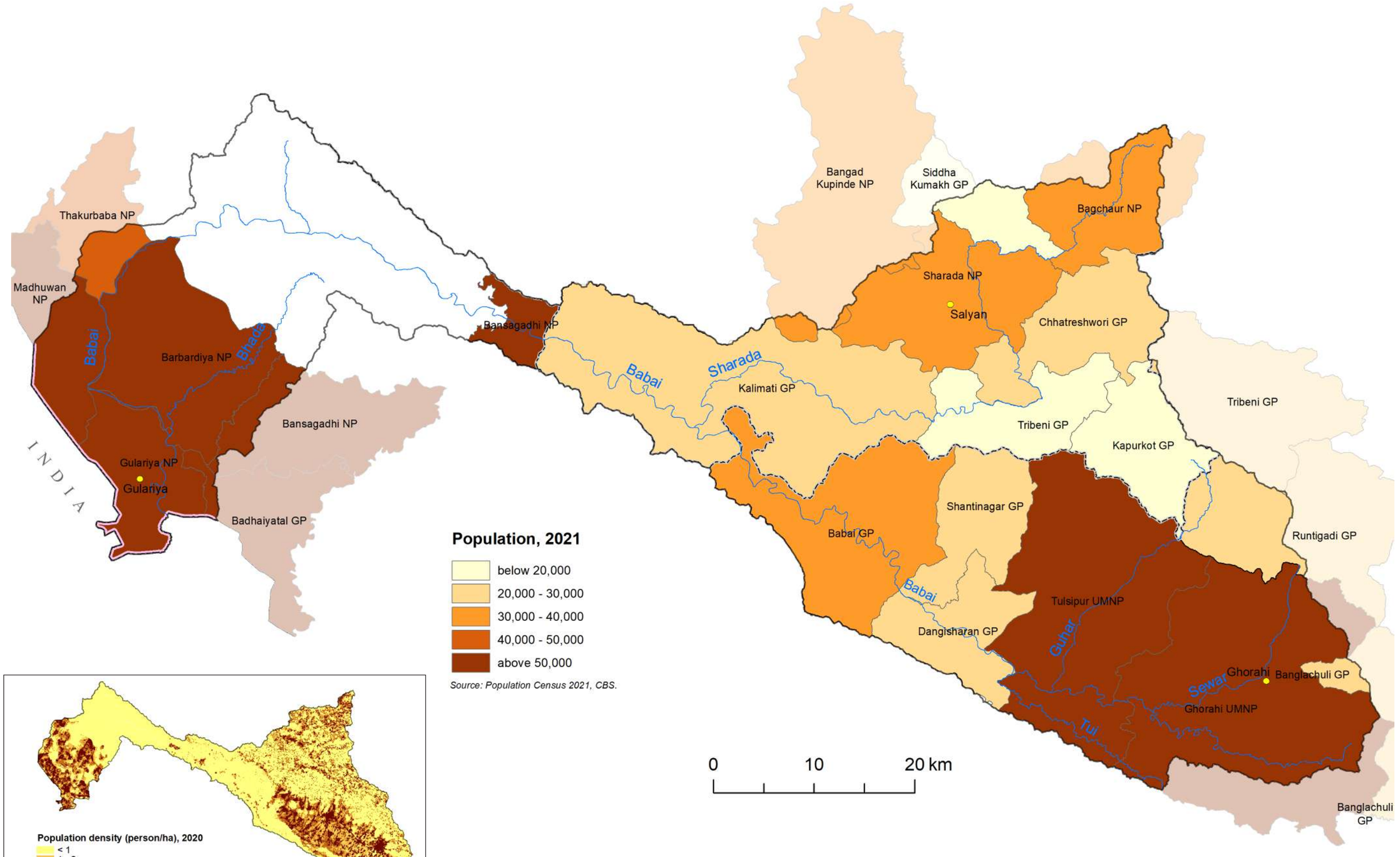
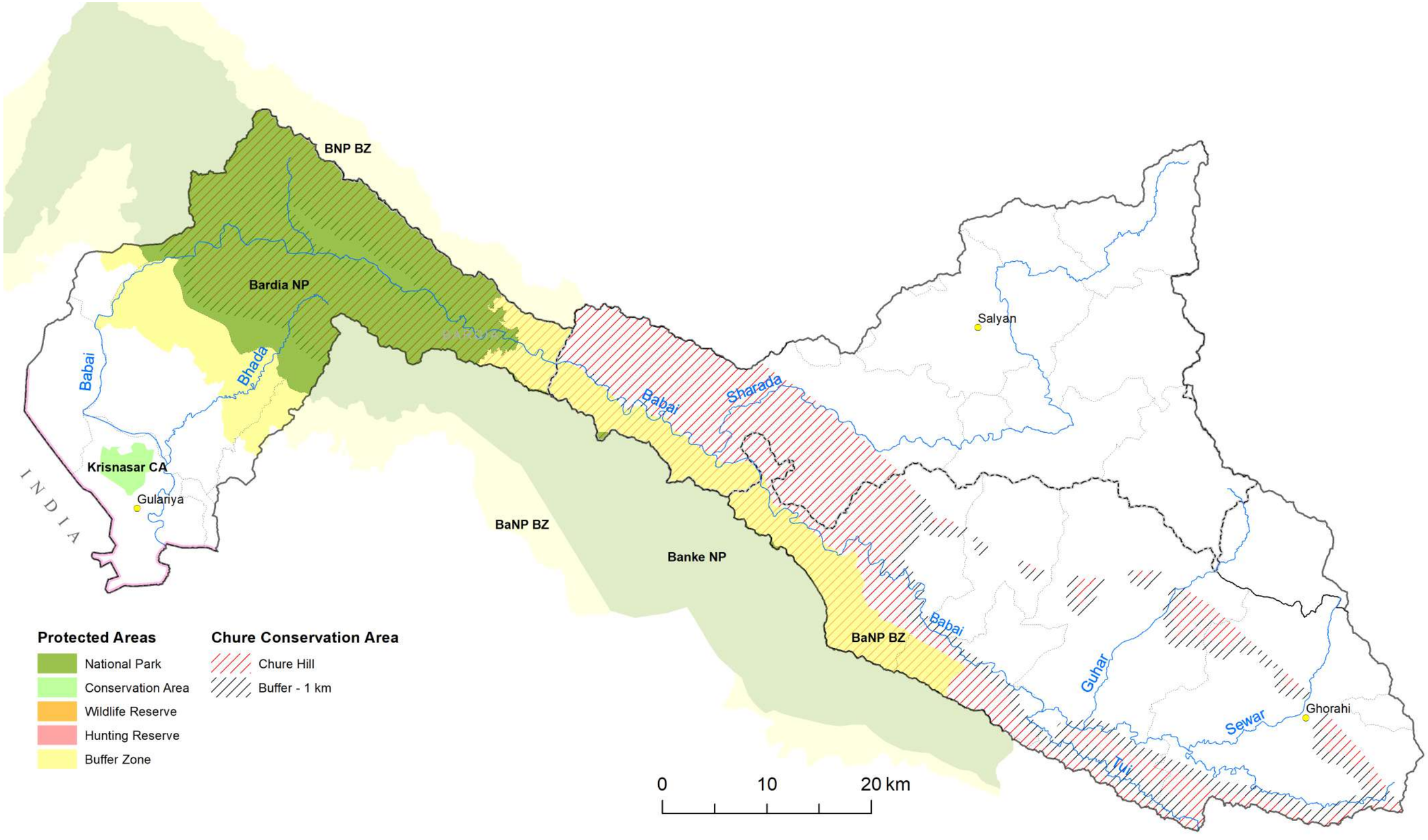
Population Distribution and Density



Protected Areas



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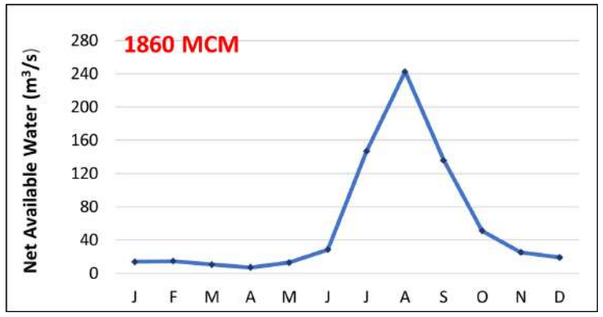
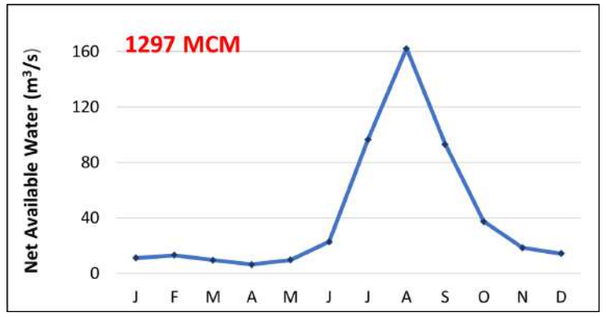
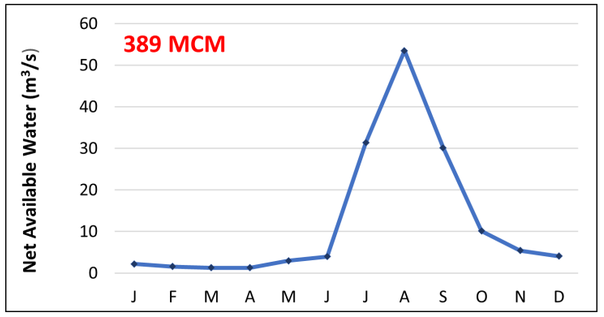
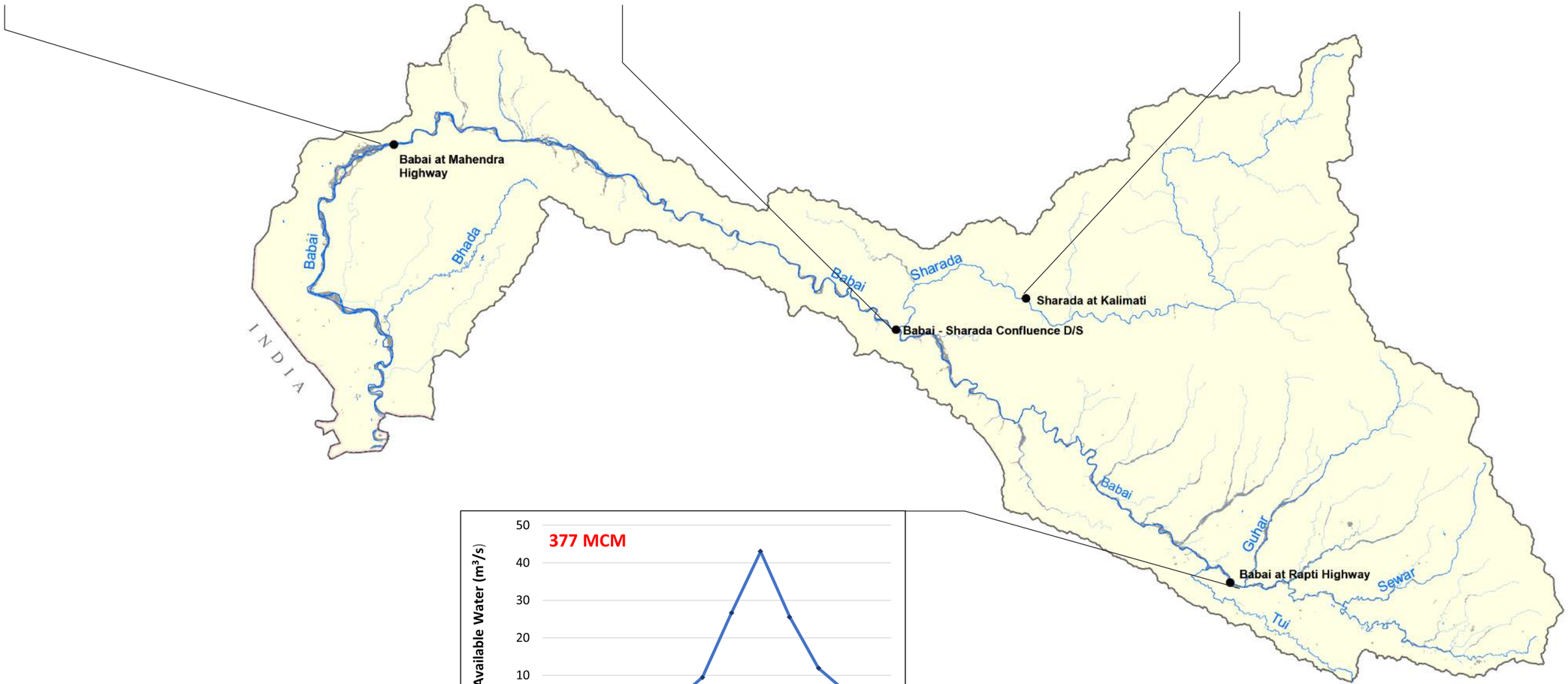
Data Source: DNPWC & PCTMCDB , GoN, 2022

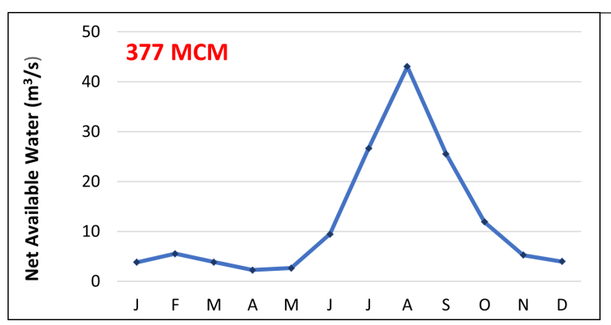
Hydrographs at Major River Nodes











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6. West Rapti Basin

West Rapti Basin

West Rapti River is called the Dangdung Khola, when it originates at Jaljala area in the high hills of Rolpa District in Thabang Municipality. The right tributary, which is called 'Chunbang Khola', originates at Manjan Danda in Bhume Rural Municipality of West Rukum District. After the confluence of Dangdung Khola and Chunbang Khola, the river flows southward, and is called Madi at the upper reach. The river flows in the south east direction after it meets Chiura Gad at about 30 km from its origin. The Madi River meets two important tributaries: Lungri Khola at a chainage of about 80 km and Jhimruk Khola at a chainage of about 140 km. The highest elevation in the basin is 3,665 m at Barun Pokhari Danda, a ridgeline separating Rolpa and Baglung Districts near Jalkarni Kharka in the Lungri Khola Basin.

The river is called Rapti after the confluence of the Madi River and Jhimruk Khola. After meeting Jhimruk Khola, the river takes a sharp right turn and flows in the westerly direction along Deukhuri Valley in Dang District. East-West highway crosses the river at Bhalubang (Capital of Lumbini Province), an emerging town on the Bank of the river at a chainage of about 170 km. Obstructed by the Duduwa Range of the Sivaliks, the river continues to flow in a westerly direction. Several small rivulets meet the river on the hills and Inner Terai, called Deukhuri Valley, on both sides of the river. The river follows westward until it reaches the end of Duduwa Range about 15 km downstream of Agaiya, Banke District and takes another sharp turn towards the south. The river meets Dunduwa Khola, another tributary at about of 330 km chainage and flows to India after a course of more than 340 km from its origin in Nepal.

The West Rapti Basin covers a basin area of 6971 km² in Nepal. It is one of the tributaries of Karnali River (known as Ghagra River in India). After crossing over to India, Rapti River flows towards the south-east direction until it merges with Ghaghara (Karnali in Nepal) River at Kaparwaaghat after flowing about 510 Km in India. Total length of the river from its origin to confluence at Ghagra River in India is about 850 km.

Figure 2.6: Rapti River flows into Deukhuri valley

Salient Features of West Rapti Basin

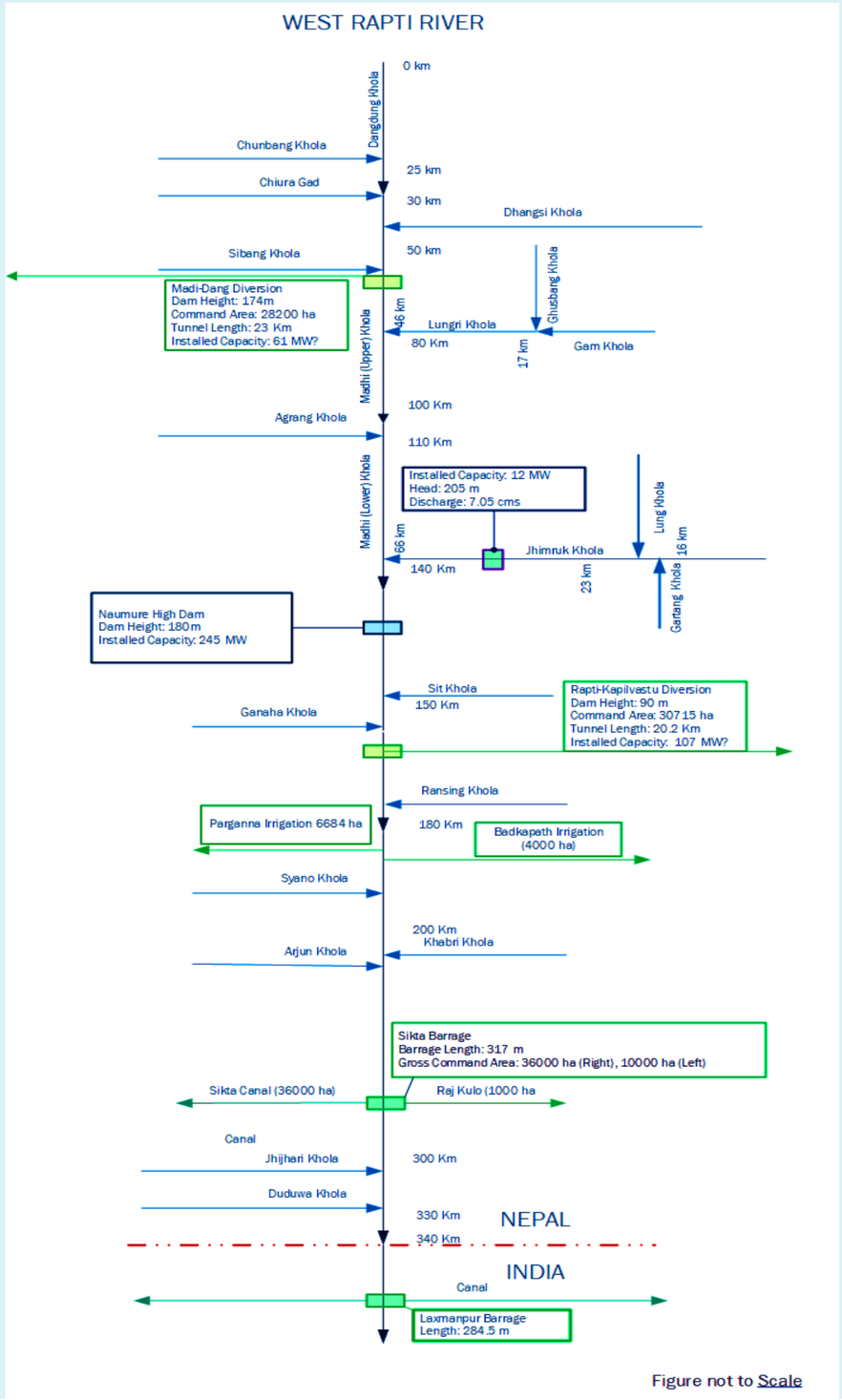
Basin location	*Latitudes: 27°40'35" to 28°34'21" N* *Longitudes: 81°39'23" to 83°09'39" E*
Catchment area	*6,971 sq.km.*
Major rivers	*Madi (127 km), Jhimruk (96 km), Rapti (195 km)*
River length	*322 km (up to Nepal-India border)*
Elevation	*Maximum - 3,665 m.;* *Minimum - 125 m.*
Hydro-meteorological stations	*8 Meteorological stations* *8 Hydrological stations*
Flood forecasting stations	*4*
Average annual rainfall	*1,587 mm*
Average river flow (Nepal - India border)	*176 cumec;* *5,550 MCM (annual)*
Existing hydropower stations and Capacity (DOED, March 2023)	*1; 12.5 MW*
Agriculture land	*144,528 ha.*
Existing big irrigation systems	*4*
Total irrigated area in basin (as per inventory of IMP, 2019)	*61,490 ha. (2025)* *63,829 ha. (2050)*
Total population (extimated from Population Census, 2021)	*1,041,930*
Forest land	*501,800 ha.*
Total water demand (for 2025)	*Irrigation demand:1,494 MCM* *Domestic demand: 55 MLD*
Administrative units	*Pradesh: Karnali, and Lumbini* *Districts: 9* *Local Bodies:* *(27 Gaupalika; 10 Nagarpalika, 2 Upamahanagarpalika)*

Administrative Division of West Rapti Basin

Table 2.6 List of Local Bodies in West Rapti Basin

SN	Province	District	Name of Local Body	% of Area
1	Lumbini	Gulmi	Madane GP	41
2		Kapilbastu	Shivaraj NP	3
3		Arghakhanchi	Bhumekasthan NP	96
4			Malarani GP	40
5			Sandhikharka NP	9
6			Sitganga NP	63
7		Pyuthan	Ayirabati GP	100
8			Gaumukhi GP	100
9			Jhimruk GP	100
10			Mallarani GP	100
11			Mandavi GP	100
12			Naubahini GP	100
13			Pyuthan NP	100
14			Sarumarani GP	100
15			Sworgadwary NP	100
16		Rolpa	Paribartan GP	100
17			Lungri GP	100
18			Madi GP	100
19			Rolpa NP	100
20			Runtigadi GP	59
21			Sukidaha GP	100
22			Sunchhahari GP	100
23			Suwarnabati GP	100
24			Thawang GP	74
25			Tribeni GP	100
26		Dang	Banglachuli GP	94
27			Gadhawa GP	97
28			Ghorahi UMNP	25
29			Lamahi NP	100
30			Rajpur GP	100
31			Rapti GP	100
32		Banke	Duduwa GP	84
33			Janki GP	2
34			Kohalpur NP	71
35			Narainapur GP	100
36			Nepalgunj UMNP	19
37			Rapti Sonari GP	100
38		Rukum East	Bhume GP	15
39	Karnali	Salyan	Bagchaur NP	17

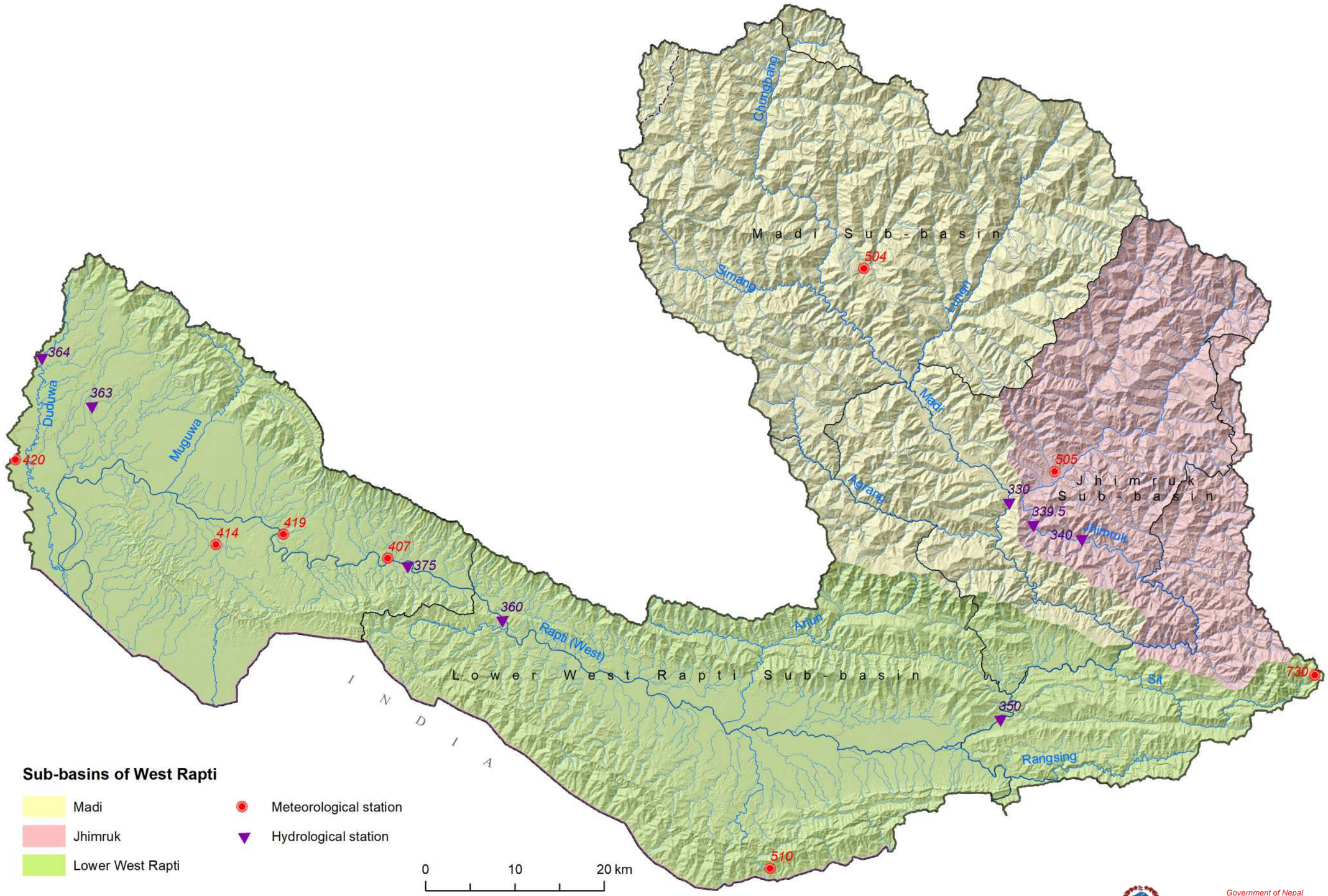
River Flow Line Diagram of West Rapti River



Sikta Irrigation Project

Sikta Irrigation Project
A barrage of length 317 m is constructed across the Rapti River at Agaiya of Rapti Sonari Rural Municipality in Banke District of Lumbini Province, with the aim of providing reliable irrigation facilities to a total command area of 42,766 hectares of land of 6 rural municipalities, Kohalpur municipality and Nepalgunj sub-metropolitan in Nepalgunj District. The Sikta Irrigation Project, which was started in F.Y.2062/63 by the Government of Nepal from its own resources, covers a command area 33,766 hectares on the western side and 9,000 hectares on the eastern side of the Rapti River.

River System



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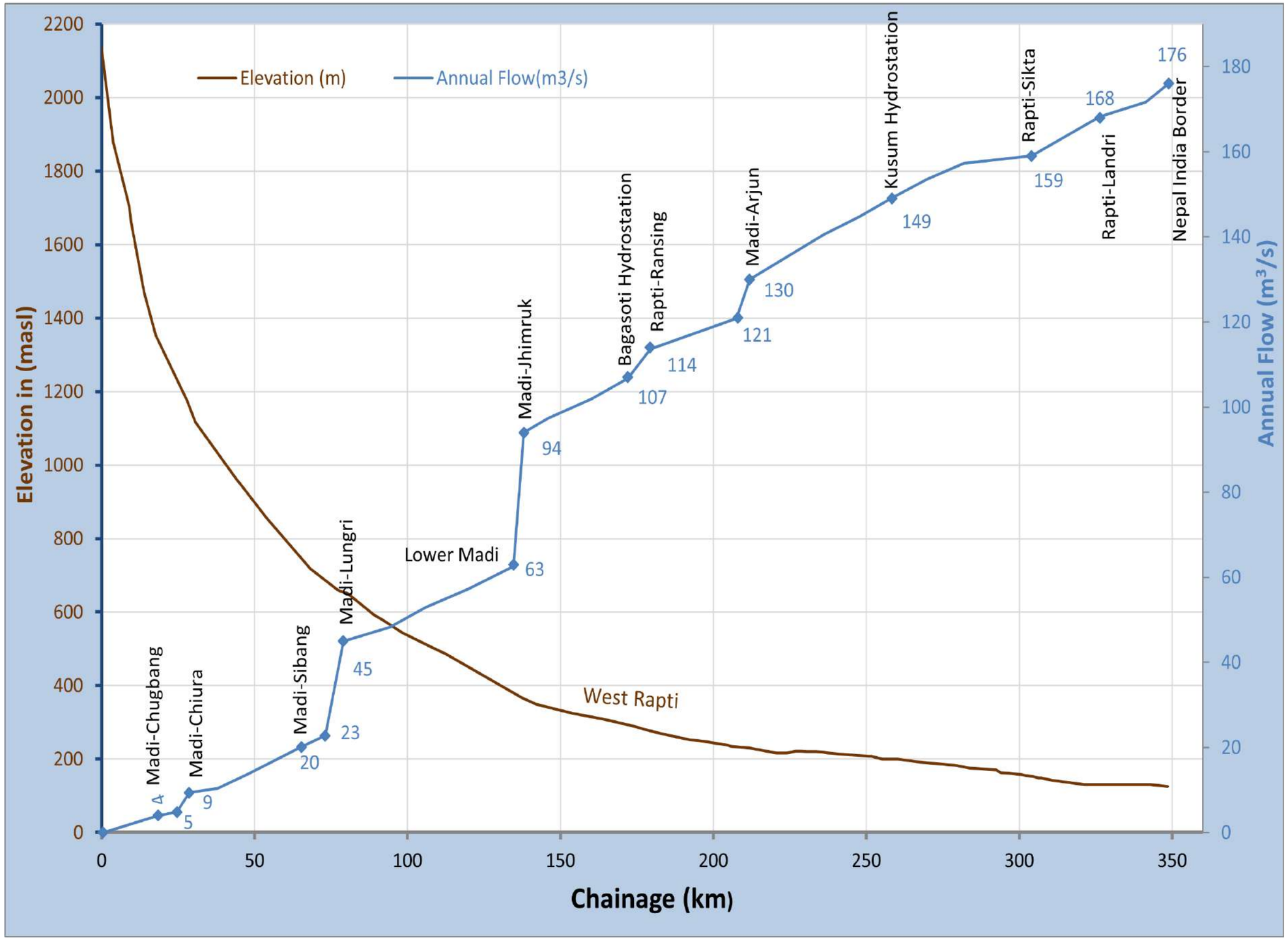
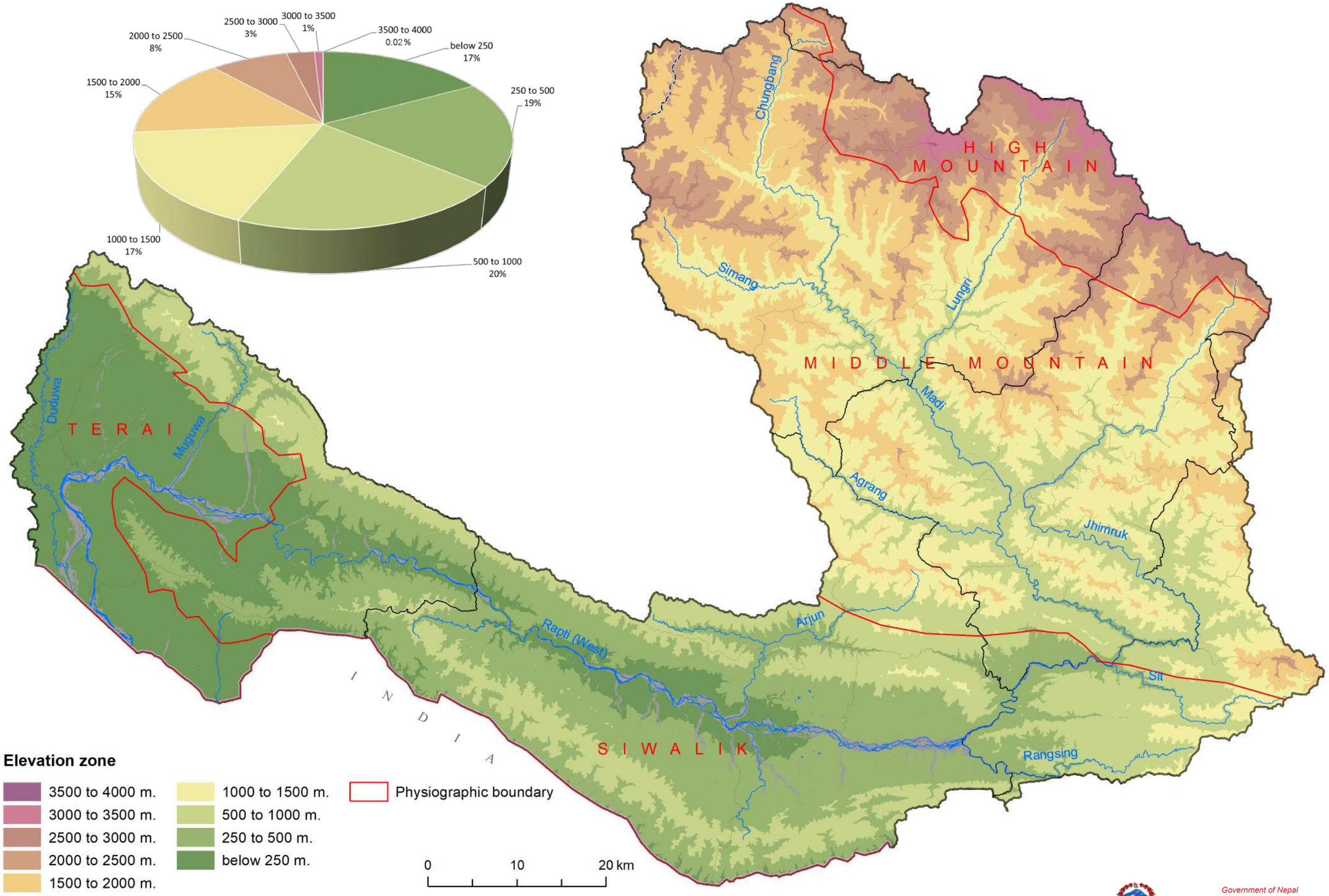
River Profile and Annual Flow



Elevation Zone



Data Source: DEM prepared from Topographic data.

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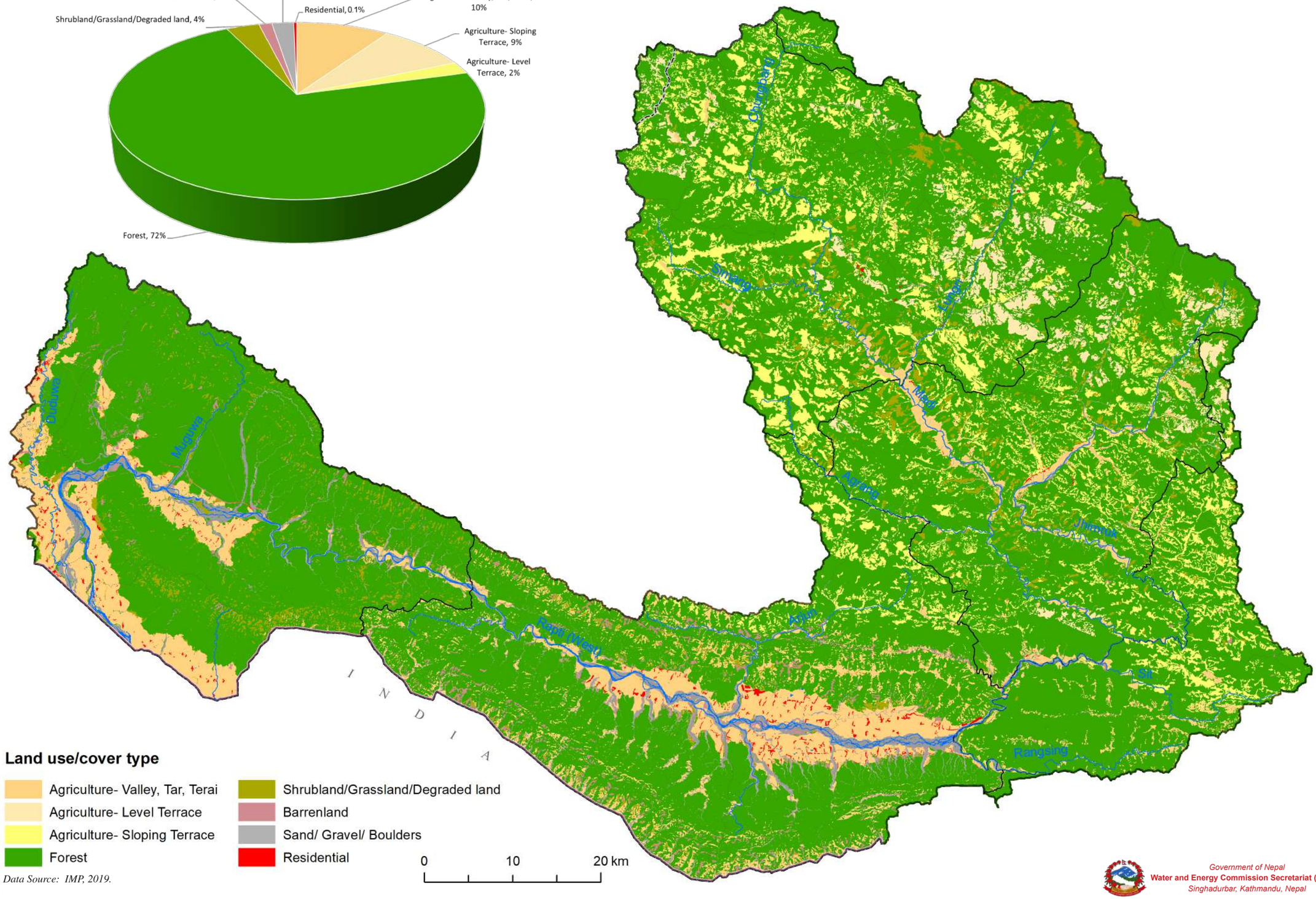
Land Use/Cover



Data Source: IMP, 2019.

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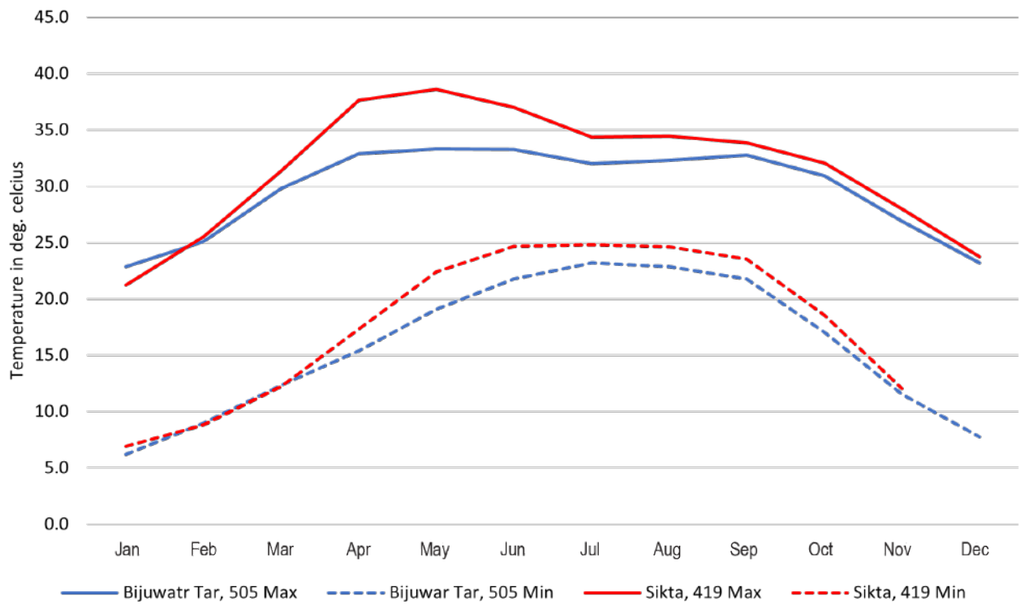
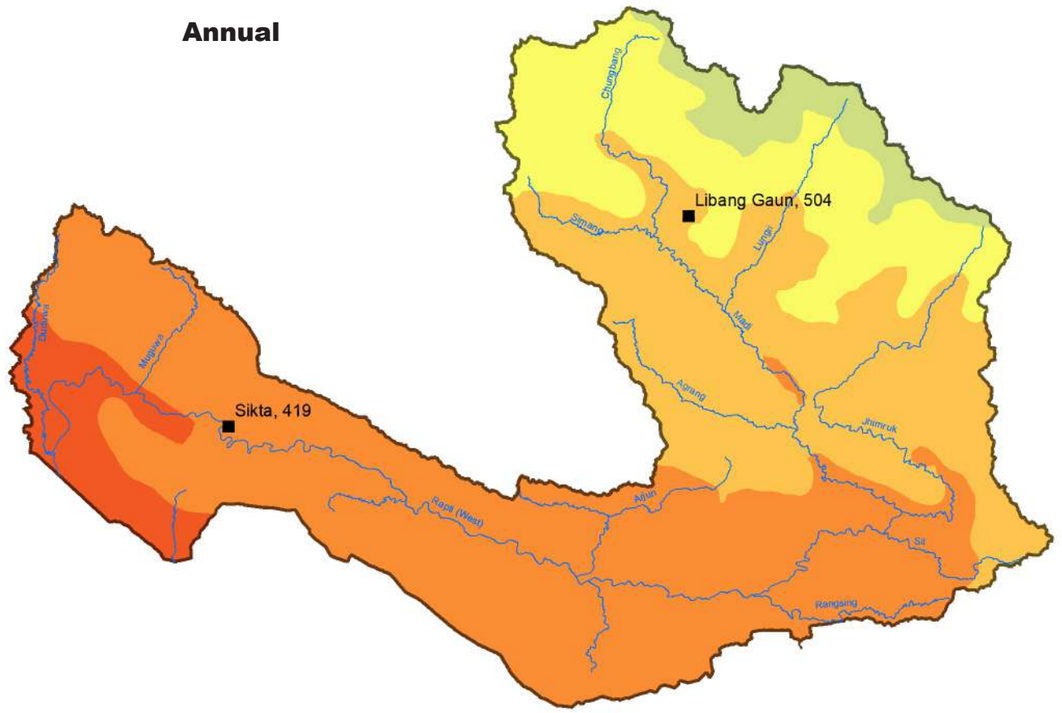
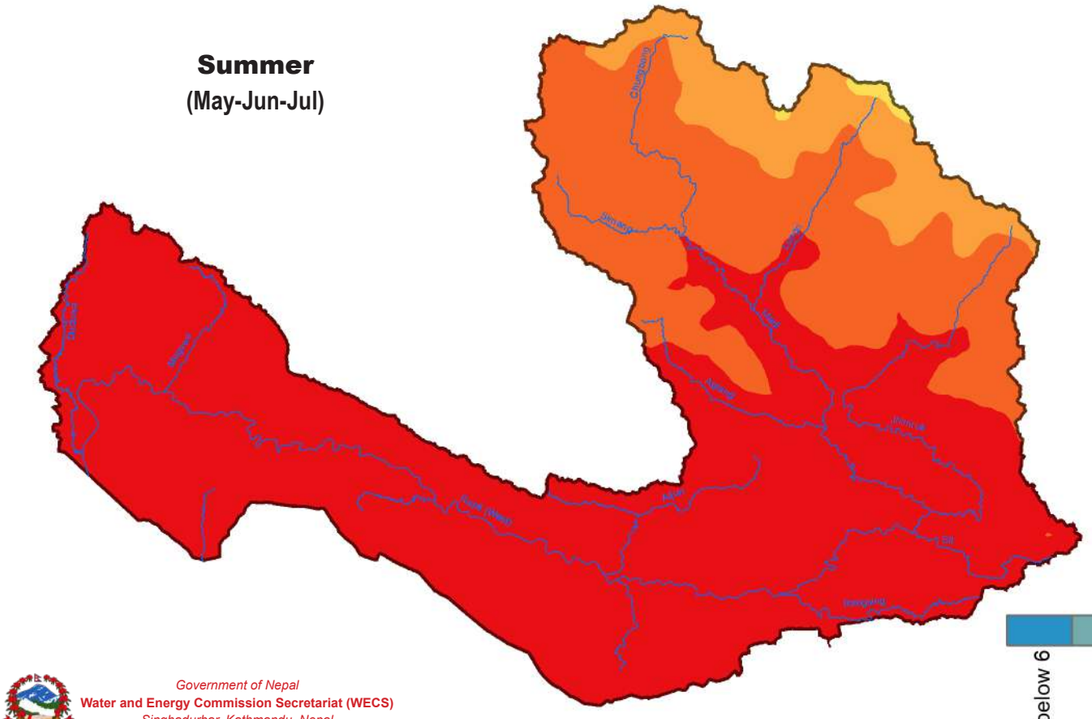
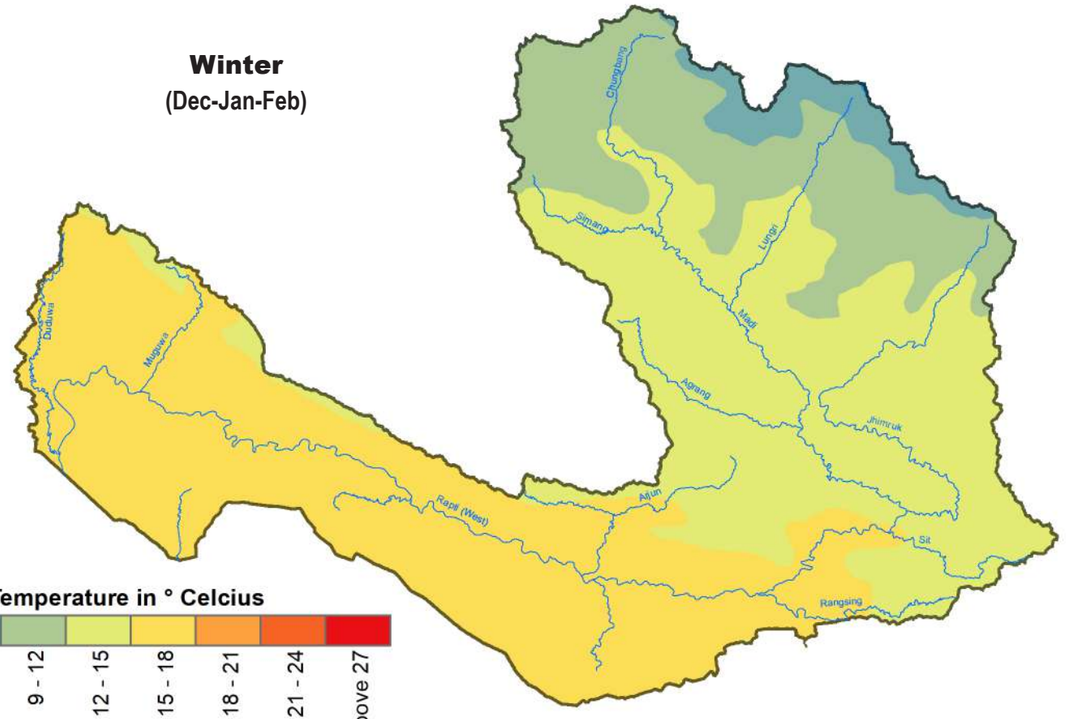
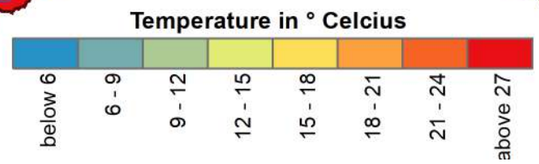
Average Temperature Distribution











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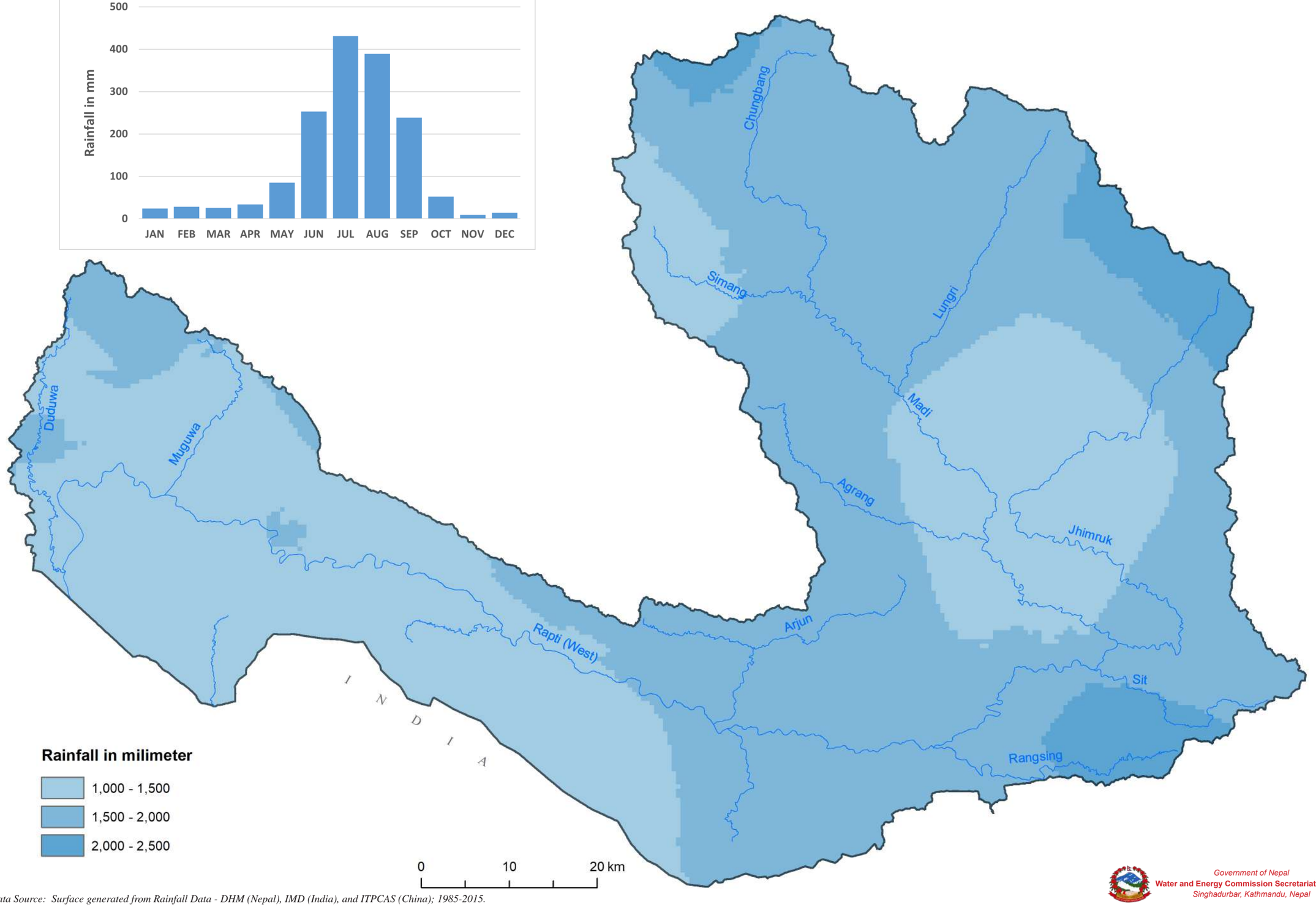
Data Source: Surface generated from DHM Temperature Data - 1985-2015.

Annual Average Rainfall Distribution



Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

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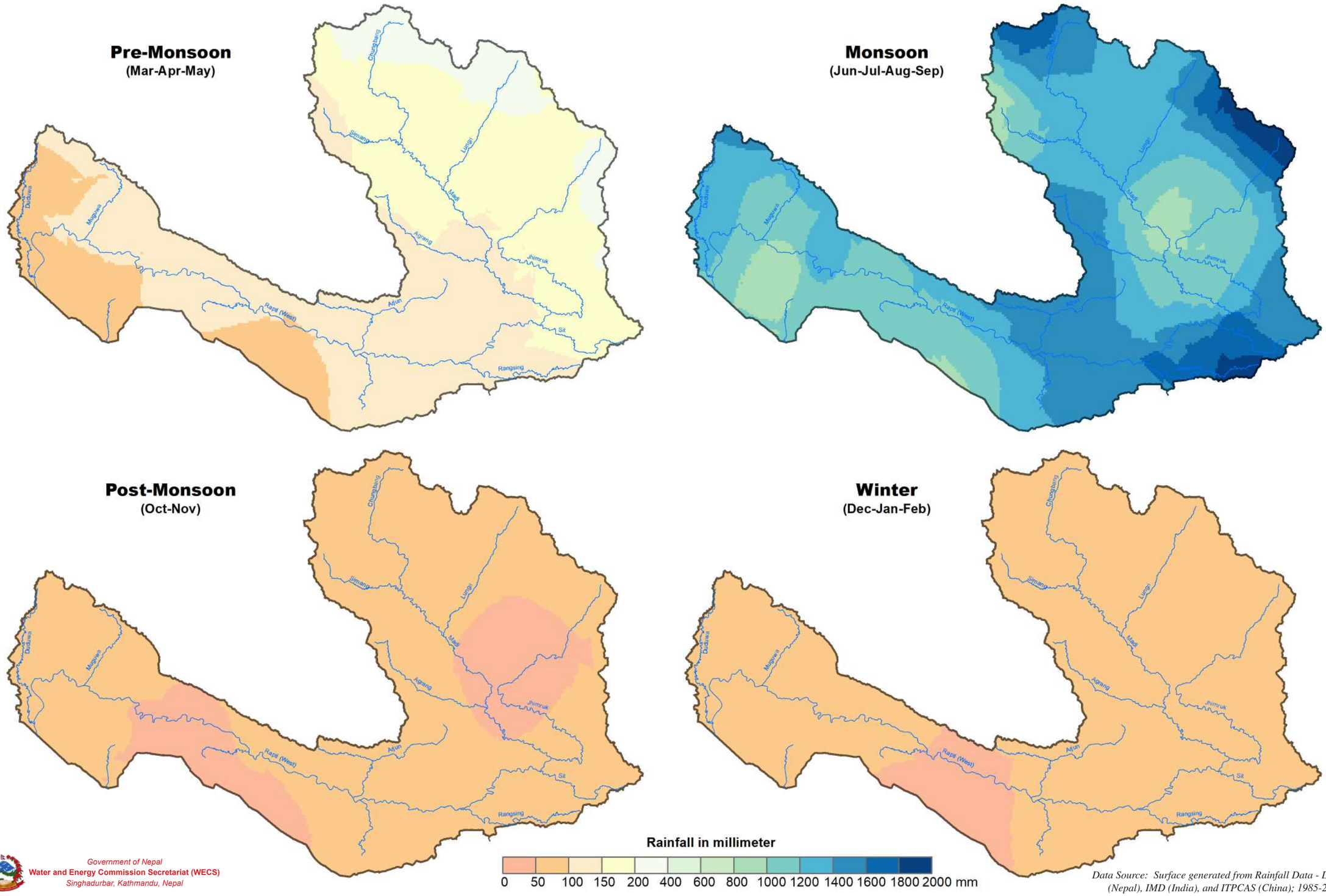
Seasonal Average Rainfall Distribution



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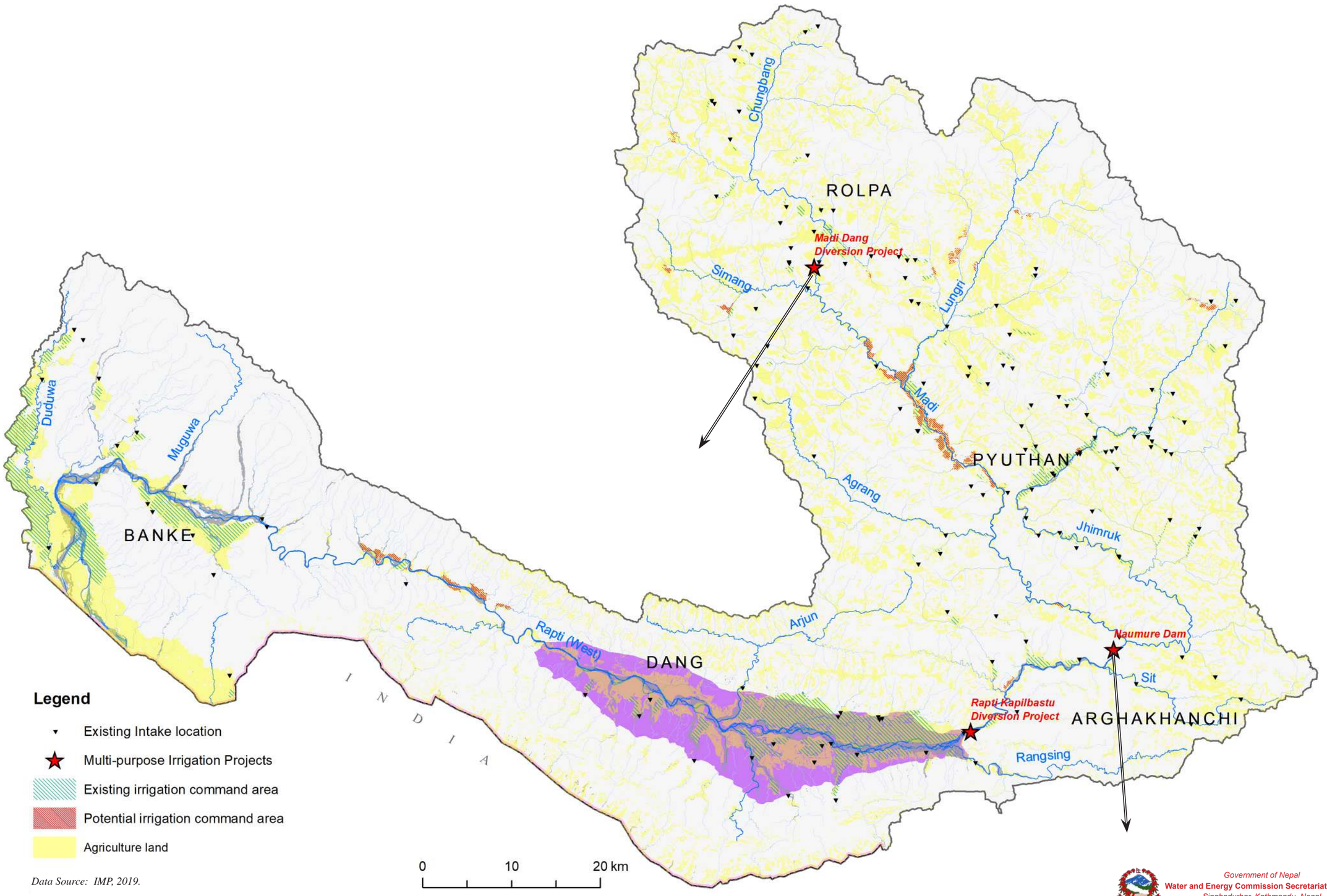
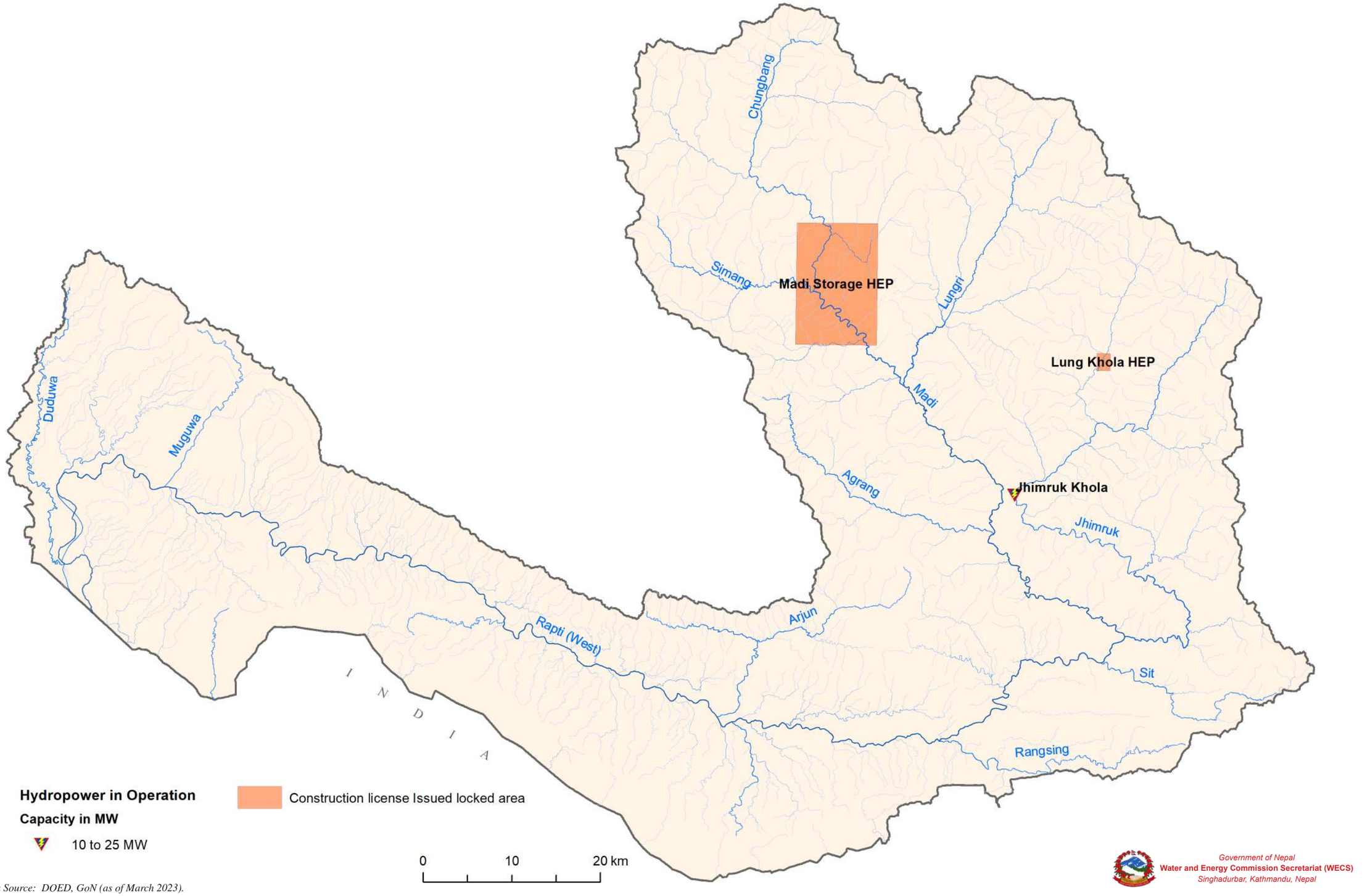
Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

Irrigation Projects



Hydropower Projects



Data Source: DOED, GoN (as of March 2023).

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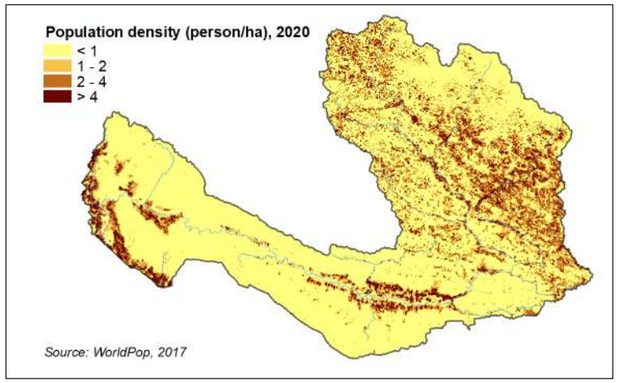
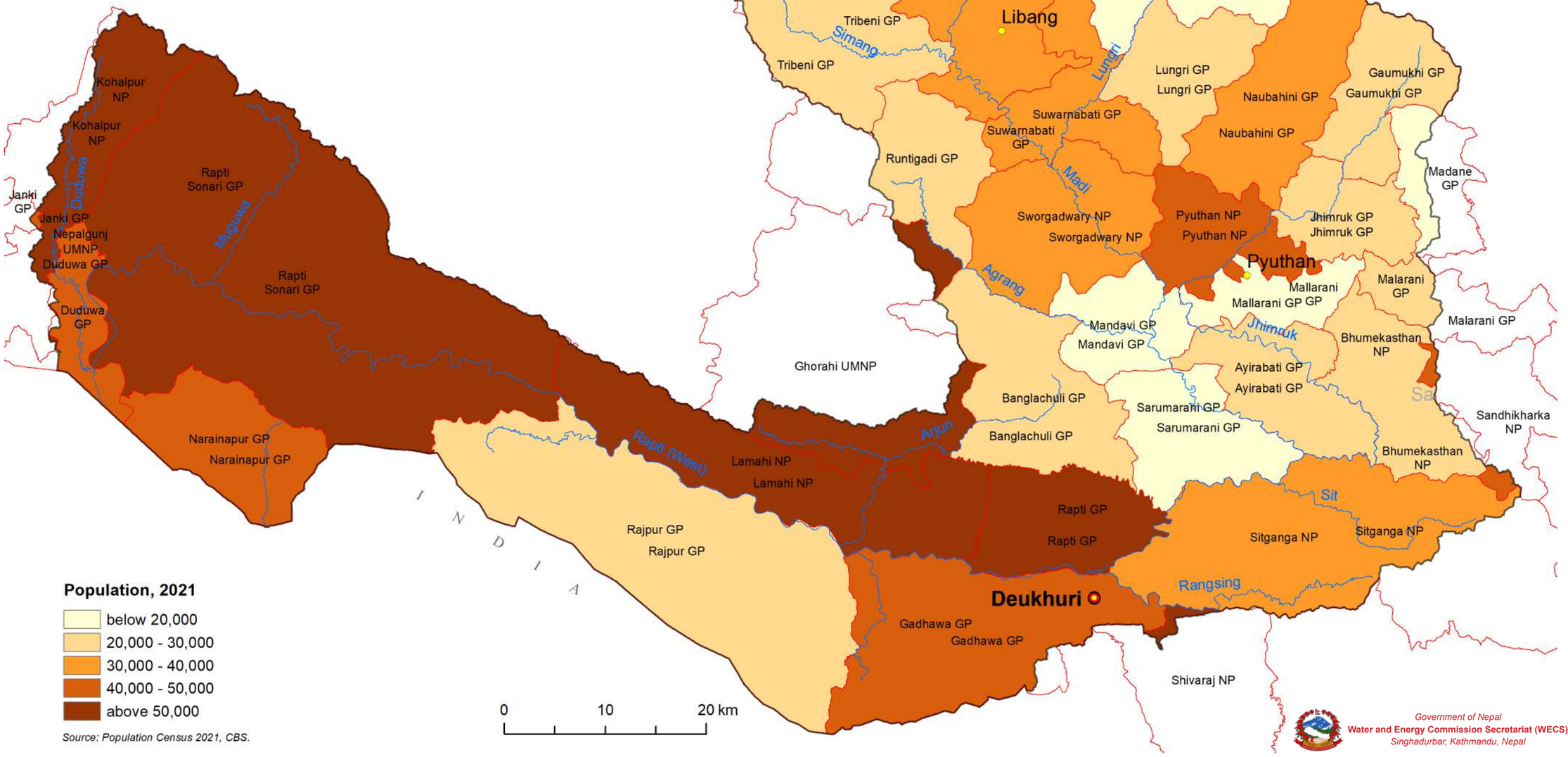
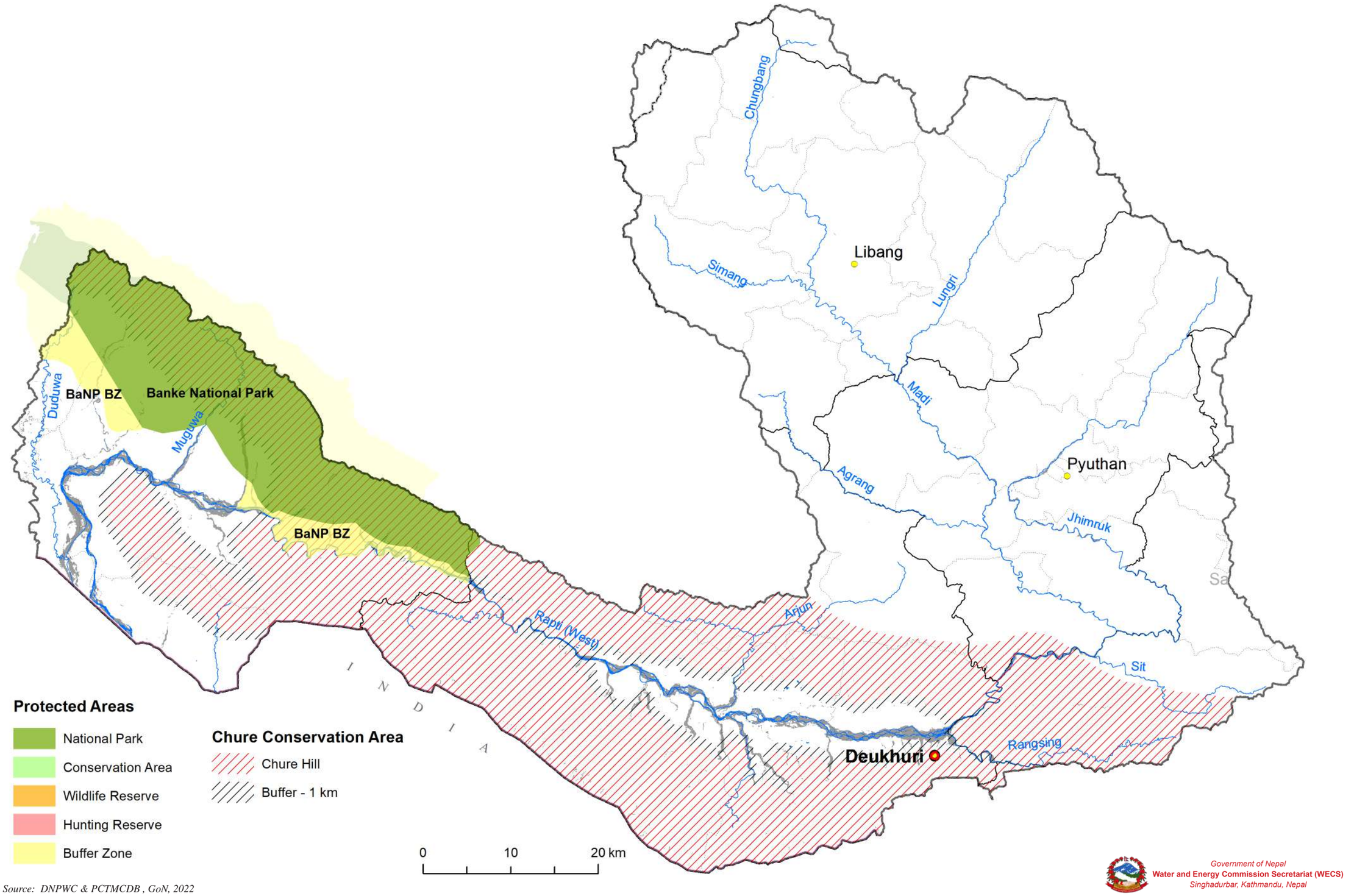
Population Distribution and Density





Protected Areas



Data Source: DNPWC & PCTMCDB , GoN, 2022

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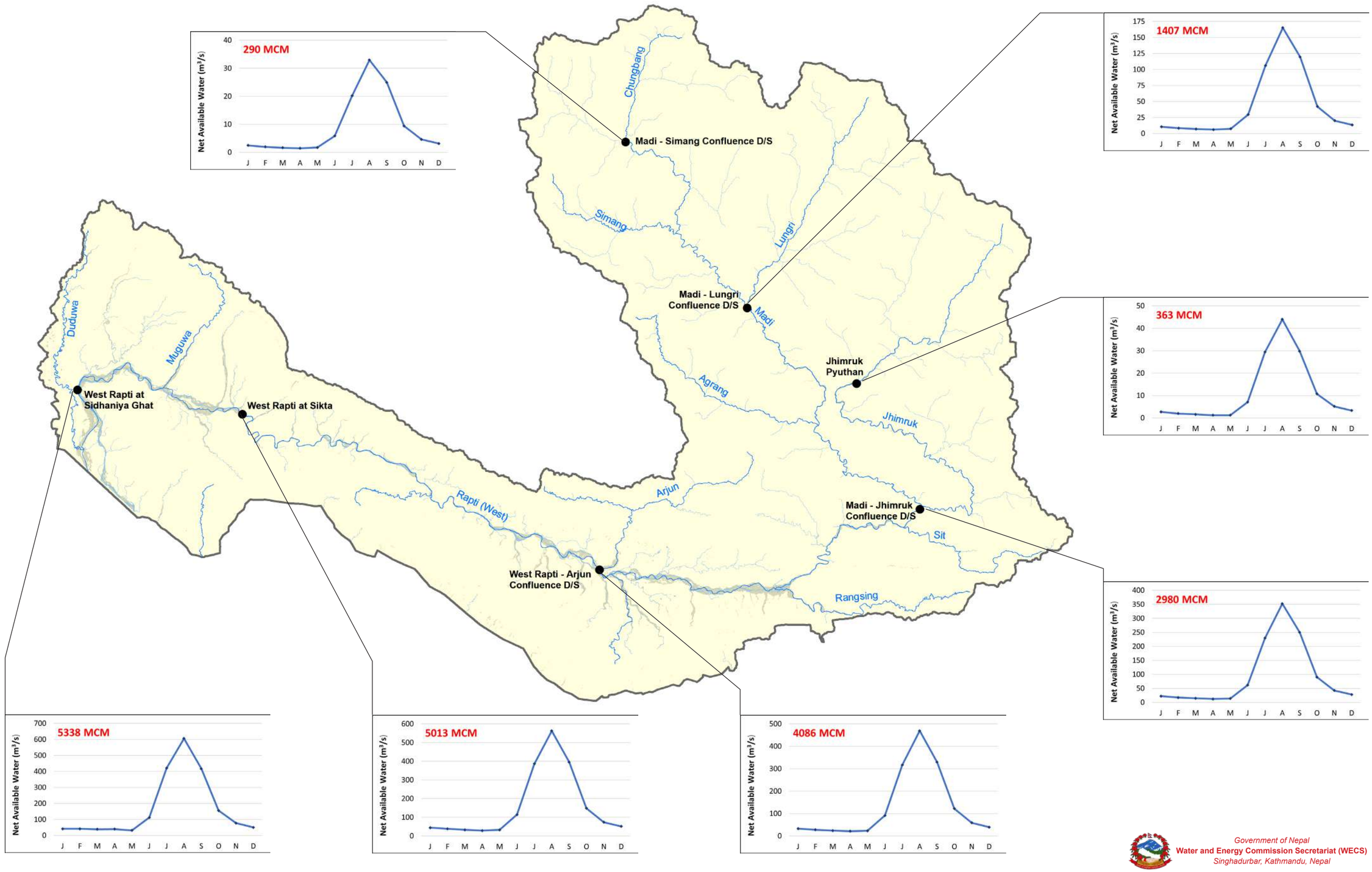
Hydrographs at Major River Nodes



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7. Bagmati Basin

Bagmati Basin

The Bagmati River Basin is a basin in central part of Nepal with a basin area of 3,844 km², which is about 2.6 percent area of the country. The basin extends from 85° 01' 21" to 85° 57' 25" East longitudes and 26° 44' 29" to 27° 49' 04" North latitudes in Nepal. The Bagmati river flows in Bagmati and Madhesh Provinces in central Nepal draining the middle hills of Mahabharat Range as well as the Siwaliks and the Terai. It drains the whole of the Kathmandu Valley and Parts of Sindhuli, Makawanpur, Sarlahi and Rautahat district. The elevation range of the of the river basin ranges from 69 m to 2,940 m. The river enters India at Gaur (Nepal) / Bairgainia (India). The river crosses Nepal, flows through Bihar, India joins Kamala and merges into the Koshi River. The river is called Bagmati from its origin at Bagdwar in Shivpuri National Park in Kathmandu district to the outflow in the river Ganges.

The average annual rainfall in the basin is about 1,795 mm. The existing irrigation systems cover an area of 59,085 ha. using both surface and ground water resources. Due to lack of sufficient dry season flow, it is necessary to the augment water resources in the basin either by storage or by an inter-basin transfer from Sunkoshi River. At present, a river diversion project diverting water from water surplus Sunkoshi basin to Marin River, a tributary of the Bagmati River is being implemented.

There are 3 small hydropower plants operational in 88 with a total installed capacity of MW. The first storage project, Kulekhani Hydropower Project, has been developed and with 104 MW installed capacity (3 phases). The project diverts water from Kulekhani River in Bagmati River Basin to East Rapti Basin in Gandaki River Basin.

The basin area has 27 meteorological stations and 13 hydrological stations .

Figure 2.7: Bagmati River flows into Terai plain land

Salient Features of Bagmati Basin

Basin location	*Latitudes: 26°44'29" to 27°49'04" N* *Longitudes: 85°01'21" to 85°57'25" E*
Catchment area	*3,844 sq.km.*
Major rivers	*Bishnumati (17 km), Kulekhnani (39 km), Marin (75 km)*
River length	*207 km (up to Nepal-India border)*
Elevation	*Maximum - 2,940 m.;* *Minimum - 69 m.*
Hydro-meteorological stations	*27 Meteorological stations* *13 Hydrological stations*
Flood forecasting stations	*3*
Average annual rainfall	*1,795 mm*
Average river flow (Nepal - India border)	*127.7 cumec;* *4028 MCM (annual)*
Existing hydropower stations and Capacity (DOED, March 2023)	*6; 41.9 MW*
Agriculture land	*1,246 sq.km.*
Existing big irrigation systems	*1*
Total irrigated area in basin (as per inventory of IMP, 2019)	*48,662 ha.(2025)* *57,016 ha. (2050)*
Total population (extimated from Population Census, 2021)	*3,738,216*
Forest land	*2,020 sq.km.*
Total water demand (for 2025)	*Irrigation demand: 1068 MCM* *Domestic demand: 359.7 MLD*
Administrative units	*Pradesh: Bagmati and Madhes* *Districts: 8* *Local Bodies:* *(19 Gaupalika; 33 Nagarpalika, 2 Mahanagarpalika)*

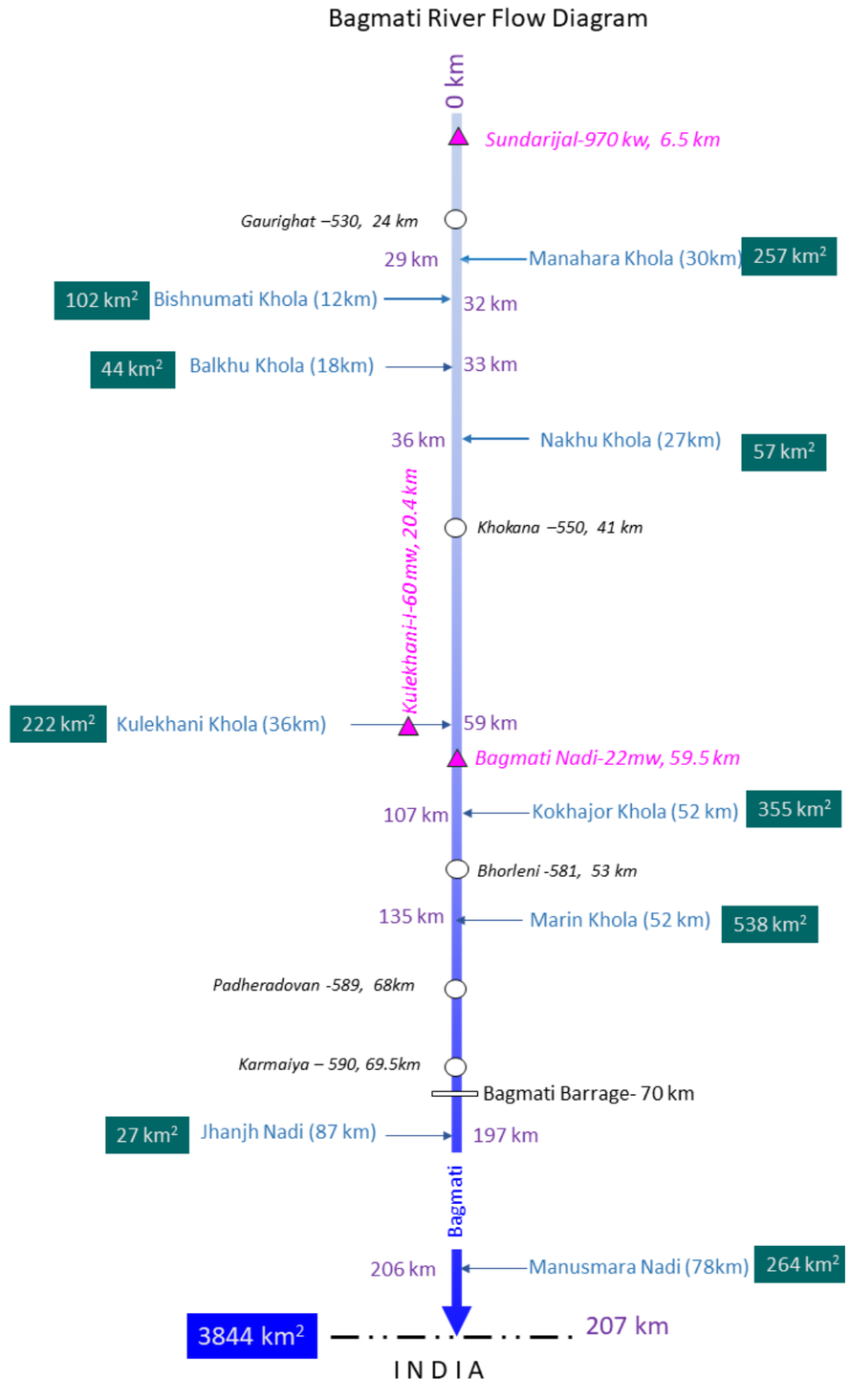
Administrative Division of Bagmati Basin

Table 2.7 List of Local Bodies in Bagmati Basin

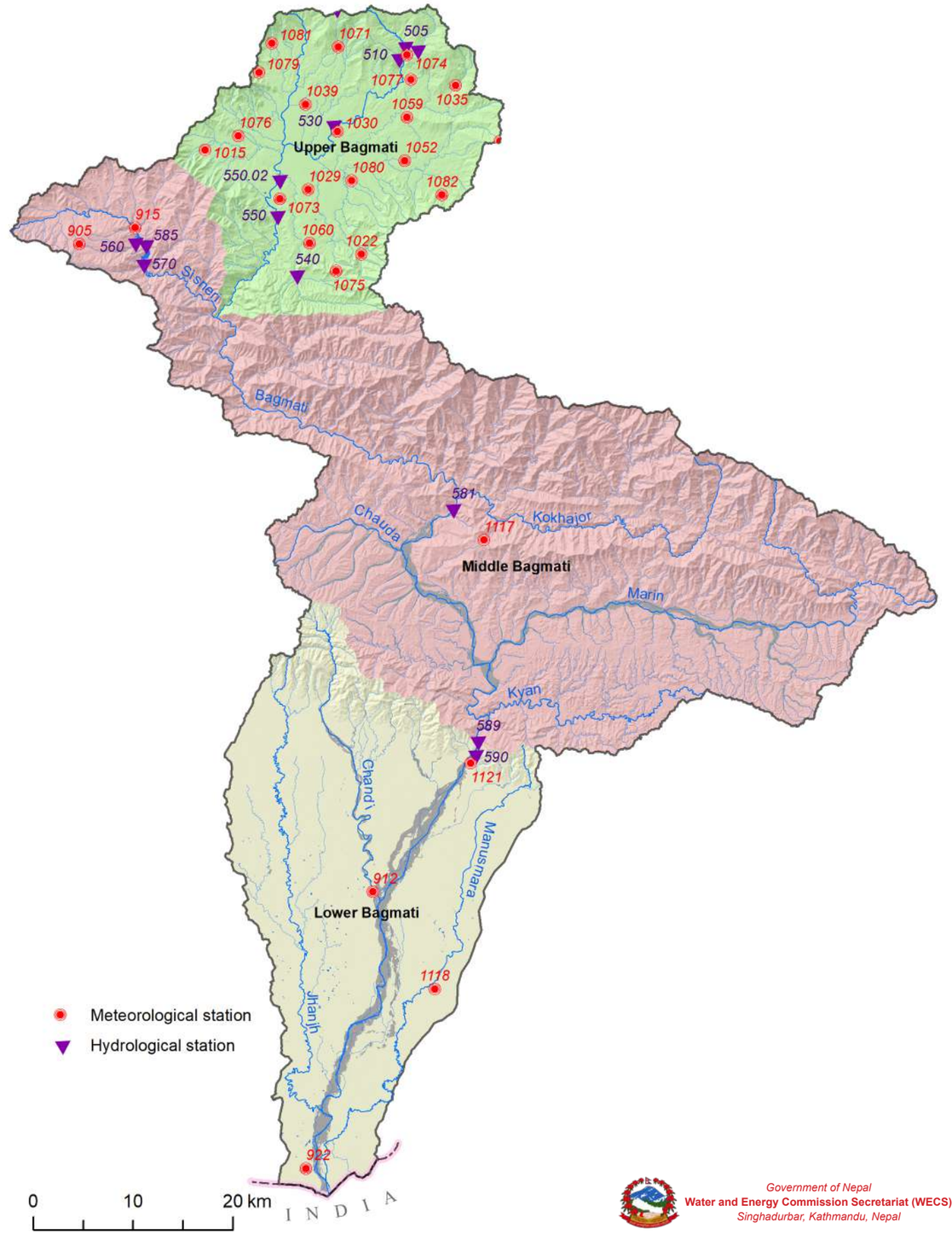
SN	Province	District	Name of Local Body	% of Area
1	Madhesh	Sarlahi	Bagmati NP	100
2			Balara NP	74
3			Barahathawa NP	82
4			Basbariya GP	73
5			Dhankaul GP	82
6			Haripur NP	6
7			Hariwan NP	22
8			Ramnagar GP	83
9		Rautahat	Brindaban NP	100
10			Chandrapur NP	100
11			Dewahhi Gonahi NP	6
12			Durga Bhagwati GP	100
13			Gadhimai NP	100
14			Garuda NP	100
15			Gaur NP	11
16			Gujara NP	82
17			Katahariya NP	25
18			Madhav Narayan NP	87
19			Rajdevi NP	100
20			Yemunamai GP	79
21	Bagamati	Sindhuli	Ghanglekh GP	100
22			Hariharpurgadhi GP	100
23			Kamalamai NP	29
24			Marin GP	100
25		Kabhrepalan-chok	Bethanchowk GP	25
26			Khanikhola GP	100
27			Mahabharat GP	100

SN	Province	District	Name of Local Body	% of Area
28	Bagamati	Kabhrepalanchok	Roshi GP	3
29		Lalitpur	Bagmati GP	100
30			Godawari NP	100
31			Konjyosom GP	100
32			Lalitpur MNP	100
33			Mahalaxmi NP	83
34			Mahankal GP	100
35		Bhaktapur	Bhaktapur NP	100
36			Changunarayan NP	100
37			Madhyapur Thimi NP	100
38			Suryabinayak NP	98
39		Kathmandu	Budhanilakantha NP	100
40			Chandragiri NP	92
41			Dakshinkali NP	100
42			Gokarneshwor NP	100
43			Kageshwori Manahora NP	100
44			Kathmandu MNP	100
45			Kirtipur NP	100
46			Nagarjun NP	92
47			Shankharapur NP	50
48			Tarakeshwor NP	86
49			Tokha NP	100
50		Makawanpur	Bagmati GP	100
51			Bakaiya GP	19
52			Bhimphedi GP	24
53			Indrasarowar GP	100
54			Thaha NP	60

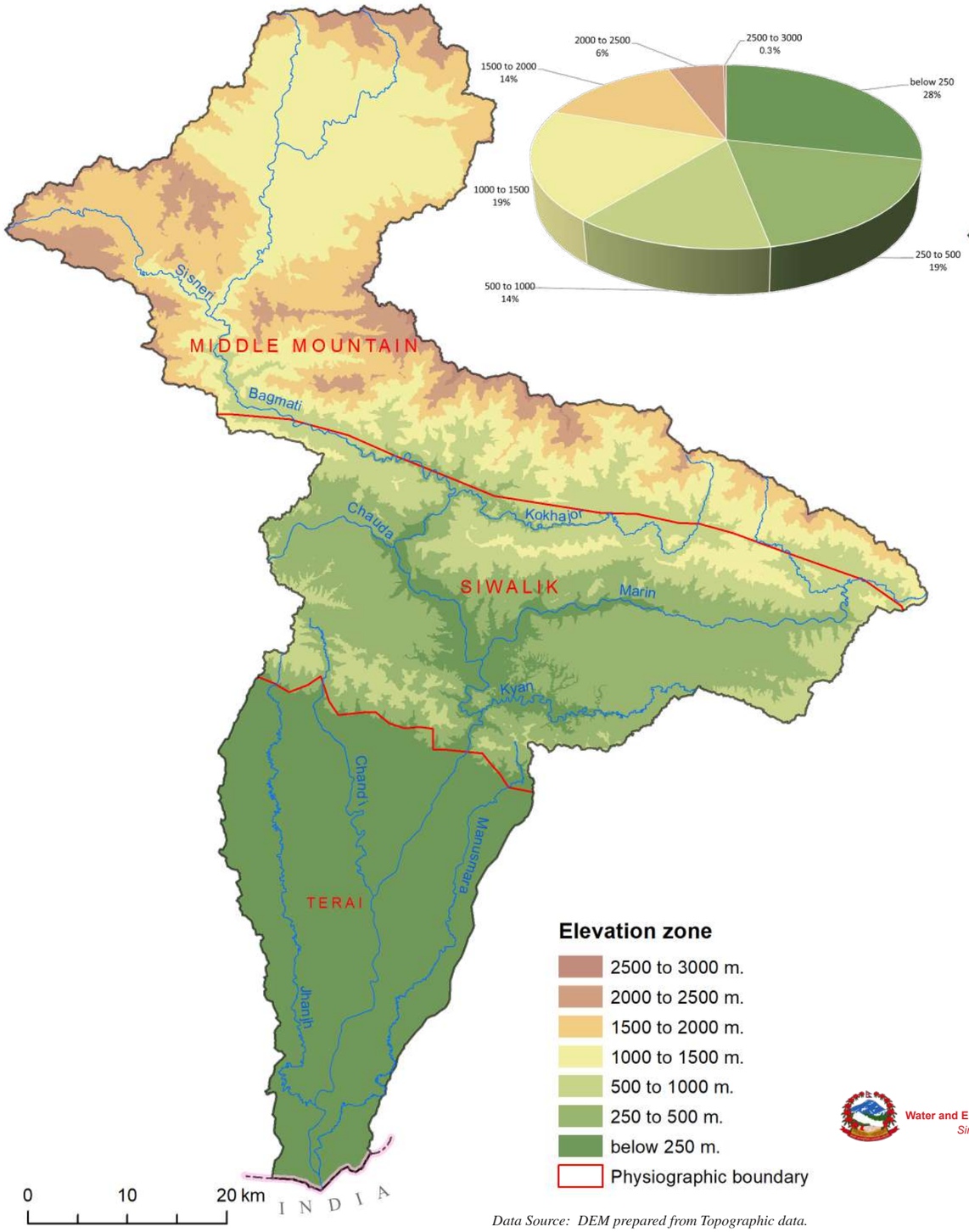
River Flow Line Diagram of Bagmati River



River System



Elevation Zone

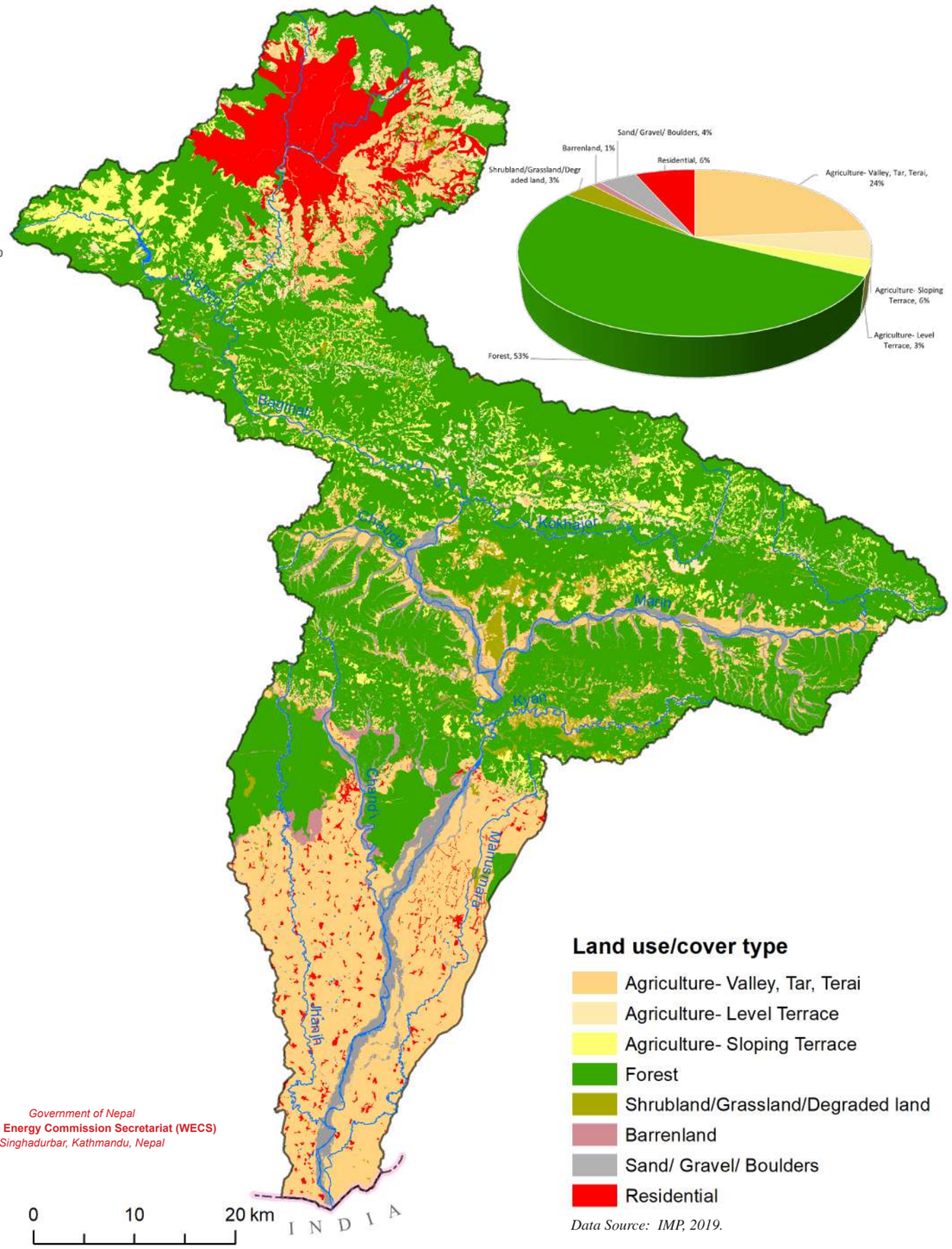


Elevation zone

- 2500 to 3000 m.
- 2000 to 2500 m.
- 1500 to 2000 m.
- 1000 to 1500 m.
- 500 to 1000 m.
- 250 to 500 m.
- below 250 m.
- Physiographic boundary

Data Source: DEM prepared from Topographic data.

Land Use/Cover



Land use/cover type

- Agriculture- Valley, Tar, Terai
- Agriculture- Level Terrace
- Agriculture- Sloping Terrace
- Forest
- Shrubland/Grassland/Degraded land
- Barrenland
- Sand/ Gravel/ Boulders
- Residential

Data Source: IMP, 2019.

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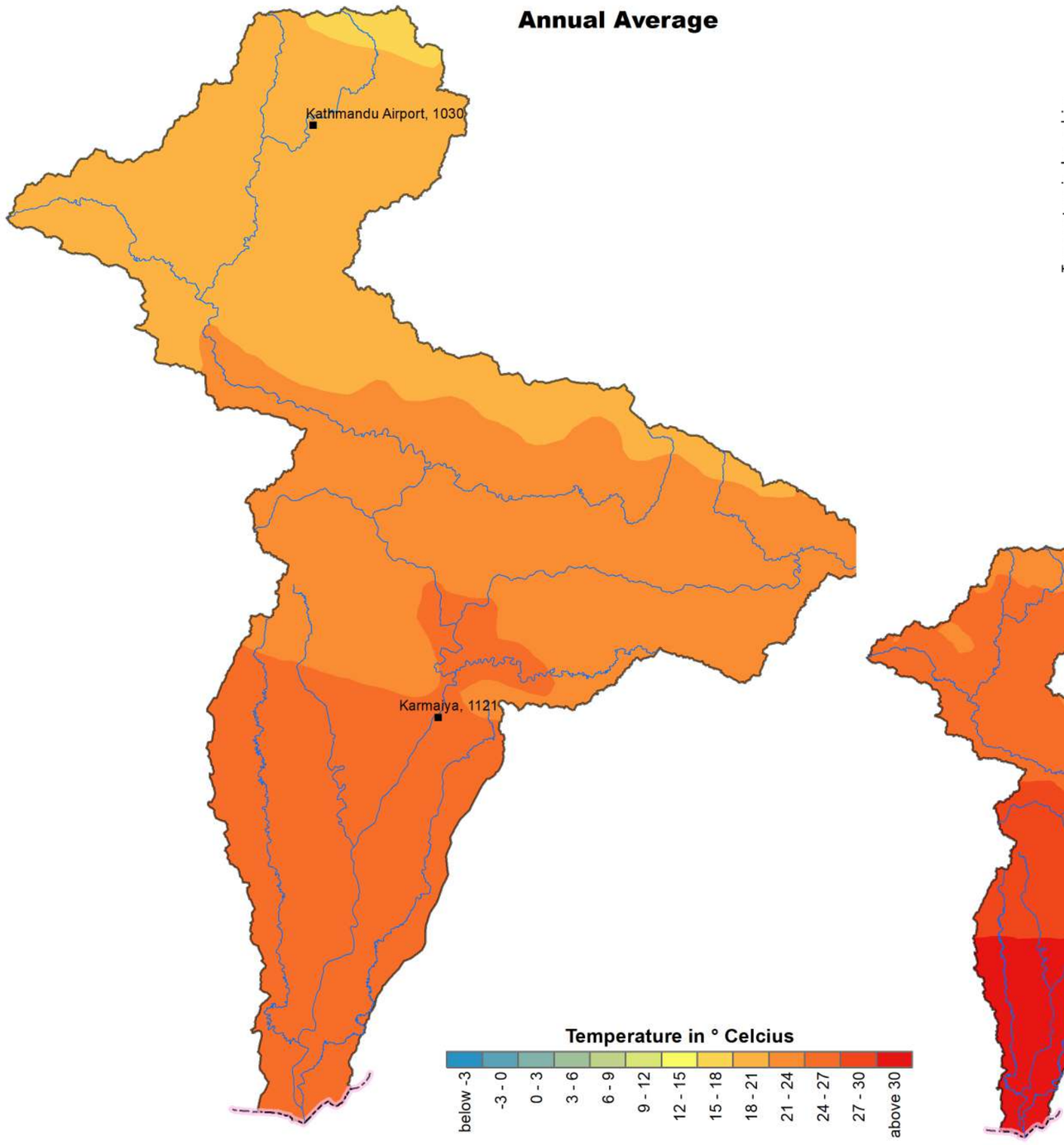
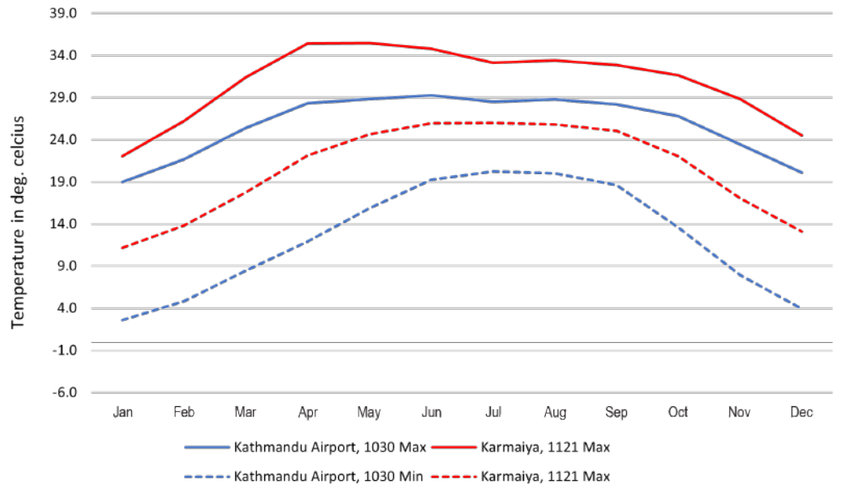
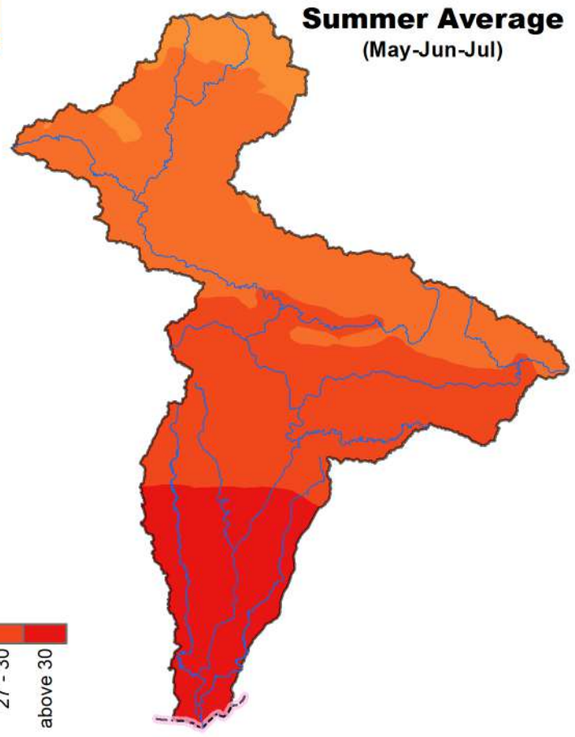
Average Temperature Distribution







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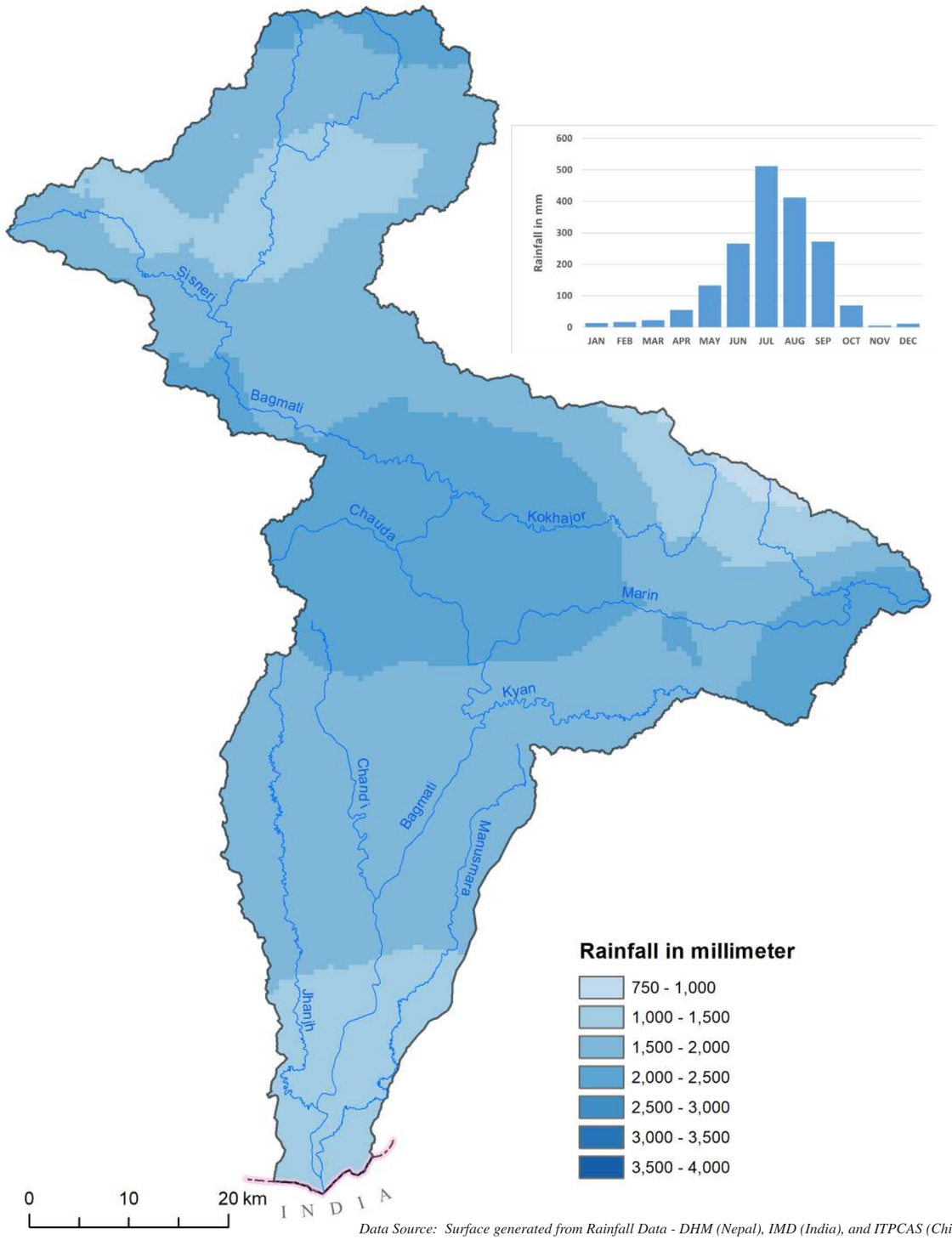
Data Source: Surface generated from DHM Temperature Data - 1985-2015.

Annual Average Rainfall Distribution



Rainfall in millimeter

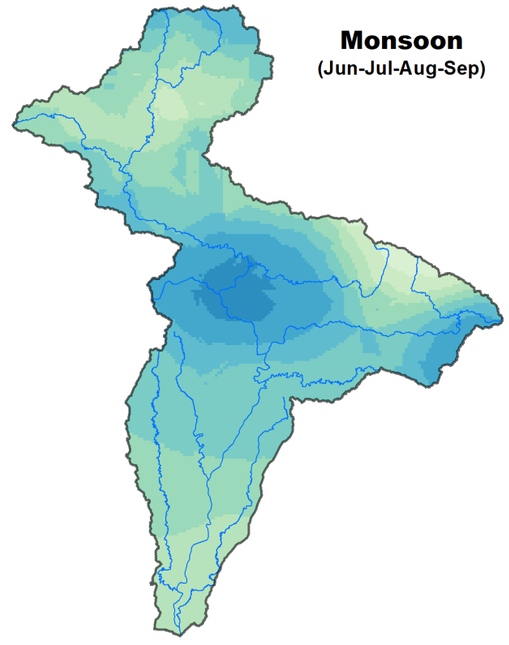
- 750 - 1,000
- 1,000 - 1,500
- 1,500 - 2,000
- 2,000 - 2,500
- 2,500 - 3,000
- 3,000 - 3,500
- 3,500 - 4,000

Rainfall

0, 50, 100, 150, 200, 400, 600, 800, 1,000, 1,200, 1,400, 1,600, 1,800, 2,000, 2,500, 3,000, 3,500, 4,000

Seasonal Average Rainfall Distribution

Pre-Monsoon
(Mar-Apr-May)



Monsoon
(Jun-Jul-Aug-Sep)

Post-Monsoon
(Oct-Nov)

Winter
(Dec-Jan-Feb)

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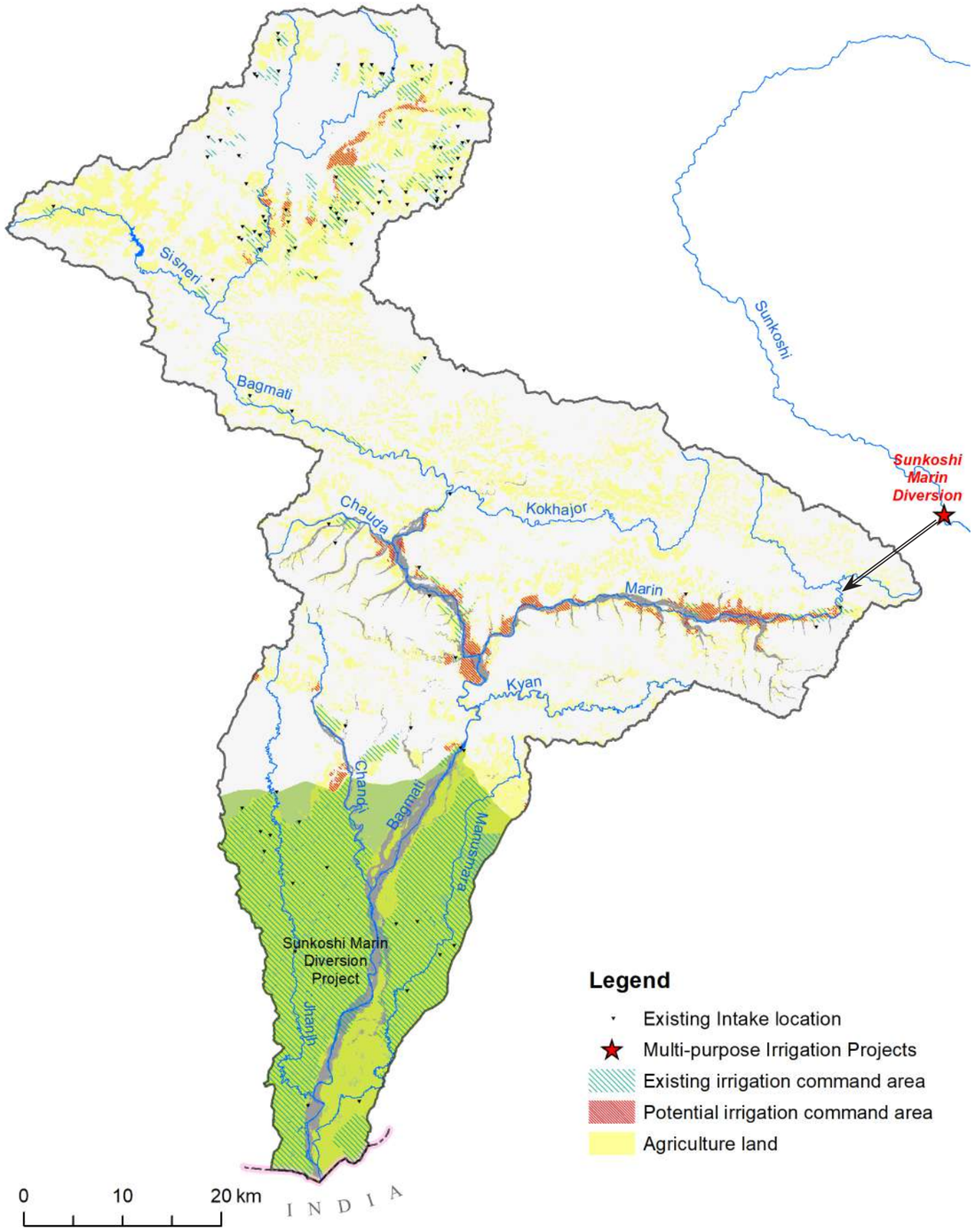
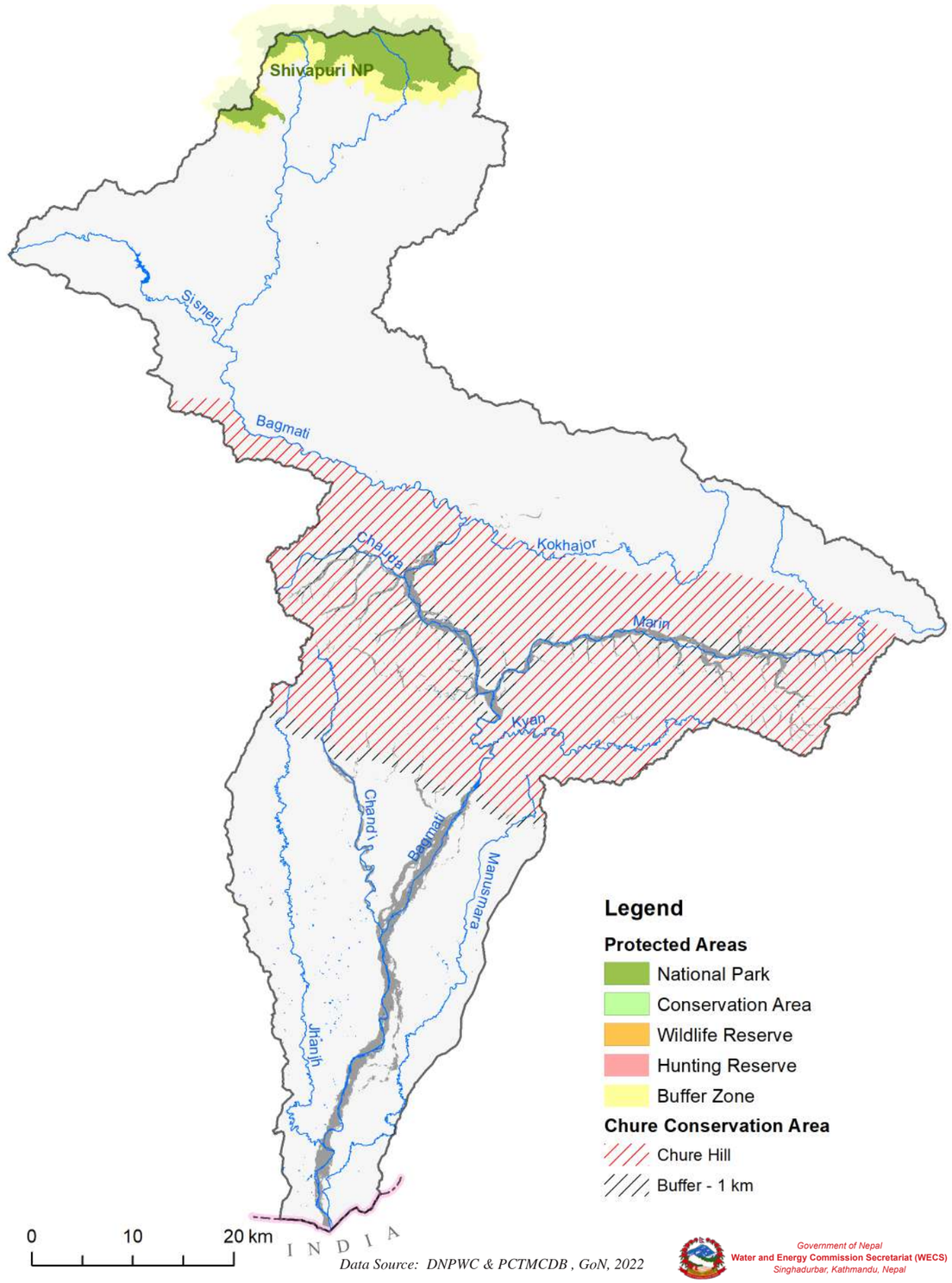
Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

Irrigation Projects



Protected Areas



Data Source: DNPWC & PCTMCDB , GoN, 2022

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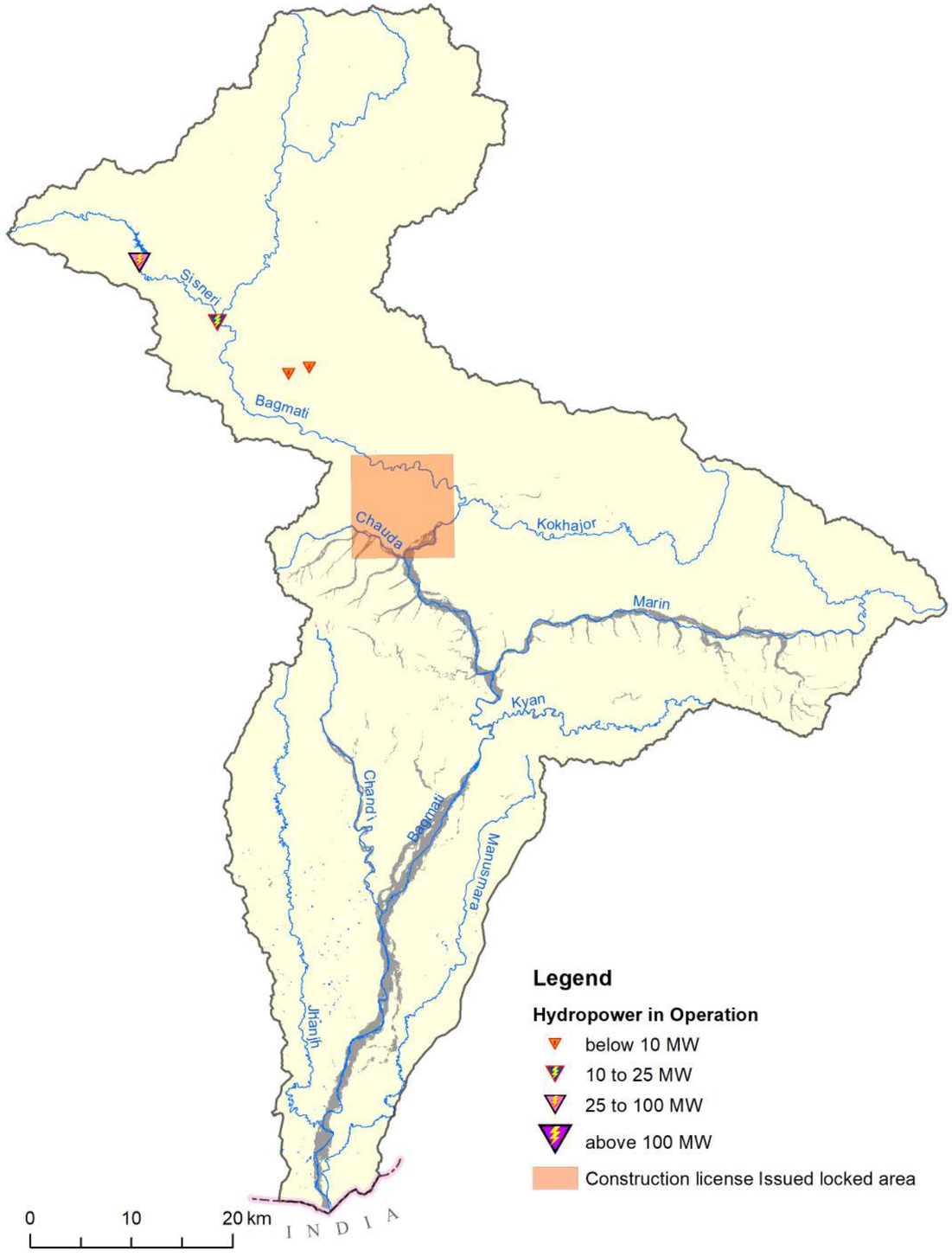
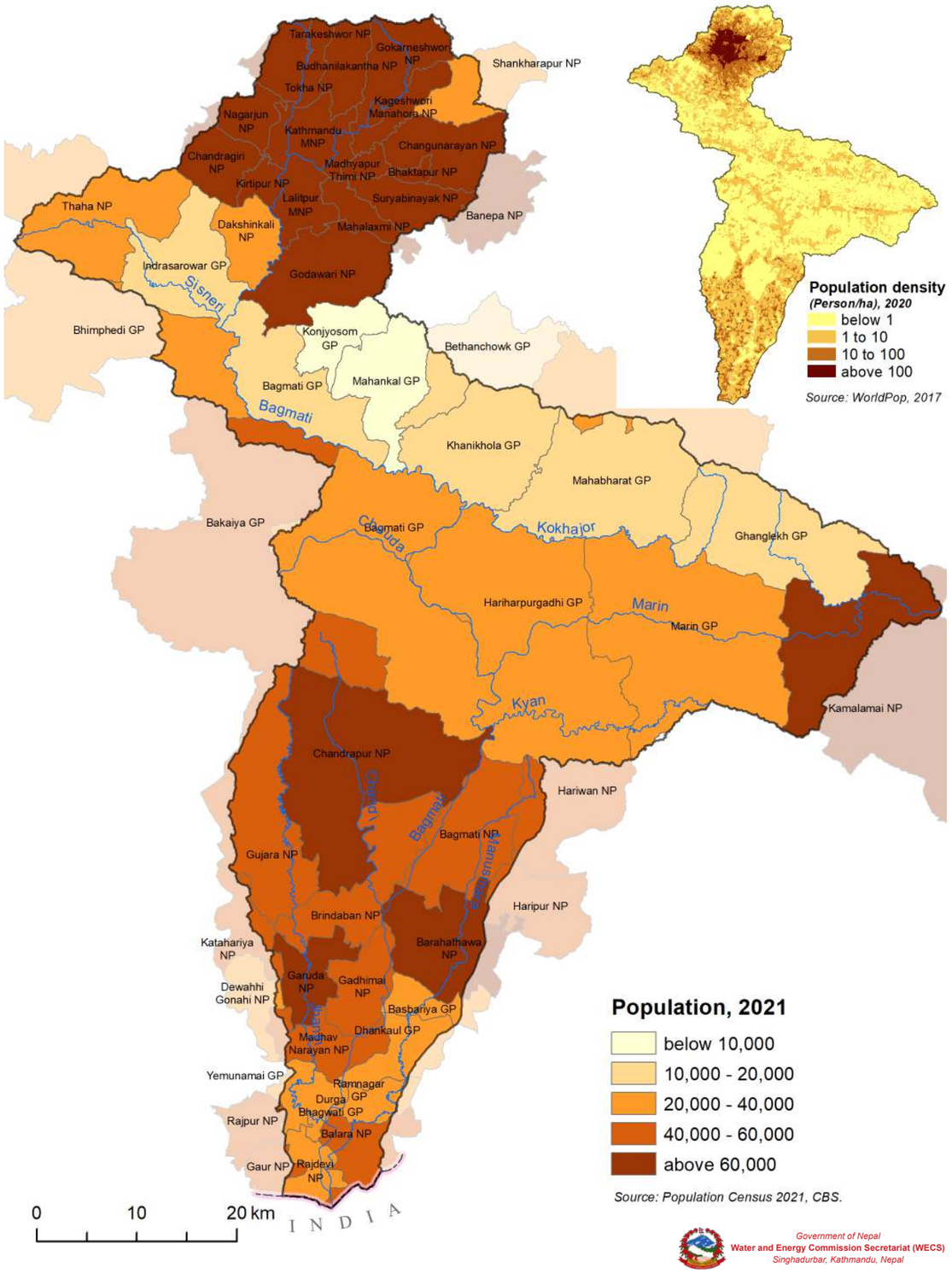
Hydropower Projects



Population Distribution and Density



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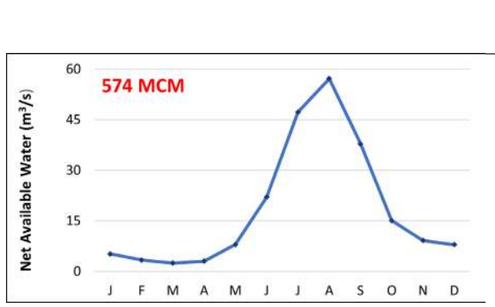
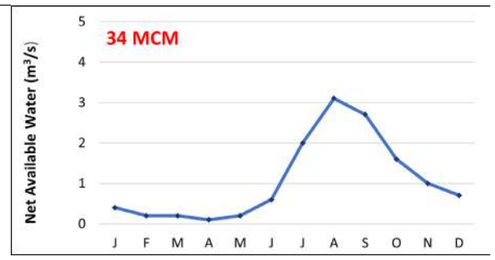
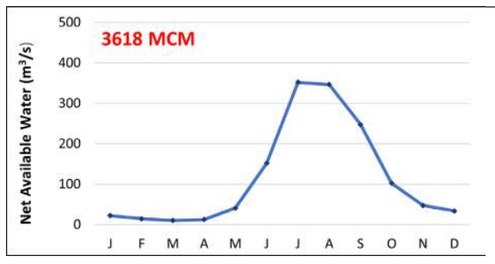
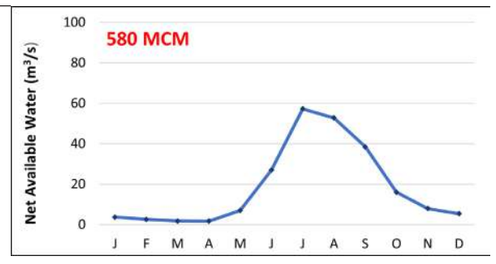
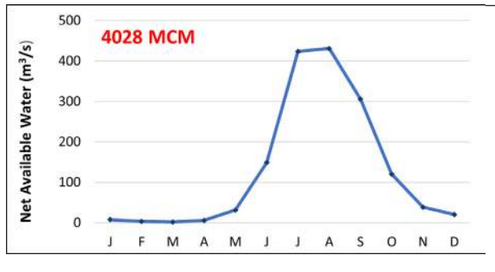
Hydrographs at Major River Nodes

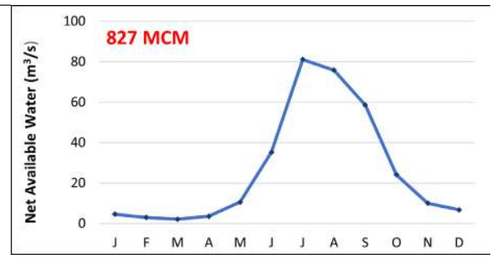












Source: Integrated River Basin Development Master Plan of Bagmati River Basin Review and Update, 2024, WECS.

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8. Kamala Basin

Kamala Basin

The Kamala River originates from the Mahabharat range in Kamala Mai Rural Municipality of Sindhuli district draining the southern slopes of the middle mountains of the Mahabharat Range. The basin extends from 85° 49' 50.16" to 86° 36' 24.12" East longitudes and 26° 36' 18.00" to 27° 16' 42.60" North latitudes in Nepal . Near Maithan, it makes a turn and flows eastwards parallel on the northside of the Siwalik hill. The river is joined by Tawa Khola, which originates from Udaypur district flowing from east to west. The Kamala makes a U-bend near Mari and flows northwest to Chisapani in Dhanusa district. From there, it turns to the south cutting through the low Siwalik Range and emerging unto the Terai just south of Chisapani Bazar. The mainstream of Kamala River is about 126 km long.

The total area of the basin up to Nepal-India Border is about 2,219 km² which is about 1.5 percent of the whole country. The elevation ranges from 66 m to 2203 m.

The basin area is located in 4 districts and has 20 local bodies with 6 Rural Munacipalities and 14 Urban Municipalities .

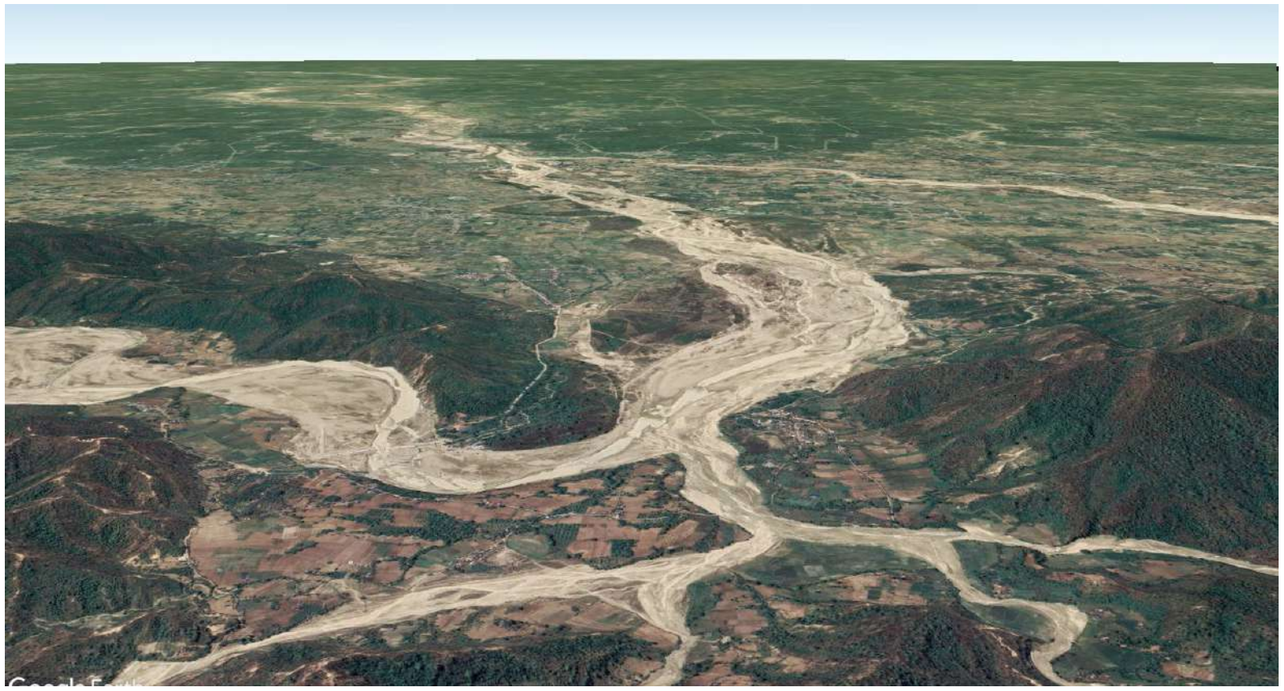


Figure 2.8: Kamala River flows down to Terai plain land

Salient Features of Kamala Basin

Basin location	*Latitudes: 26°36'18" to 27°16'43" N* *Longitudes: 85°49'50" to 86°36'25" E*
Catchment area	*2,219 sq.km.*
Major rivers	*Tawa (44 km), Chadaha (38 km) and Charnath Khola (33 km)*
River length	*126 km (up to Nepal-India border)*
Elevation	*Maximum - 2,203 m.* *Minimum - 68 m.*
Hydro-meteorological stations	*4 Meteorological stations* *2 Hydrological stations*
Flood forecasting stations	*1*
Average annual rainfall	*1,629 mm*
Average river flow (Nepal - India border)	*111.7 cumec; 3,523 MCM (annual)*
Existing hydropower stations and Capacity (DOED, March 2023)	*0*
Agriculture land	*80,916 ha.*
Existing big irrigation systems	*1*
Total irrigated area in basin (as per inventory of IMP, 2019)	*48,663 ha. (2025)* *57,016 ha. (2050)*
Total population (extimated from Population Census, 2021)	*655,074*
Forest land	*114,300 ha.*
Total water demand (for 2025)	*Irrigation demand: 1030 MCM* *Domestic demand: 43 MLD*
Administrative units	*Pradesh: Bagmati, Koshi, and Madhesh* *Districts: 4* *Local Bodies:* *(7 Gaupalika; 14 Nagarpalika)*

Administrative Division of Kamala Basin

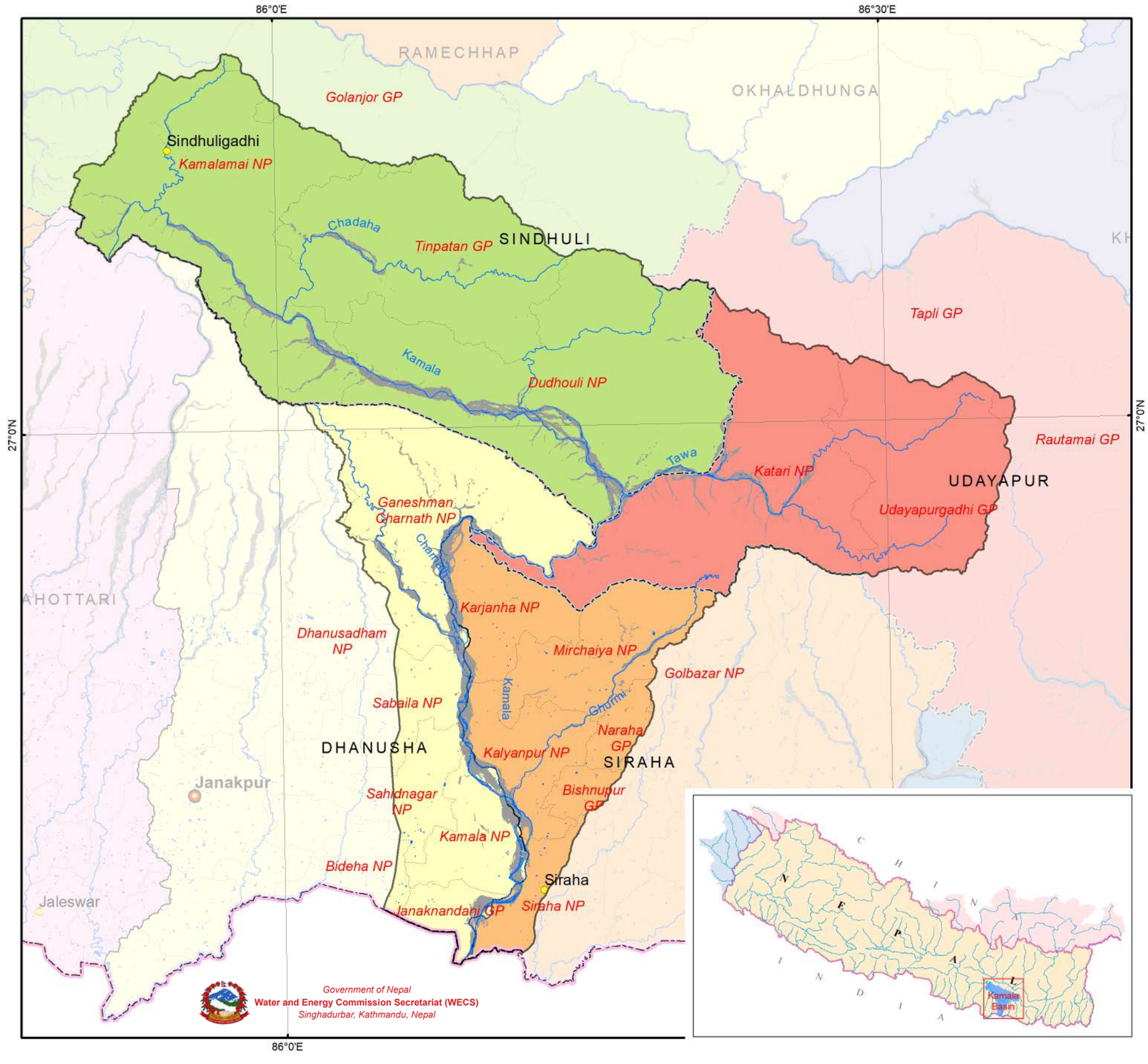
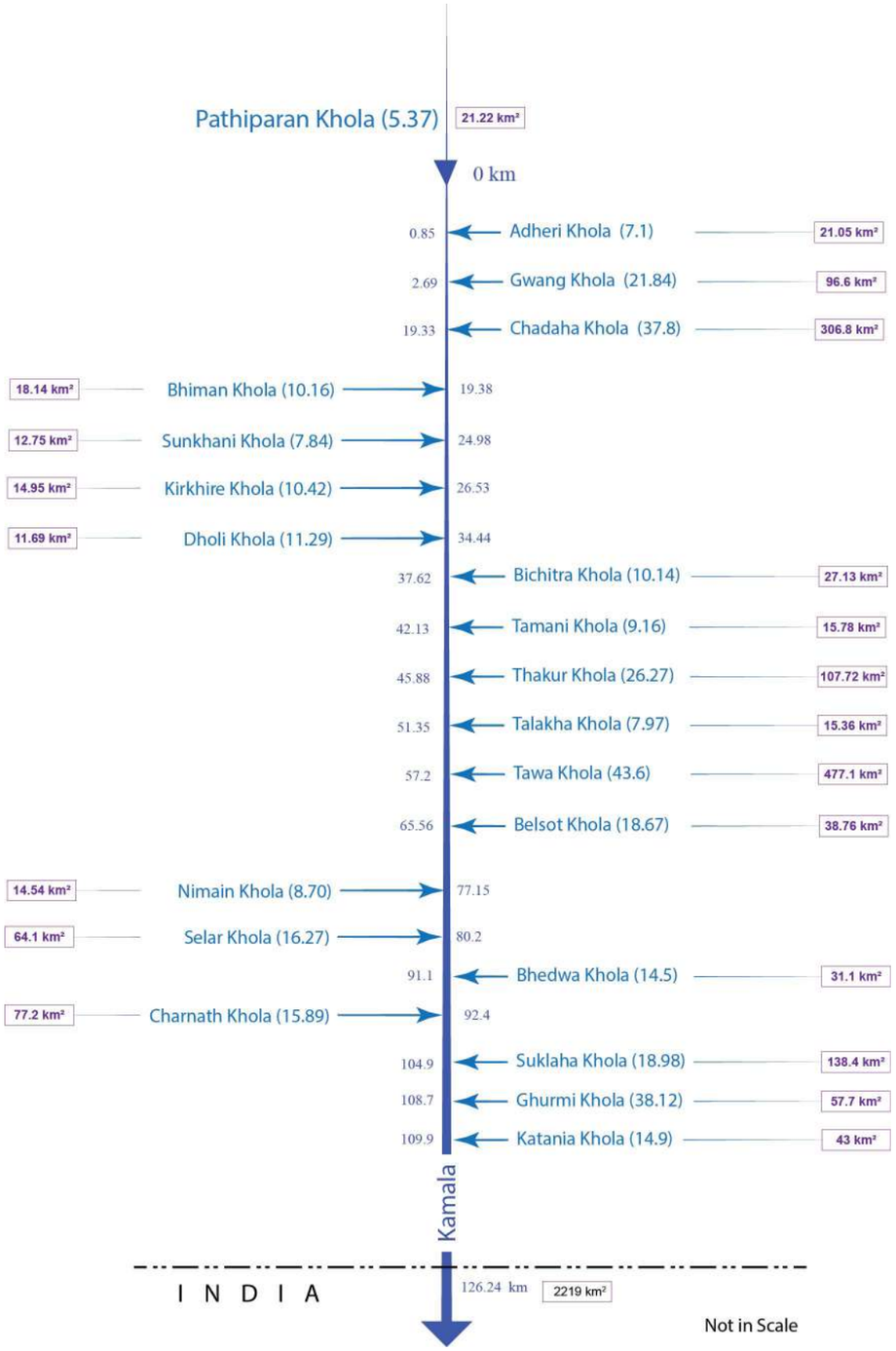


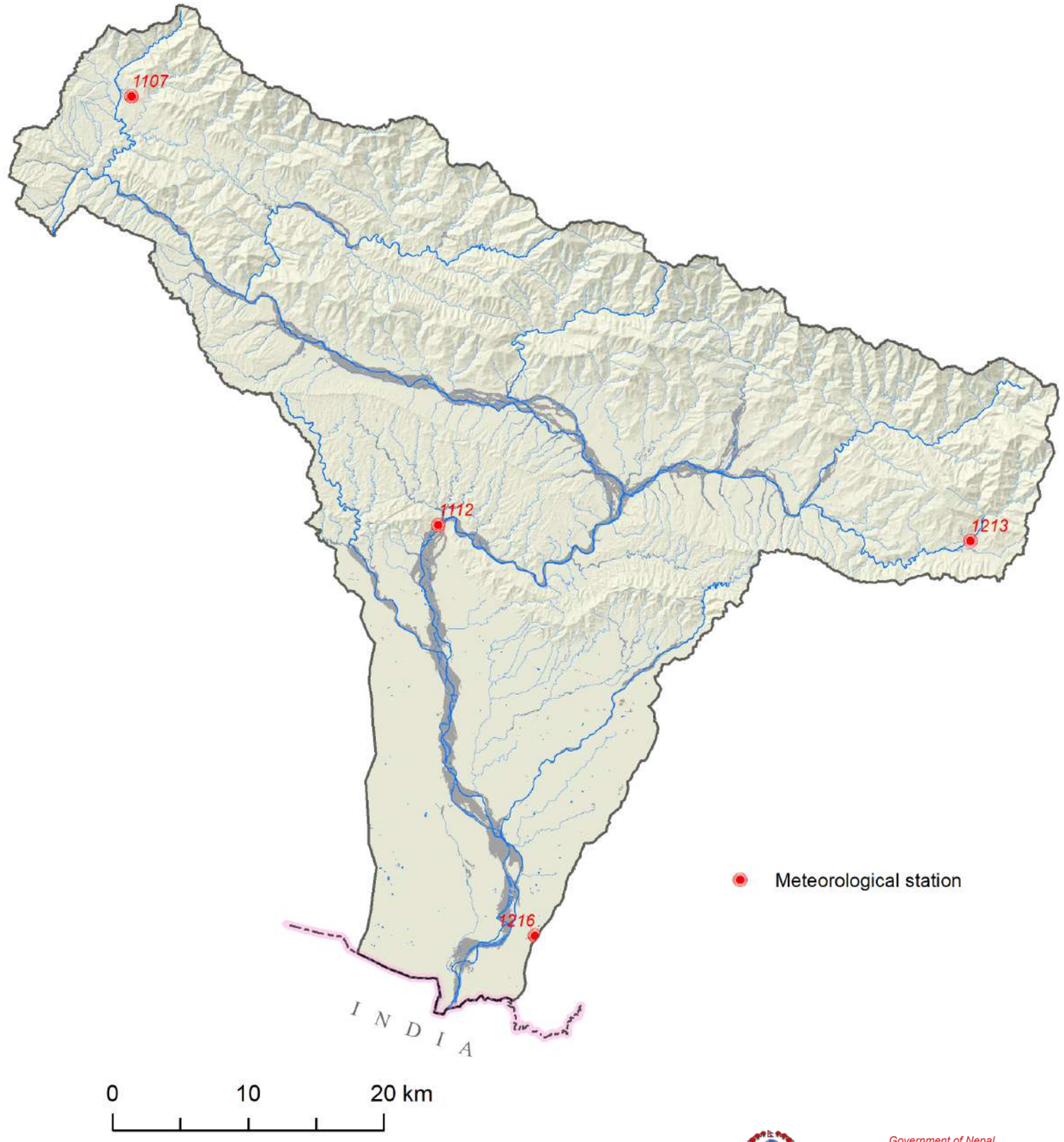
Table 2.8 List of Local Bodies in Bagmati Basin

SN	Province	District	Name of Local Body	% of Area
1	Koshi	Udayapur	Katari NP	72
2			Rautamai GP	2
3			Udayapurgadhi GP	69
4	Madhesh	Siraha	Bishnupur GP	70
5			Golbazar NP	12
6			Kalyanpur NP	100
7			Karjanha NP	100
8			Mirchaiya NP	100
9			Naraha GP	83
10			Siraha NP	40
11		Dhanusha	Bideha NP	14
12			Dhanusadham NP	2
13			Ganeshman Charnath NP	91
14			Janaknandani GP	100
15			Kamala NP	100
16			Sabaila NP	60
17			Sahidnagar NP	75
18	Bagamati	Sindhuli	Dudhouli NP	100
19			Golanjor GP	4
20			Kamalamai NP	69
21			Tinpatan GP	87

River Flow Line Diagram of Kamala River



River System



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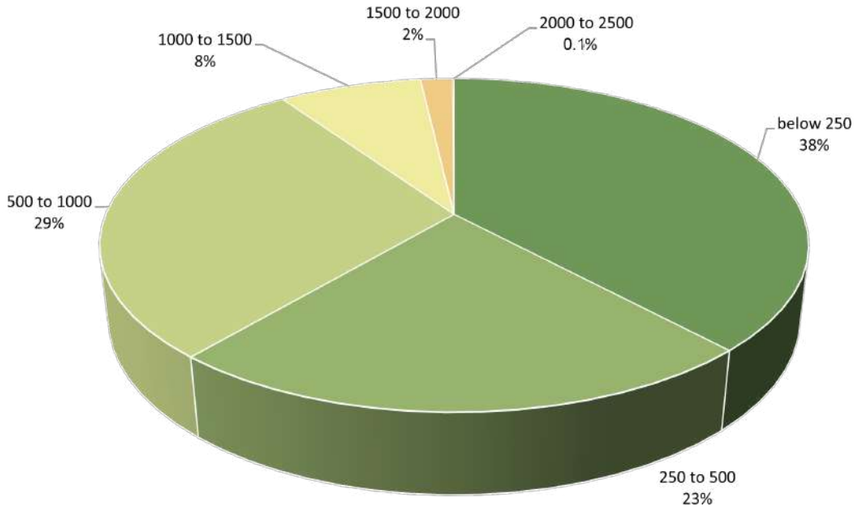
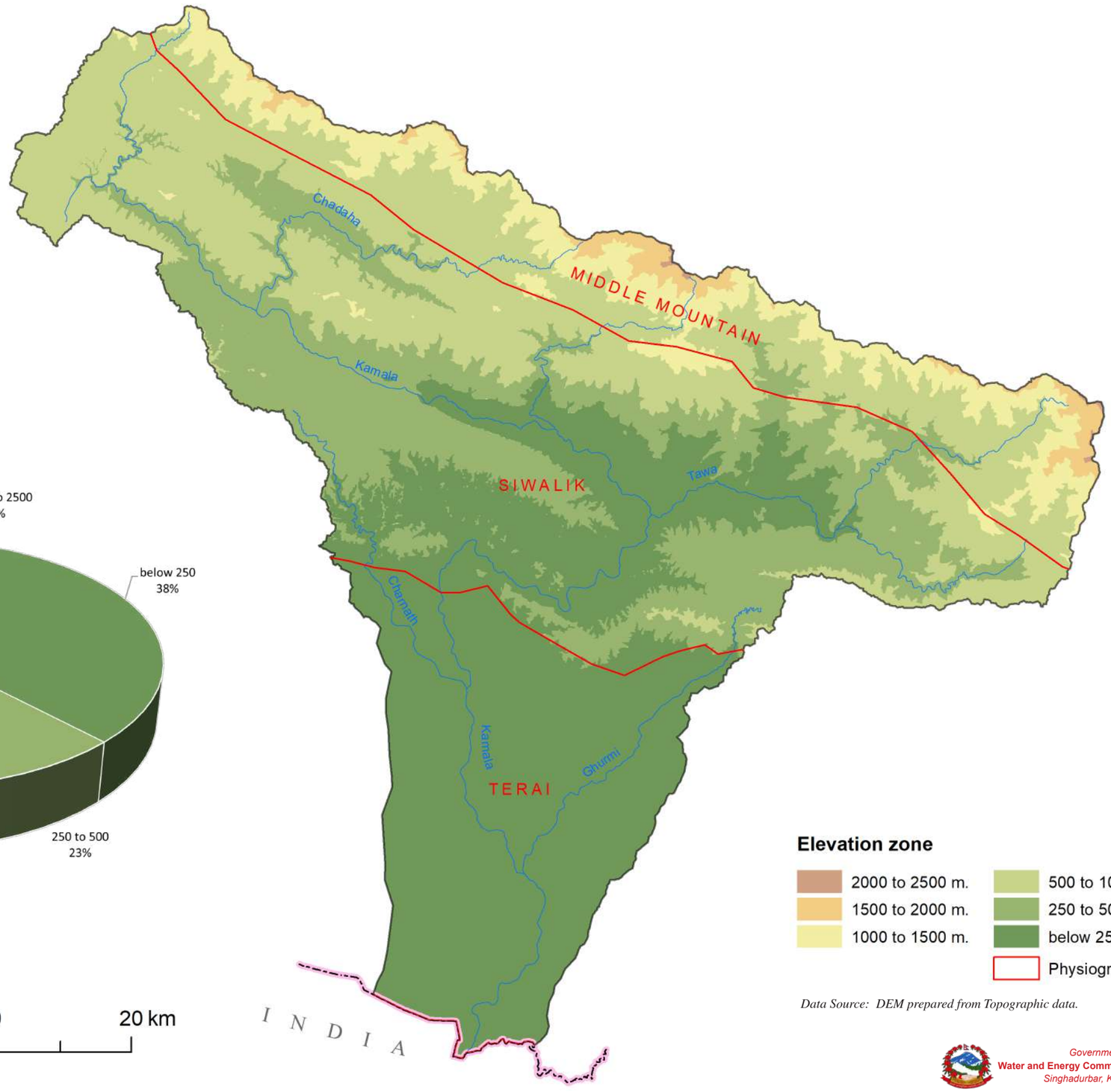
Elevation Zone





Data Source: DEM prepared from Topographic data.

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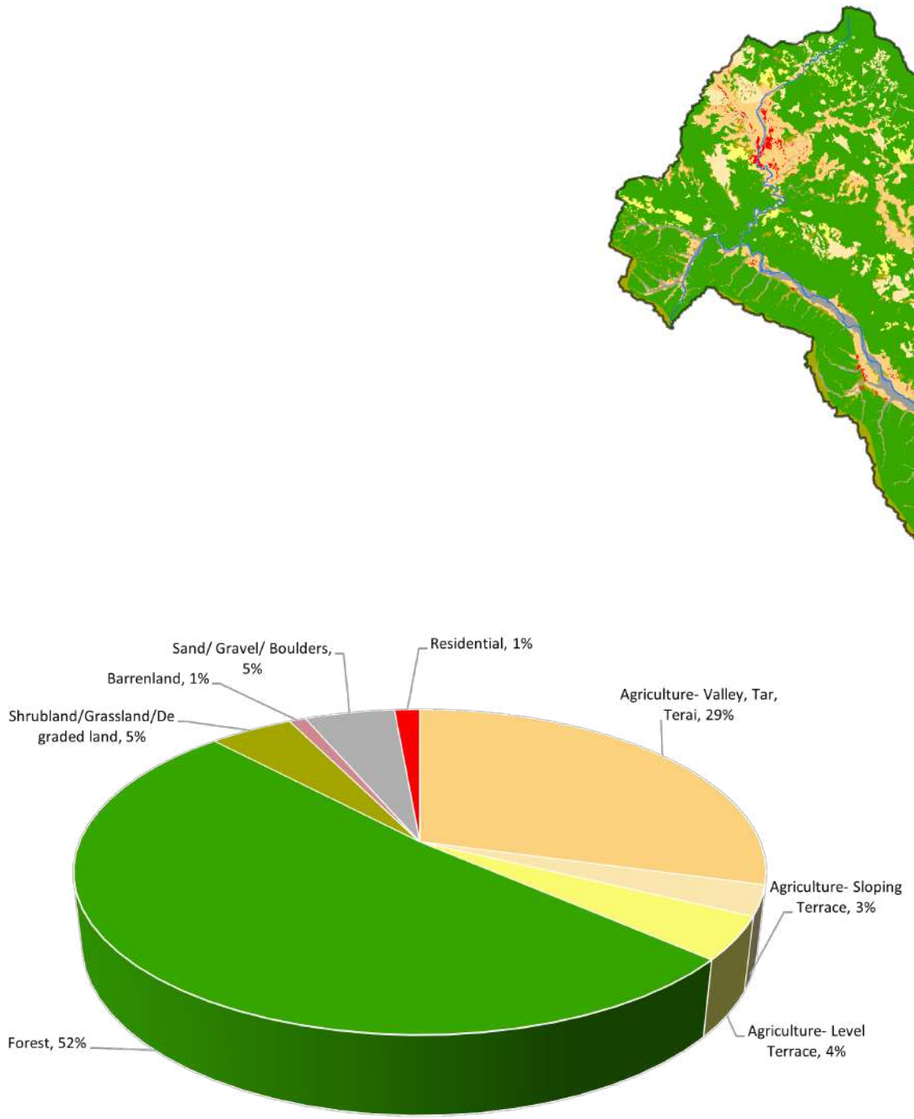
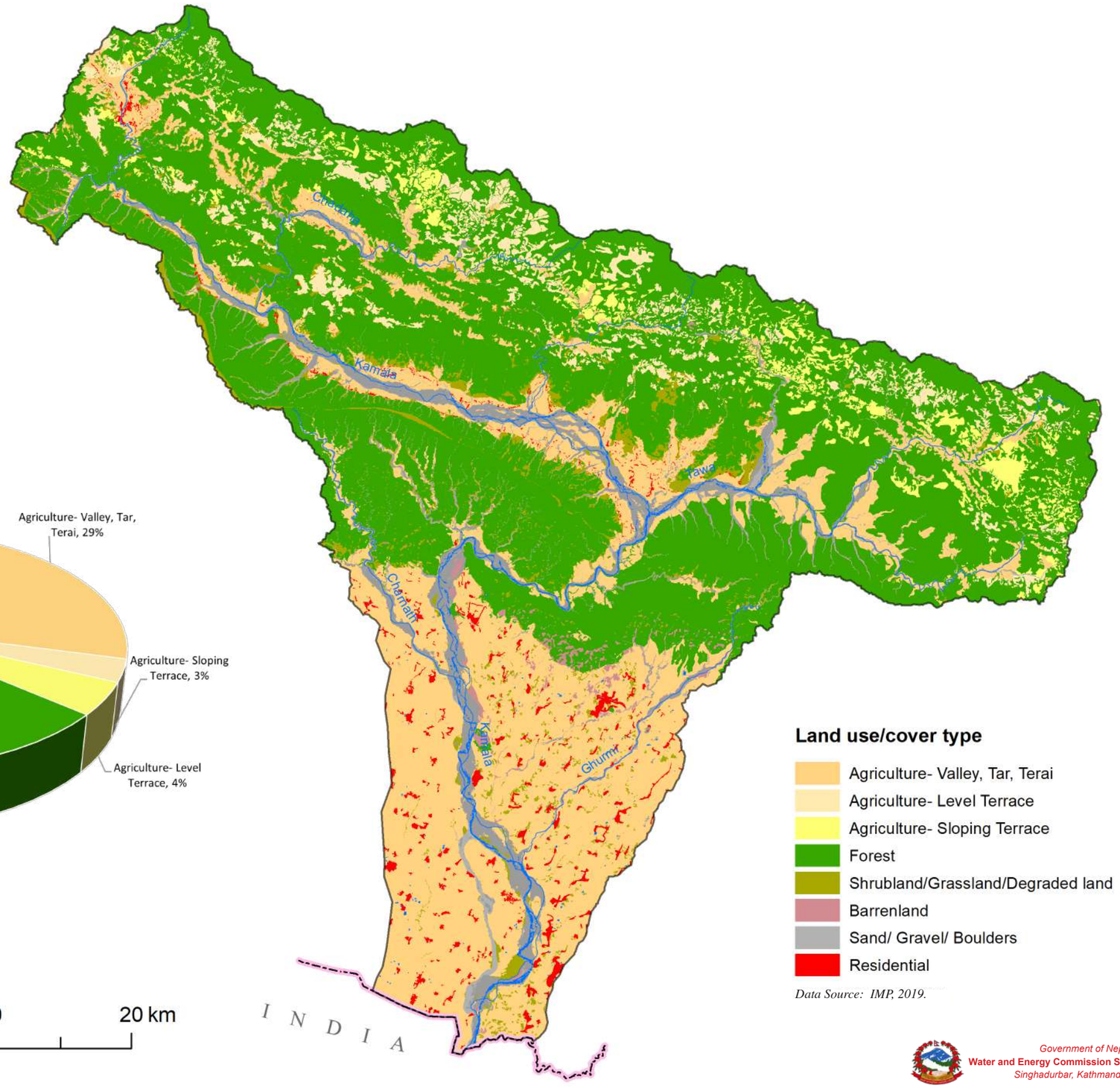
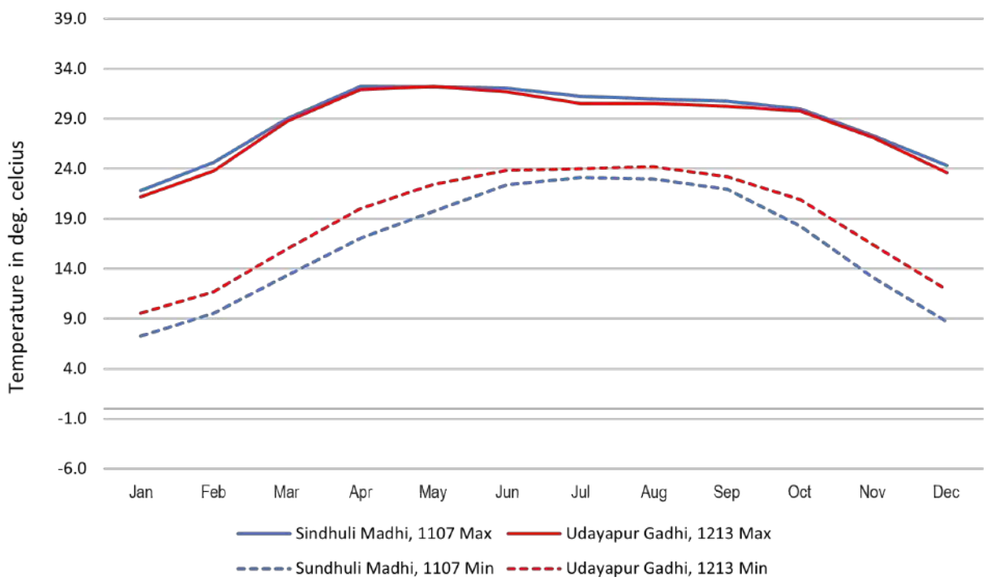
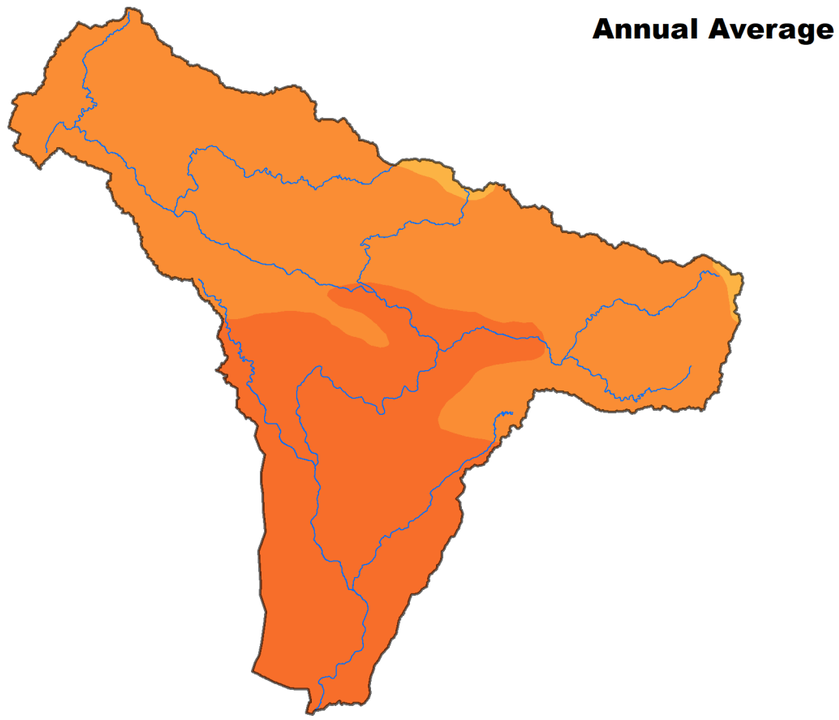
Land Use/Cover

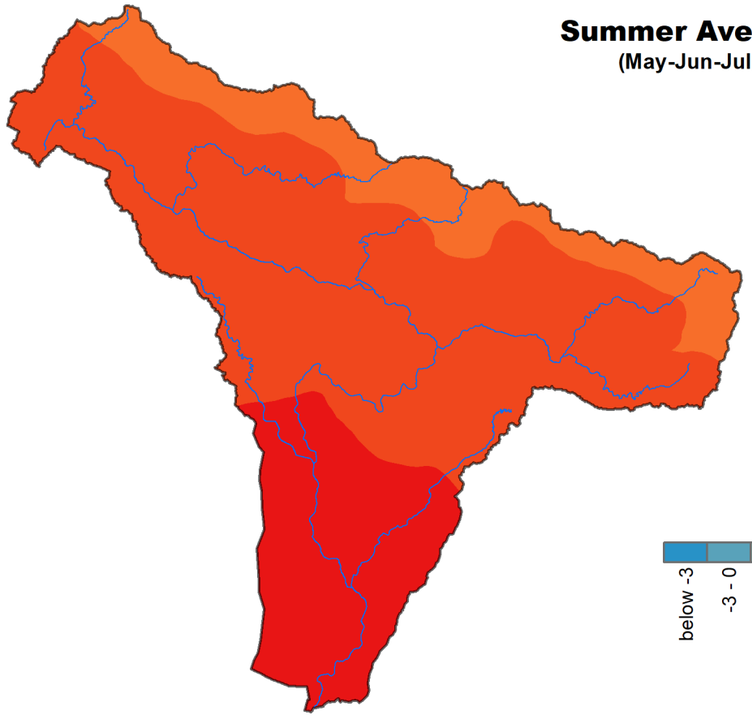


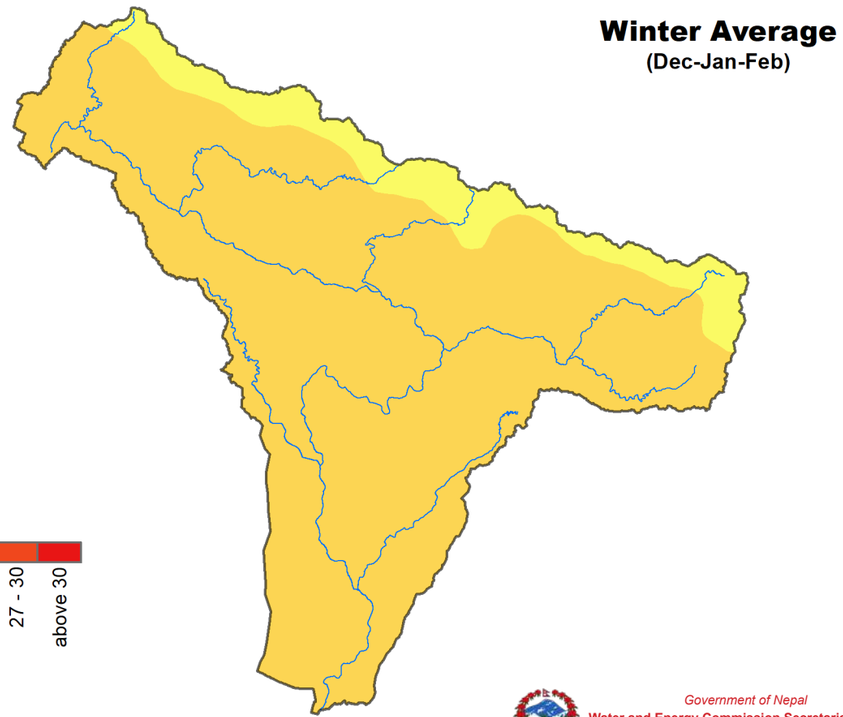


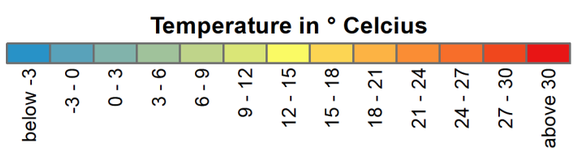
Average Temperature Distribution











Data Source: Surface generated from DHM Temperature Data - 1985-2015.

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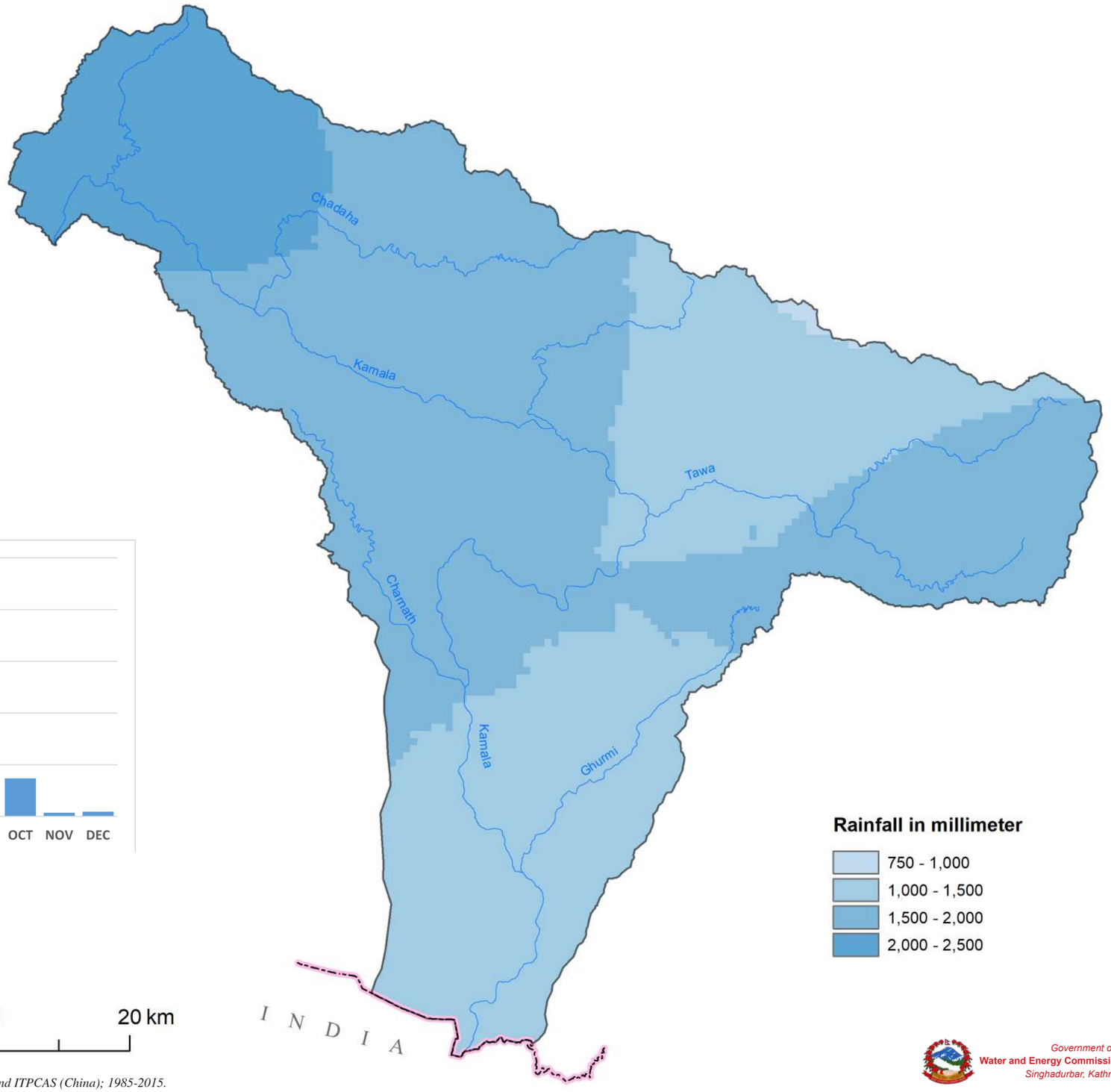
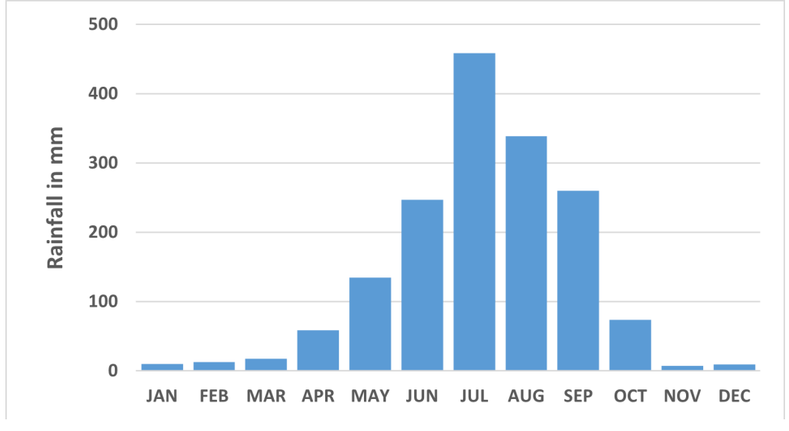
Annual Average Rainfall Distribution





Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

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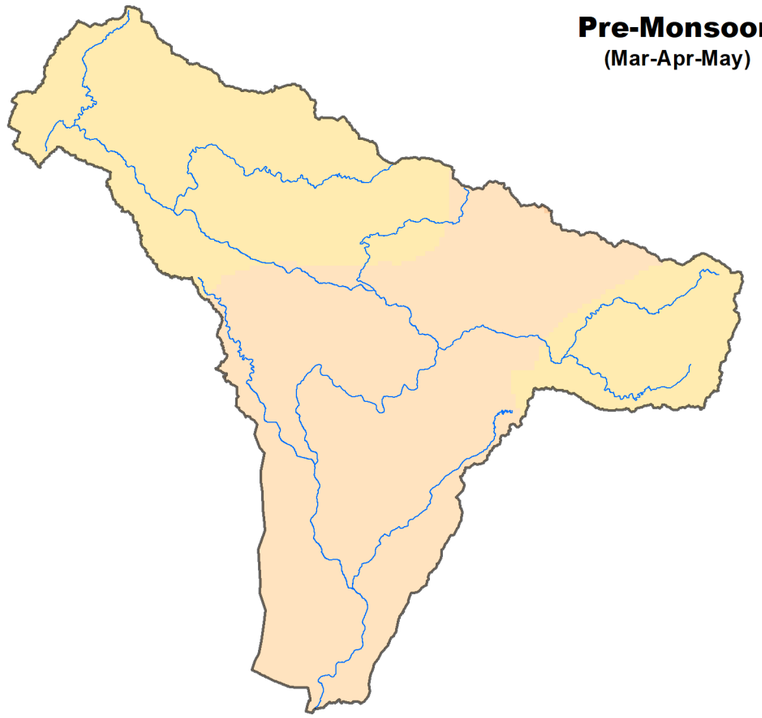
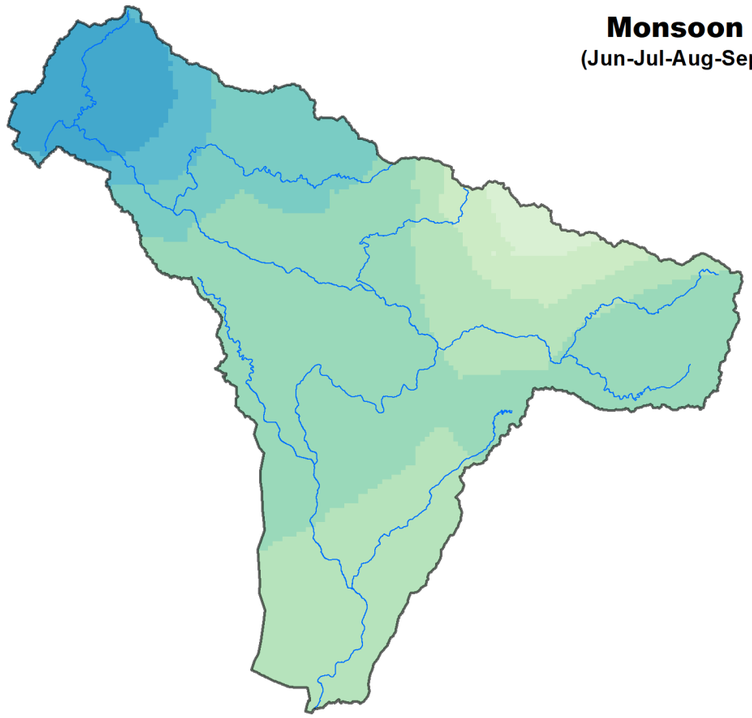
Seasonal Average Rainfall Distribution

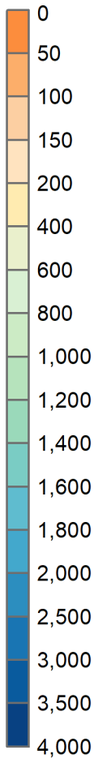
Pre-Monsoon
(Mar-Apr-May)



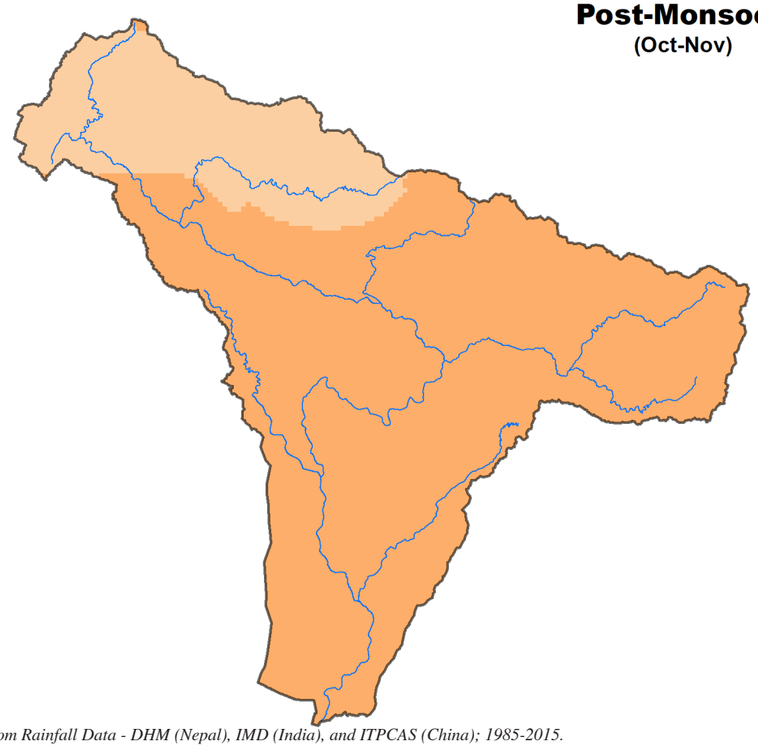
Monsoon
(Jun-Jul-Aug-Sep)



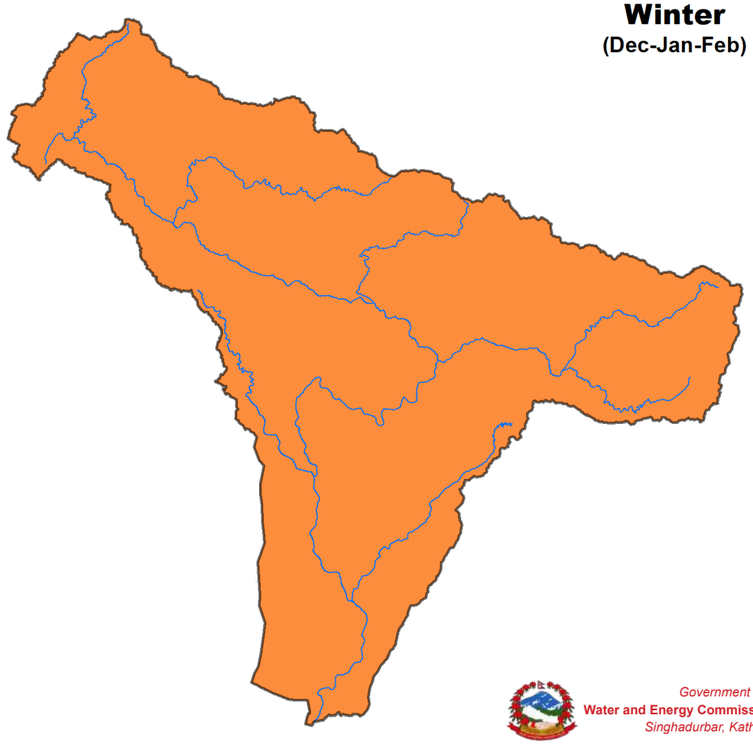
Rainfall in millimeter



Post-Monsoon
(Oct-Nov)



Winter
(Dec-Jan-Feb)



Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

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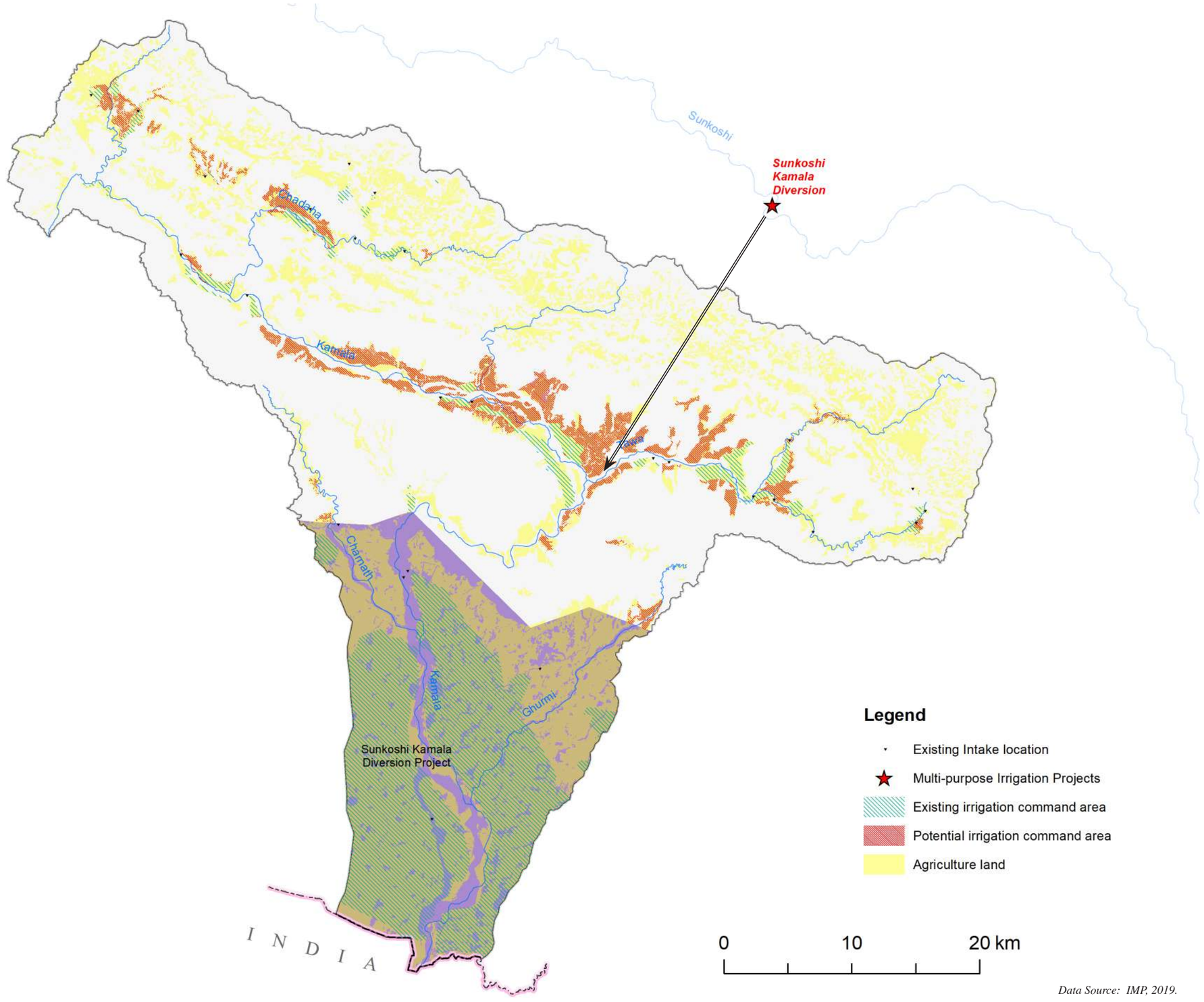
Irrigation Projects



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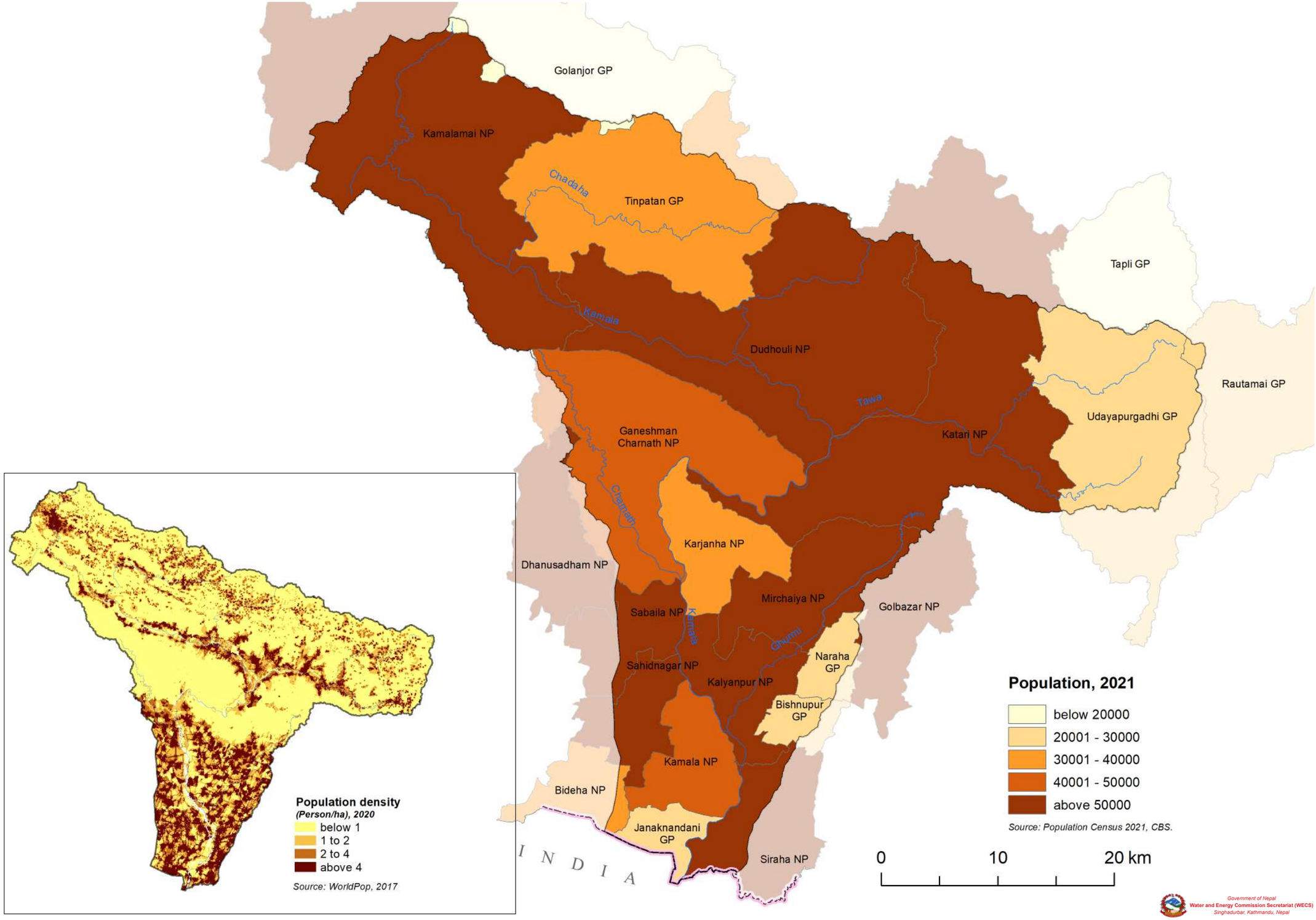
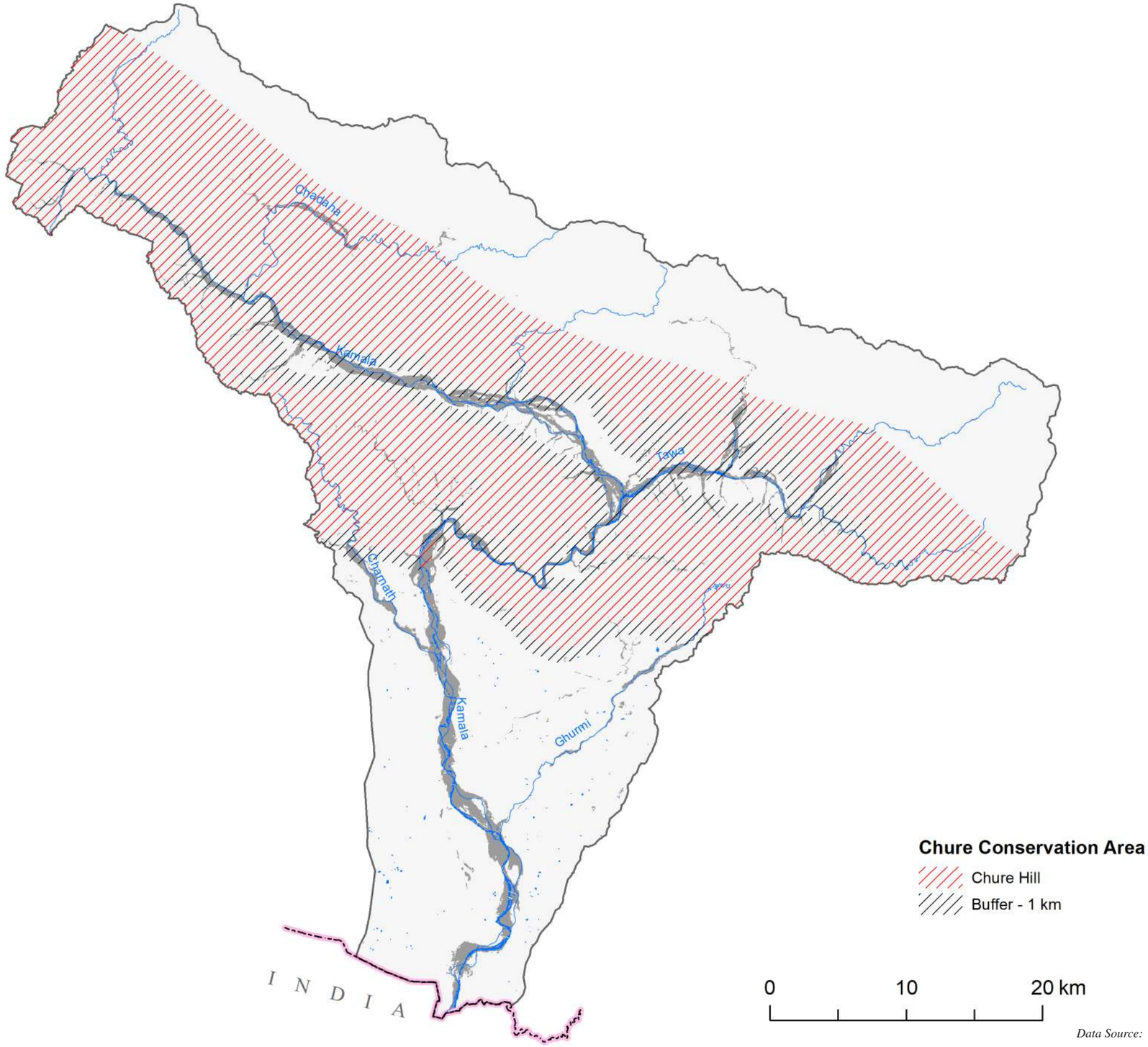
Data Source: IMP, 2019.

Population Distribution and Density



Protected Areas



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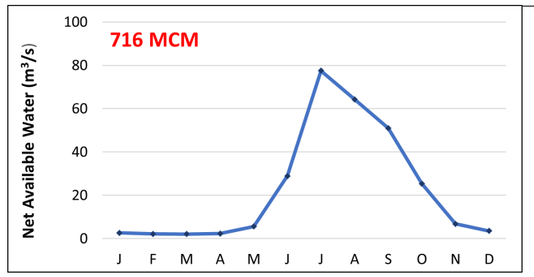
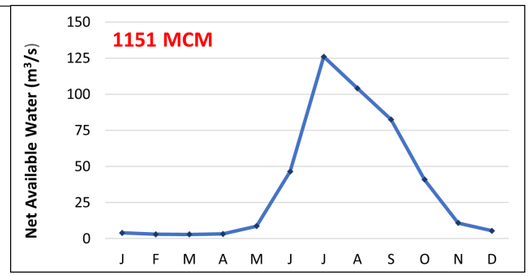
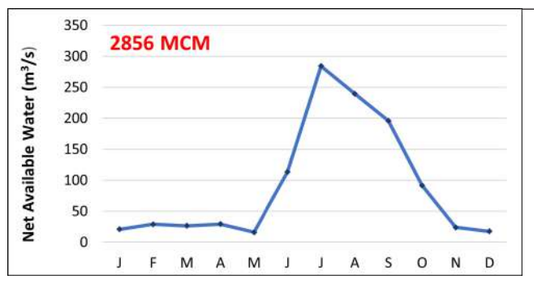
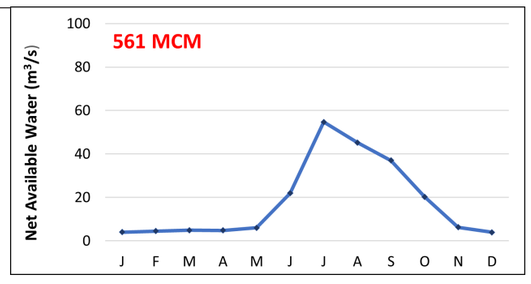
Data Source: PCTMCDB, GoN, 2022.

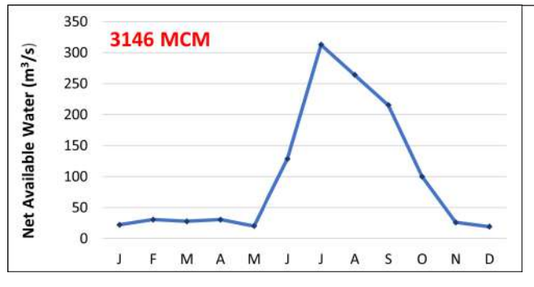
Hydrographs at Major River Nodes

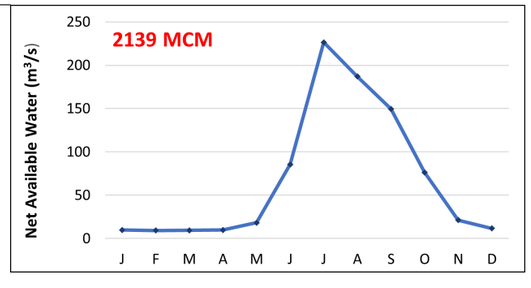












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9. Kankai Basin

Kankai Basin

The Kankai River Basin is a small basin of 1,328 km², which is about 0.9 percent land of the country. The basin extends from 87° 40' 48" to 88° 08' 08" East longitudes and 26° 26' 11" to 27° 06' 25" North latitudes in Nepal. The Kankai river flows in Koshi Pradesh in eastern Nepal draining the middle hills of Mahabharat Range as well as the Siwaliks and the Terai. It drains the northern parts of Ilam district, southeastern part of Panchthar district and a strip of the Jhapa district to the south. The basin borders India on the north-east part, and Panchthar district. The elevation range of the river basin ranges from 67 m to 3717 m. It flows through Bihar and merges into Mahananda River, called Fulahar River locally, at Bhasia of Bihar which ultimately drains into the Ganges.

The average annual rainfall is about 1,999 mm and average basin flow of 55.8 m³/s. The rainfall is more than the average for the nation, so the basin is well endowed with water resources. Due to lack of sufficient dry season flow, it is necessary to augment water resources in the basin either by storage or by conjunctive use of surface and ground water resources. The basin area has 3 meteorological stations and 3 hydrological stations

The basin coverts areas of 13 municipalities, of which 6 are Rural Municipalities and 7 are Urban Municipalities.

Salient Features of Kankai Basin

Basin location	*Latitudes: 26°2611 to 27°06'25" N* *Longitudes: 87°40'48" to 88°08'08" E*
Catchment area	*1,332 sq.km.*
Major rivers	*Deumai (36 km), Puwakhola (42 km) and Jogmai Khola (30 km)*
River length	*126 km (up to Nepal-India border)*
Elevation	*Maximum - 3,617 m.* *Minimum - 67 m.*
Hydro-meteorological stations	*3 Meteorological stations* *3 Hydrological stations*
Flood forecasting stations	*1*
Average annual rainfall	*1,999 mm*
Average river flow (Nepal - India border)	*55.8 cumec; 1,760 MCM (annual)*
Existing hydropower stations and Capacity (DOED, March 2023)	*15; 30.3 MW*
Agriculture land	*43,089 ha.*
Existing big irrigation systems	*1*
Total irrigated area in basin (as per inventory of IMP, 2019)	*21,814 ha. (2025)* *26,351 ha. (2050)*
Total population (extimated from Population Census, 2021)	*270,458*
Forest land	*77,500 ha.*
Total water demand (for 2025)	*Irrigation demand: 466 MCM* *Domestic demand: 20.5 MLD*
Administrative units	*Pradesh: Koshi* *Districts: 2* *Local Bodies:* *(6 Gaupalika; 6 Nagarpalika)*

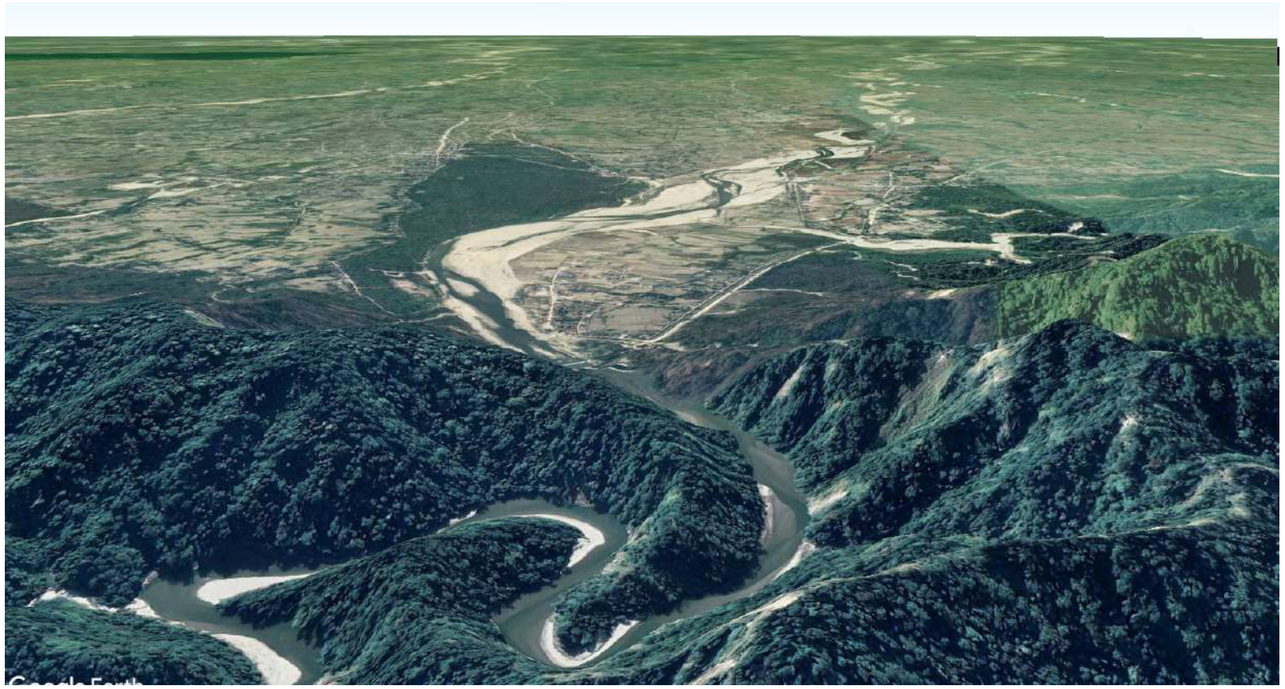

Figure 2.9: Kankai River flows down to Terai plain land

Administrative Division of Kankai Basin

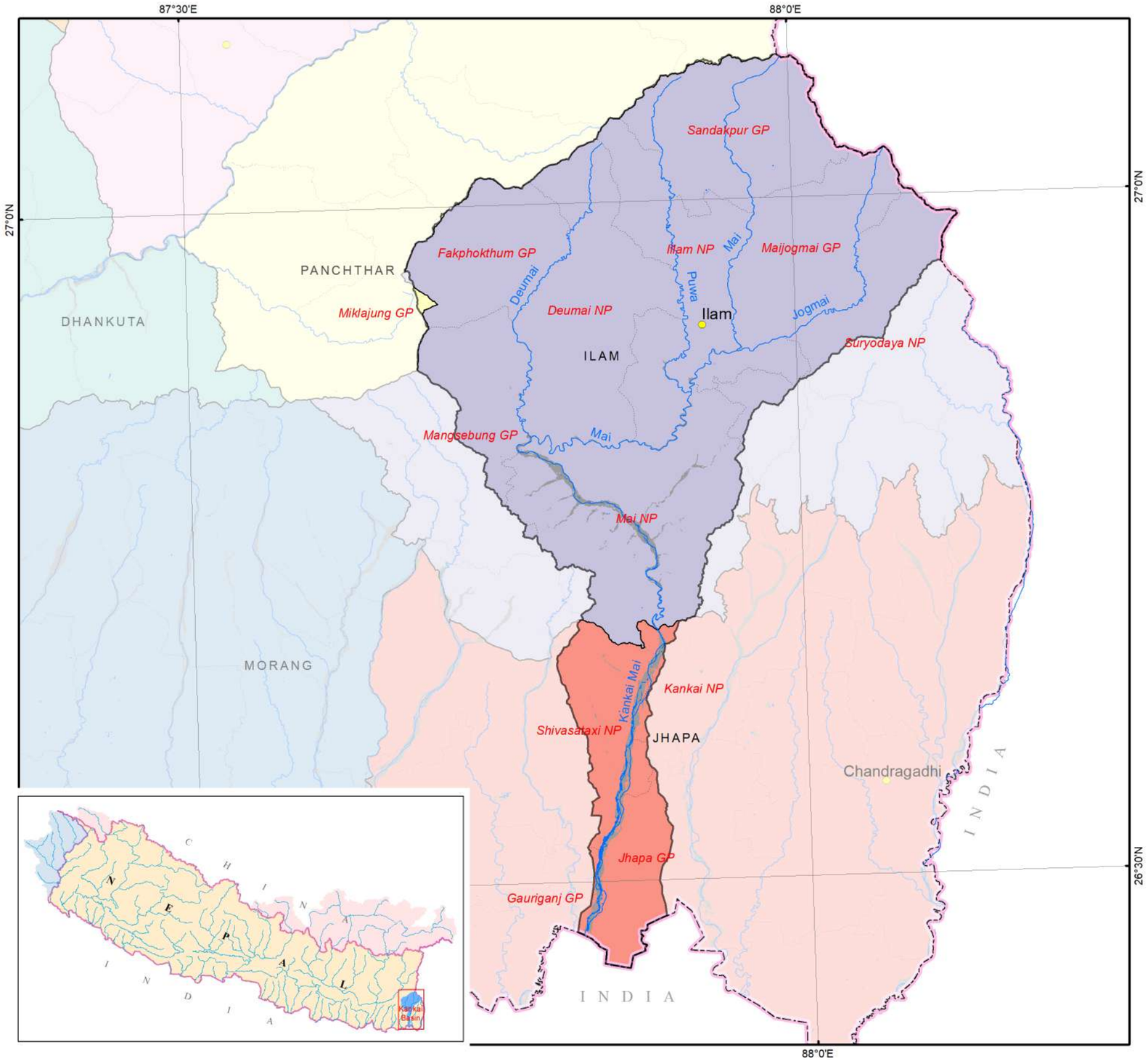

Table 2.9 List of Local Bodies in Kankai Basin

SN	Province	District	Name of Local Body	% of Area
1	Koshi	Ilam	Deumai NP	100
2			Fakphokthum GP	100
3			Illam NP	100
4			Mai NP	88
5			Maijogmai GP	100
6			Mangsebung GP	48
7			Sandakpur GP	100
8			Suryodaya NP	38
9		Jhapa	Gauriganj GP	6
10			Jhapa GP	69
11			Kankai NP	10
12			Shivasataxi NP	58

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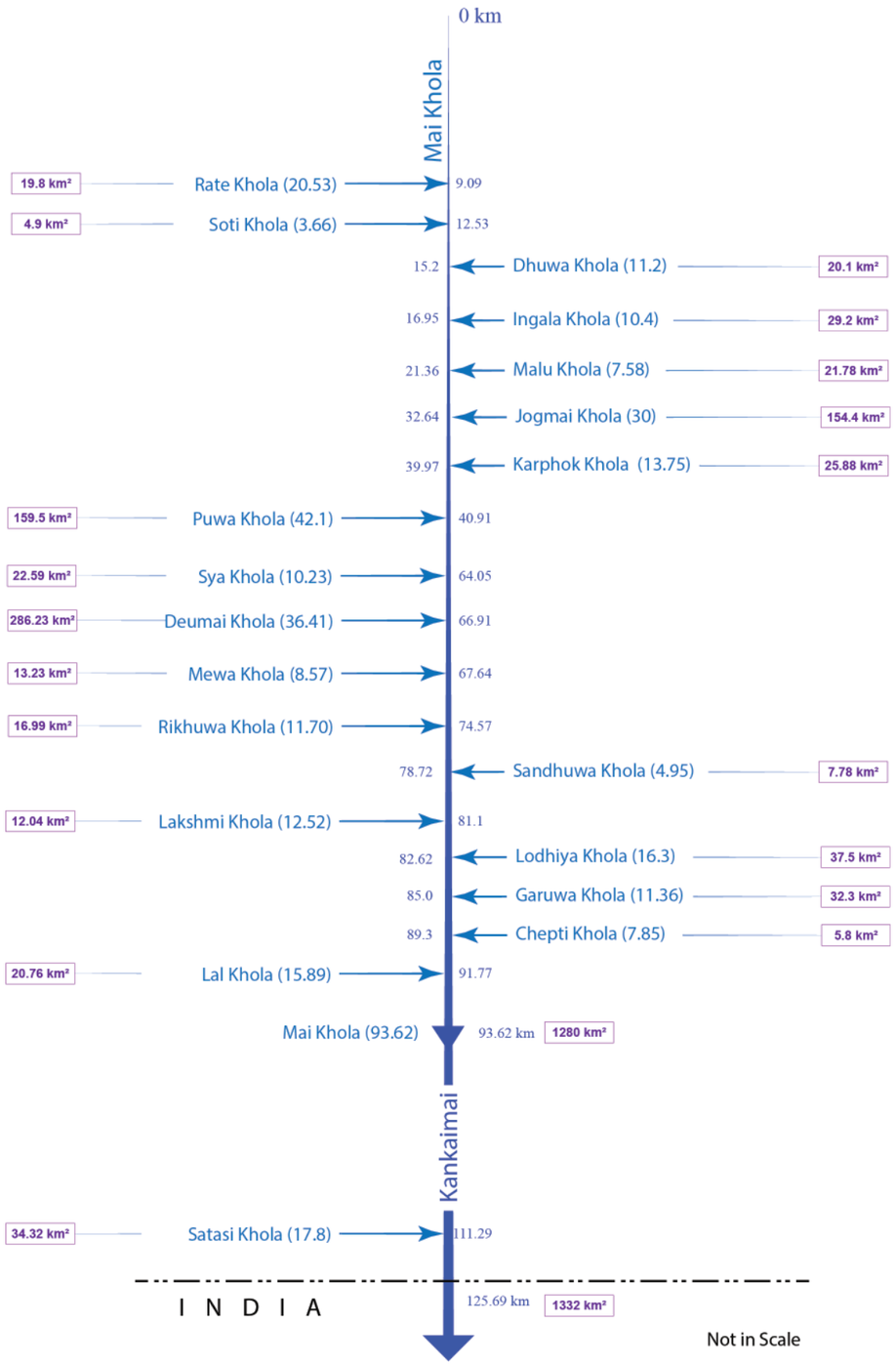
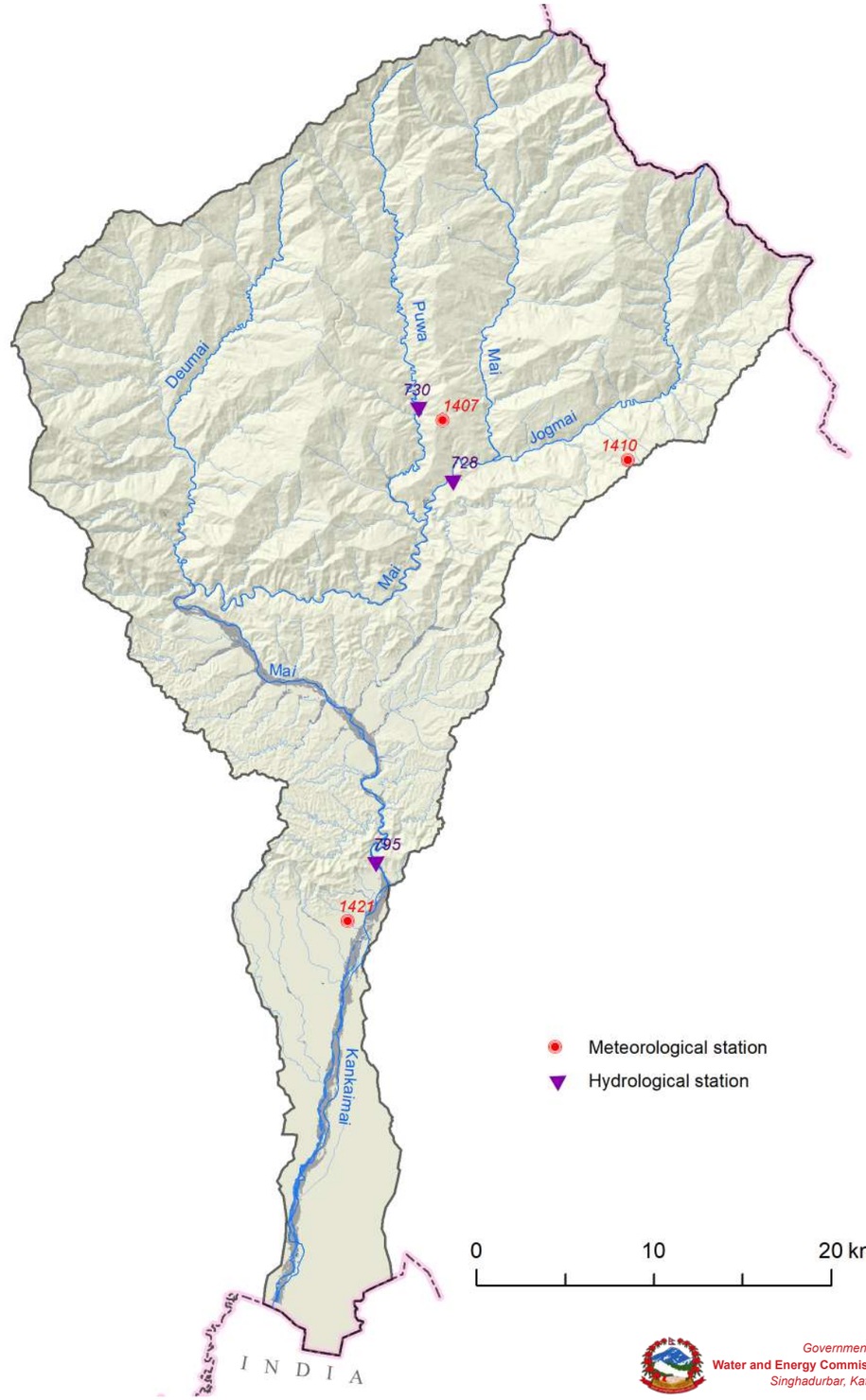
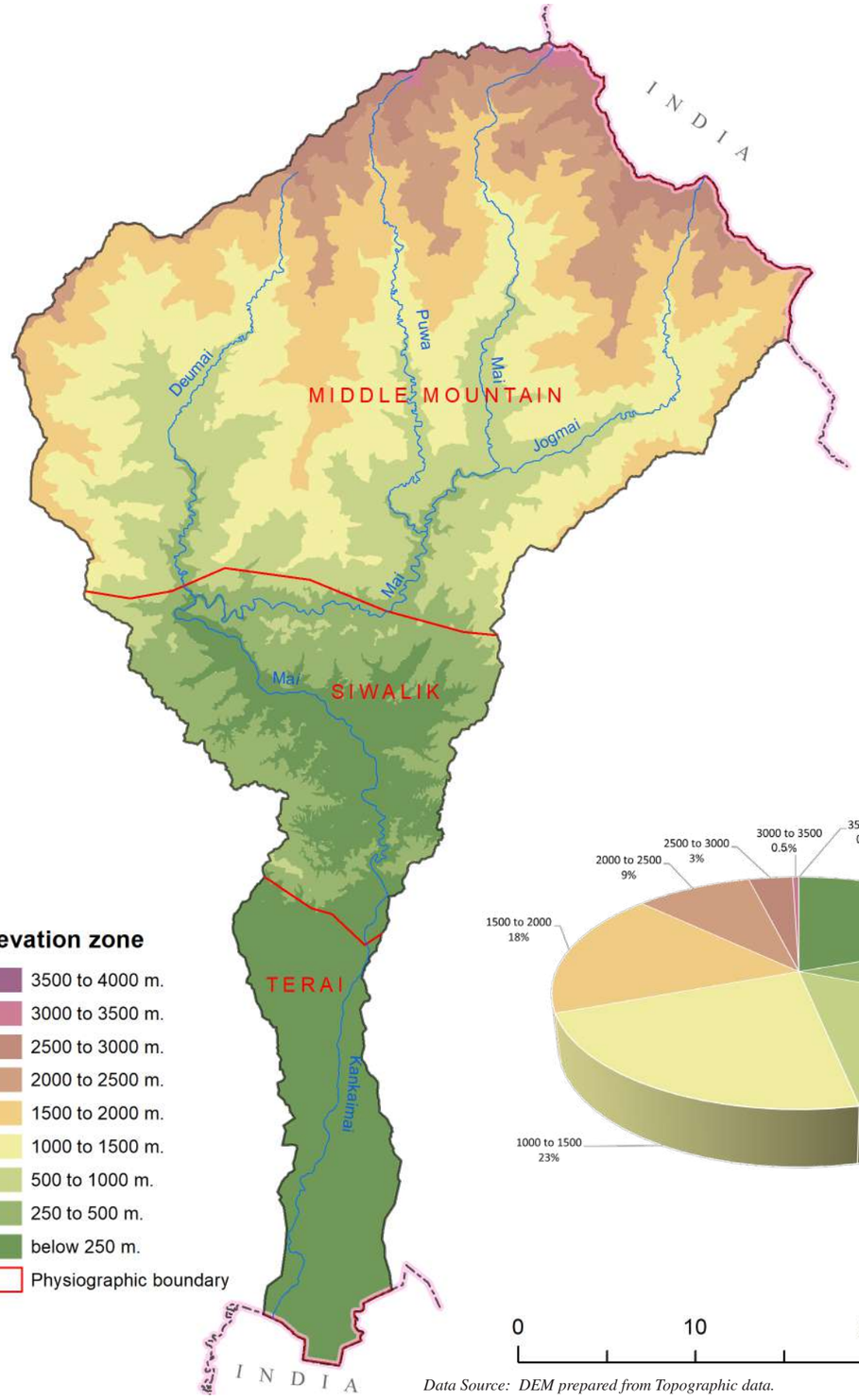
River Flow Line Diagram of Kankai River

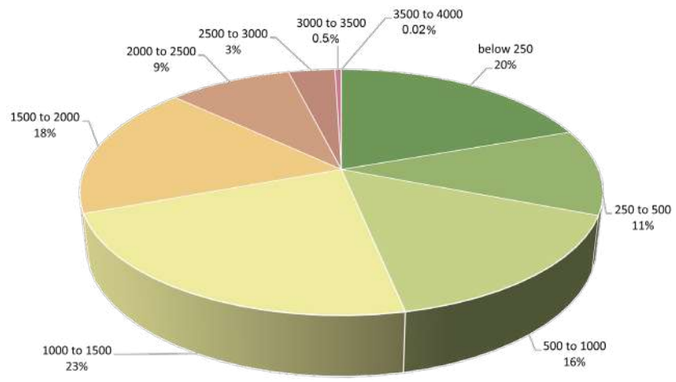


River System



Elevation Zone





Data Source: DEM prepared from Topographic data.

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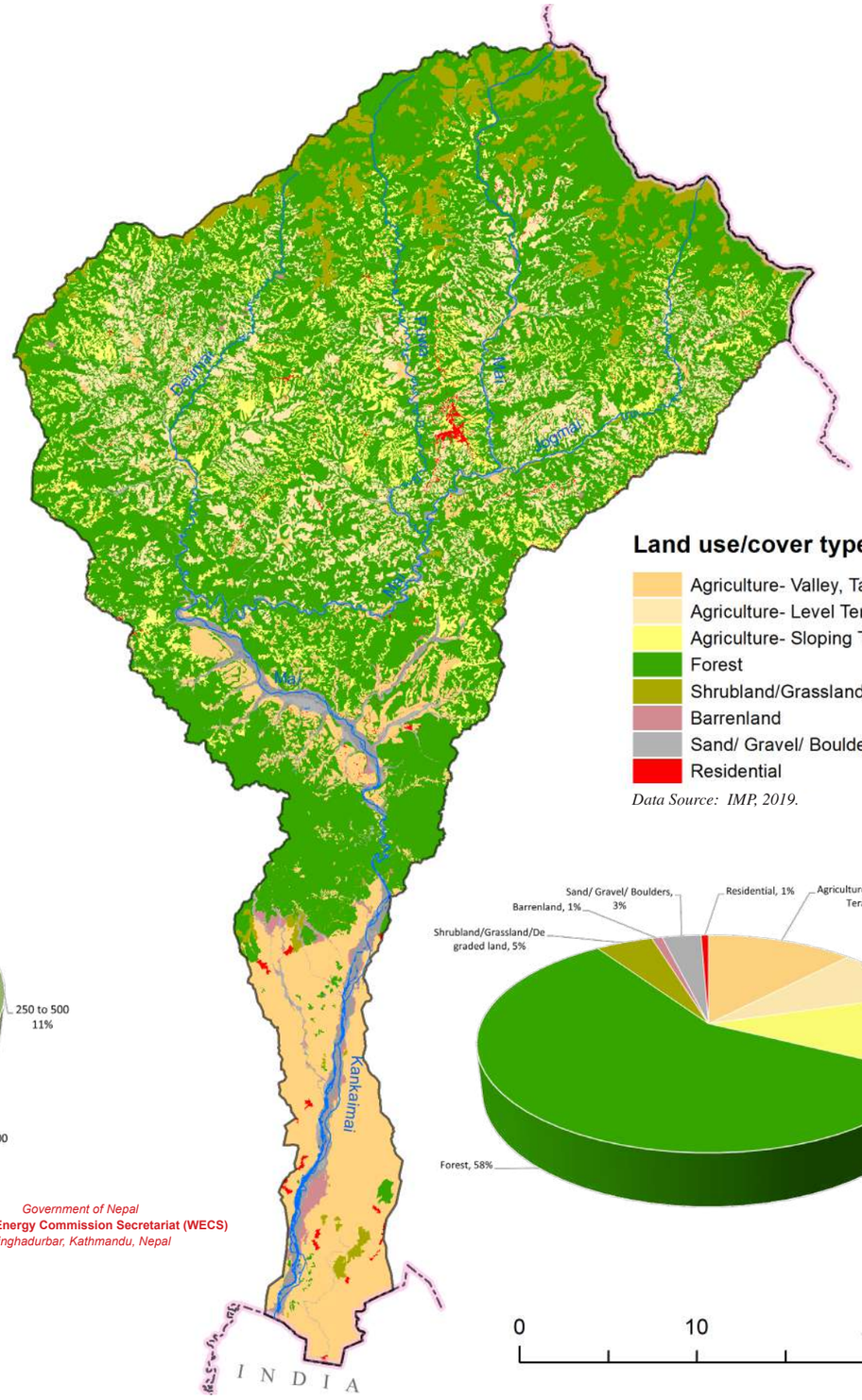
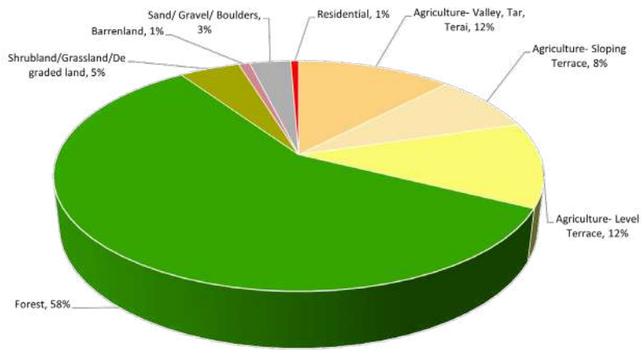
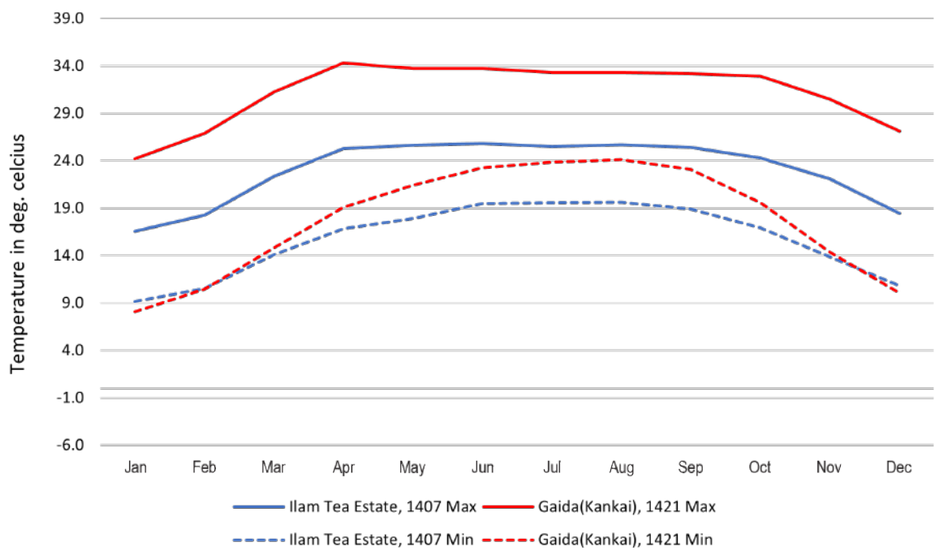
Land Use/Cover

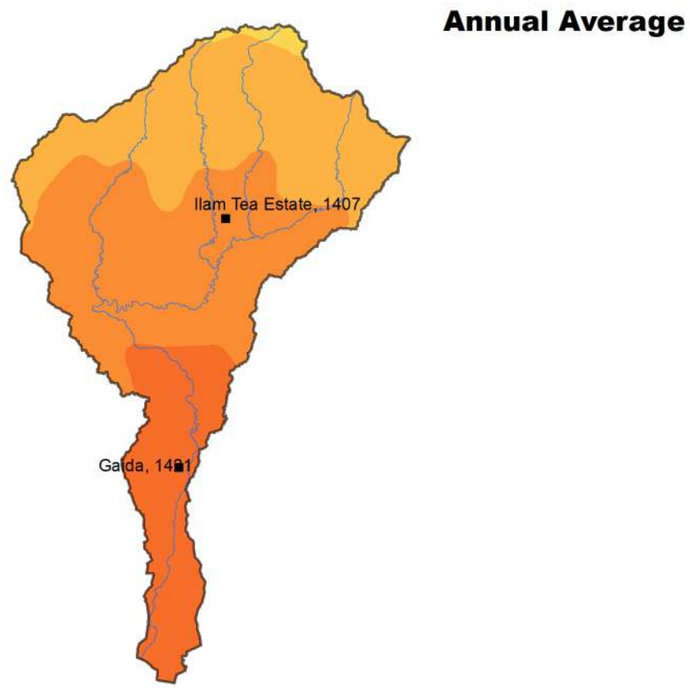


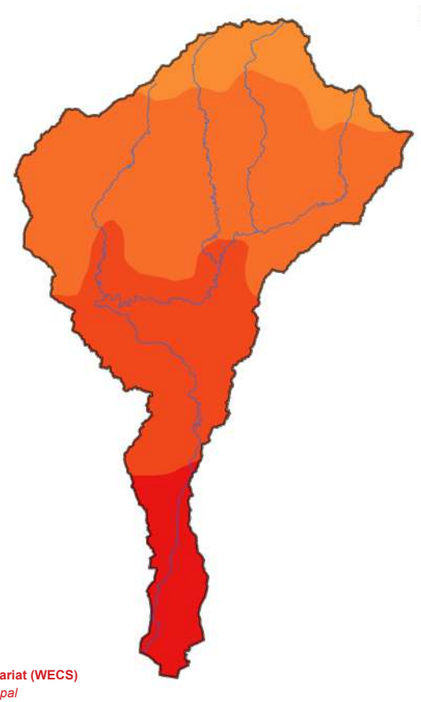
Data Source: IMP, 2019.

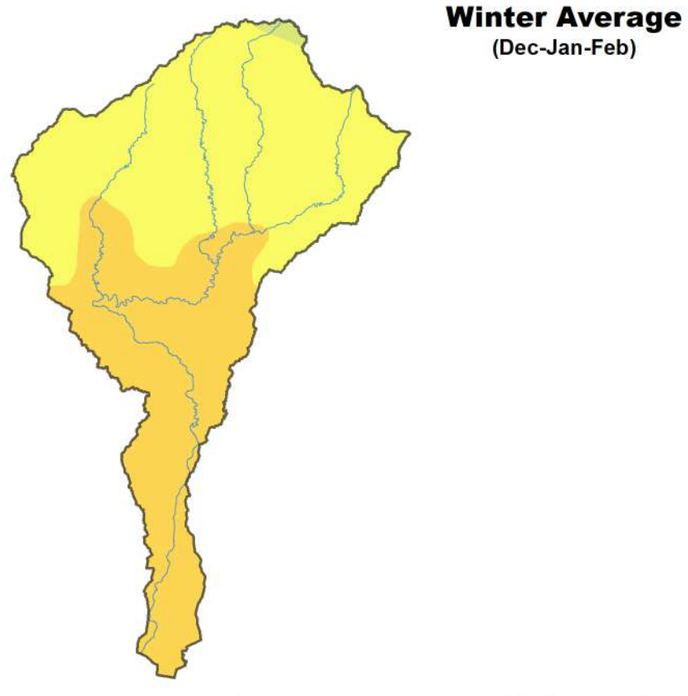


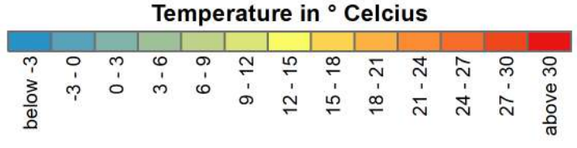
Average Temperature Distribution











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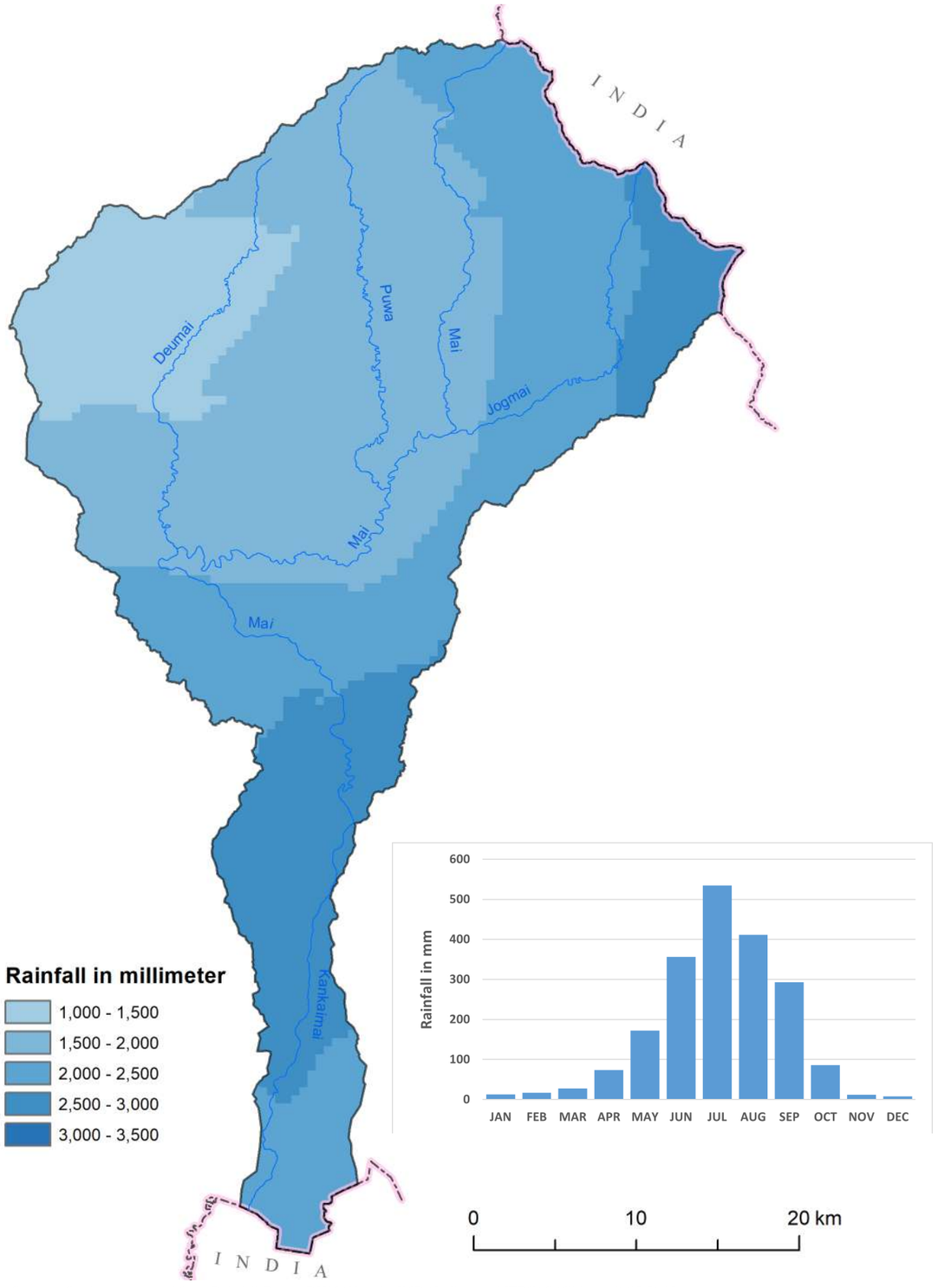
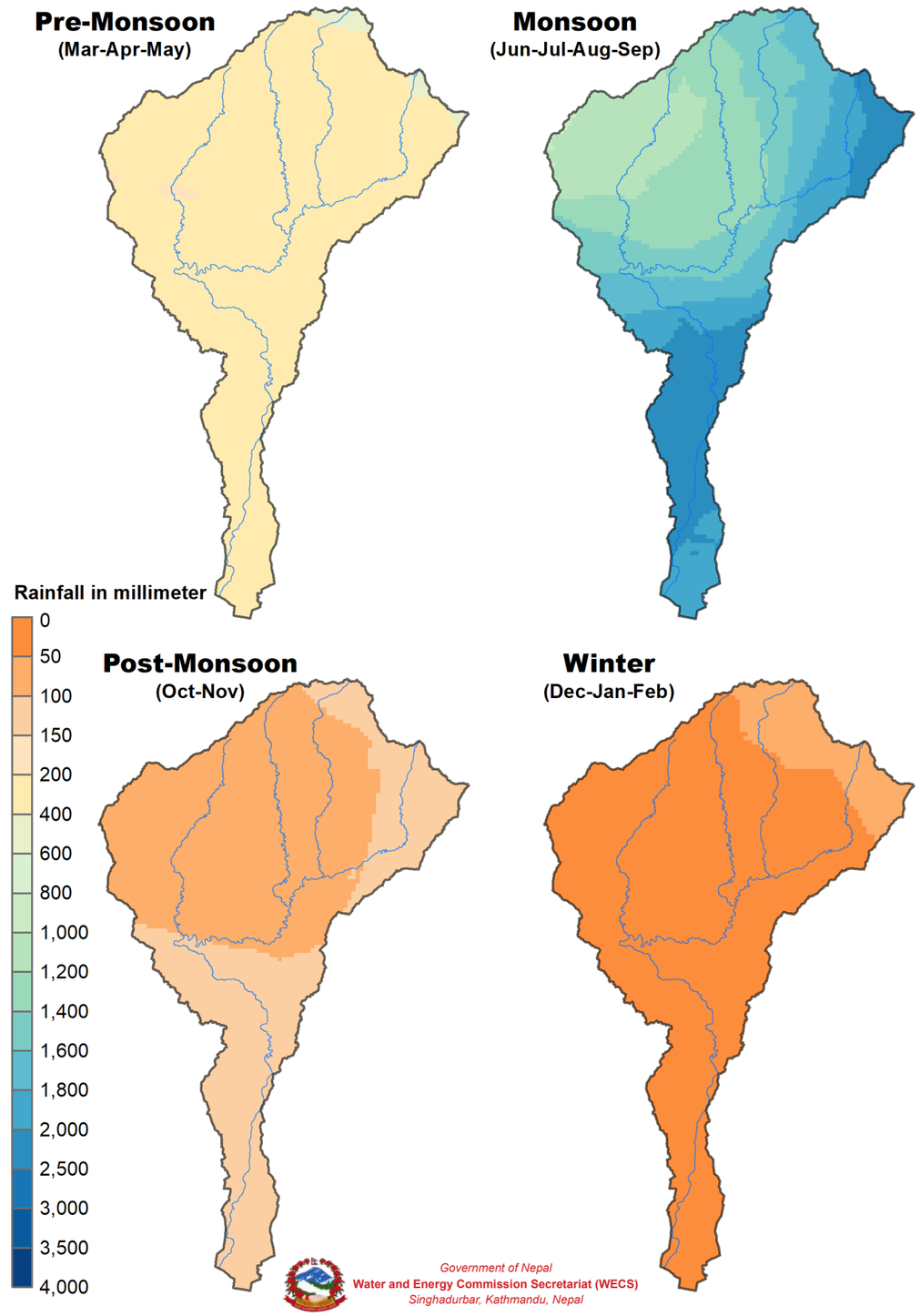
Data Source: Surface generated from DHM Temperature Data - 1985-2015.

Annual Average Rainfall Distribution



Seasonal Average Rainfall Distribution



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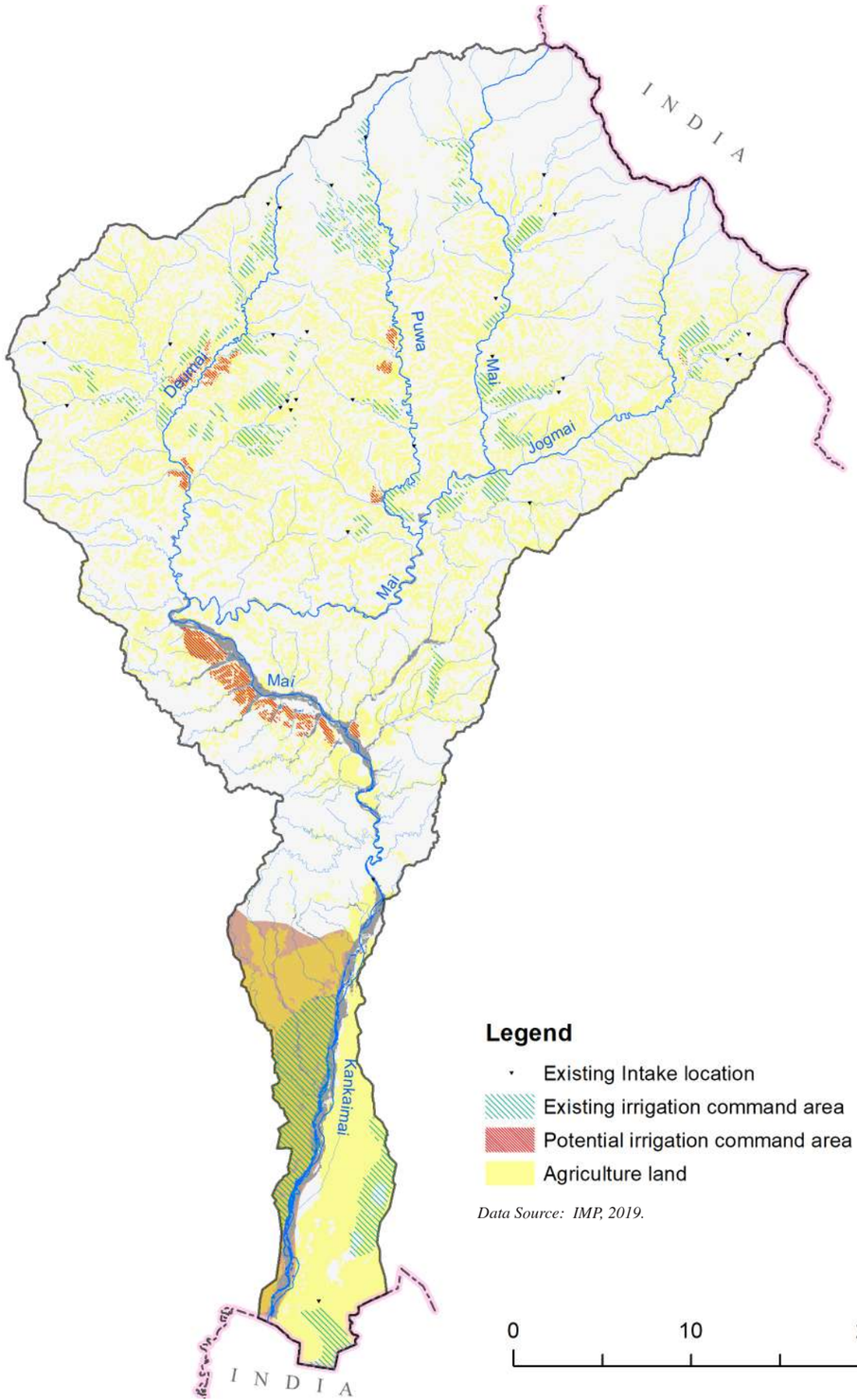
Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

Irrigation Projects



Legend

- Existing Intake location
- Existing irrigation command area
- Potential irrigation command area
- Agriculture land

Data Source: IMP, 2019.

0 10 20 km

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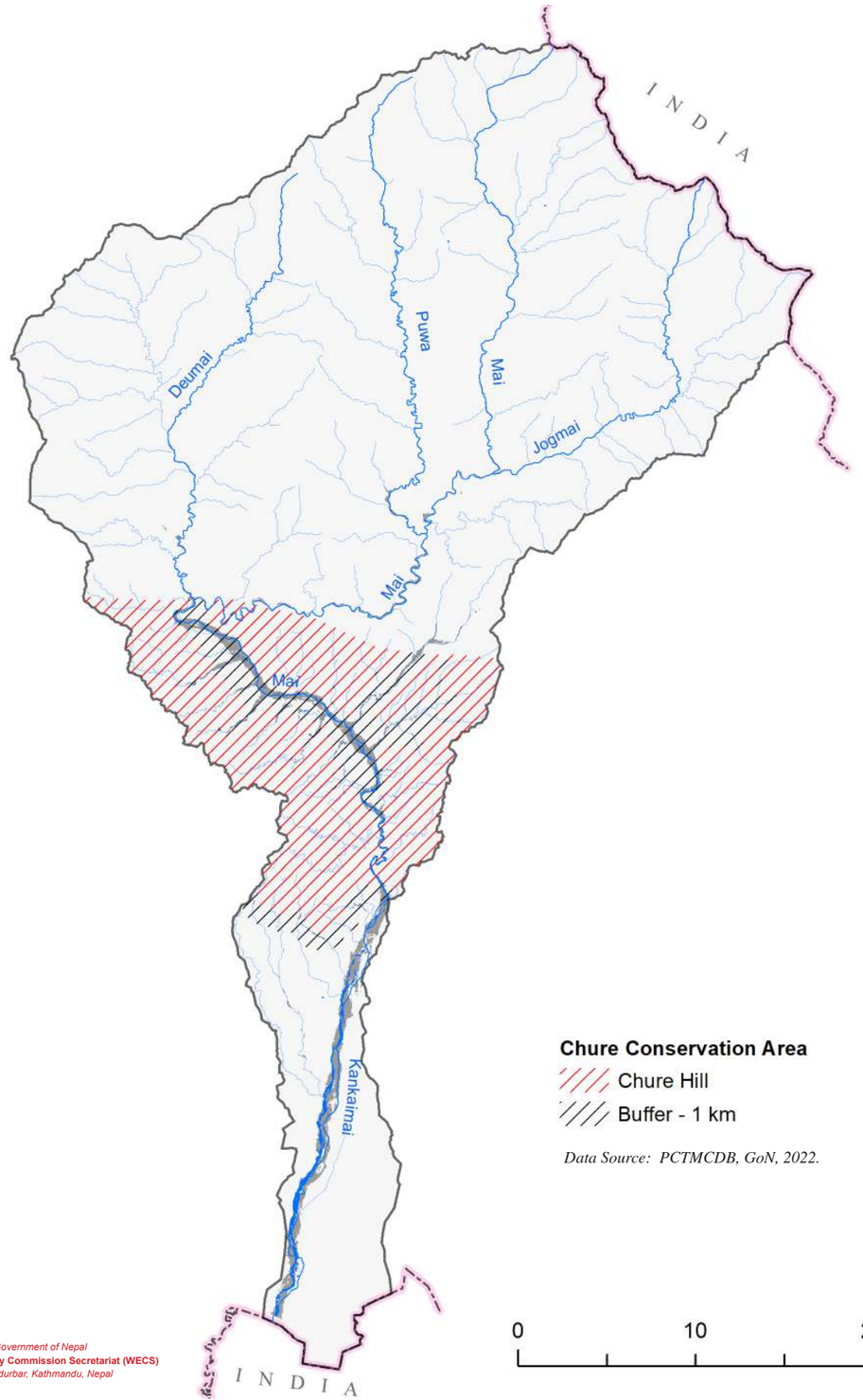
Protected Areas



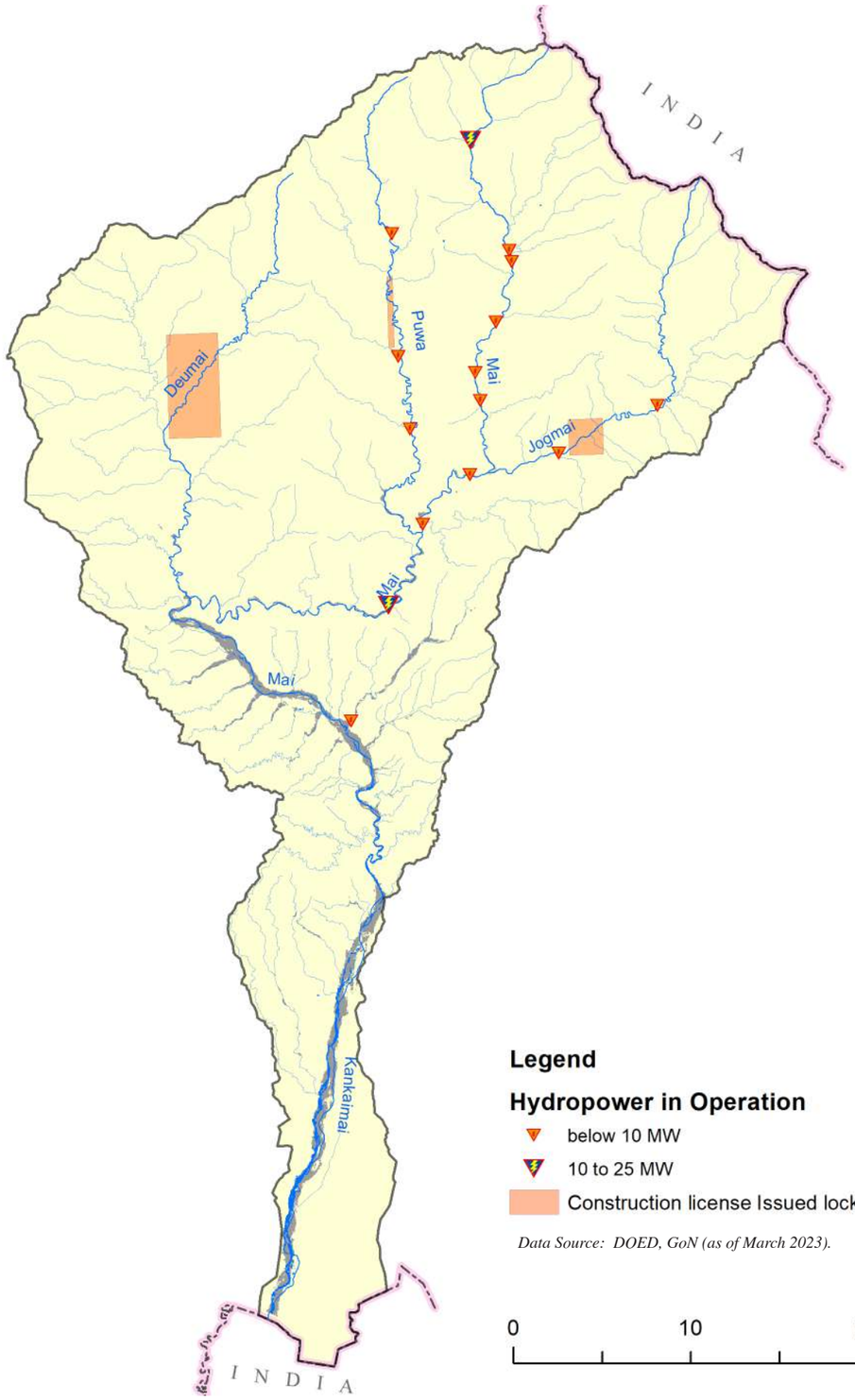
Chure Conservation Area

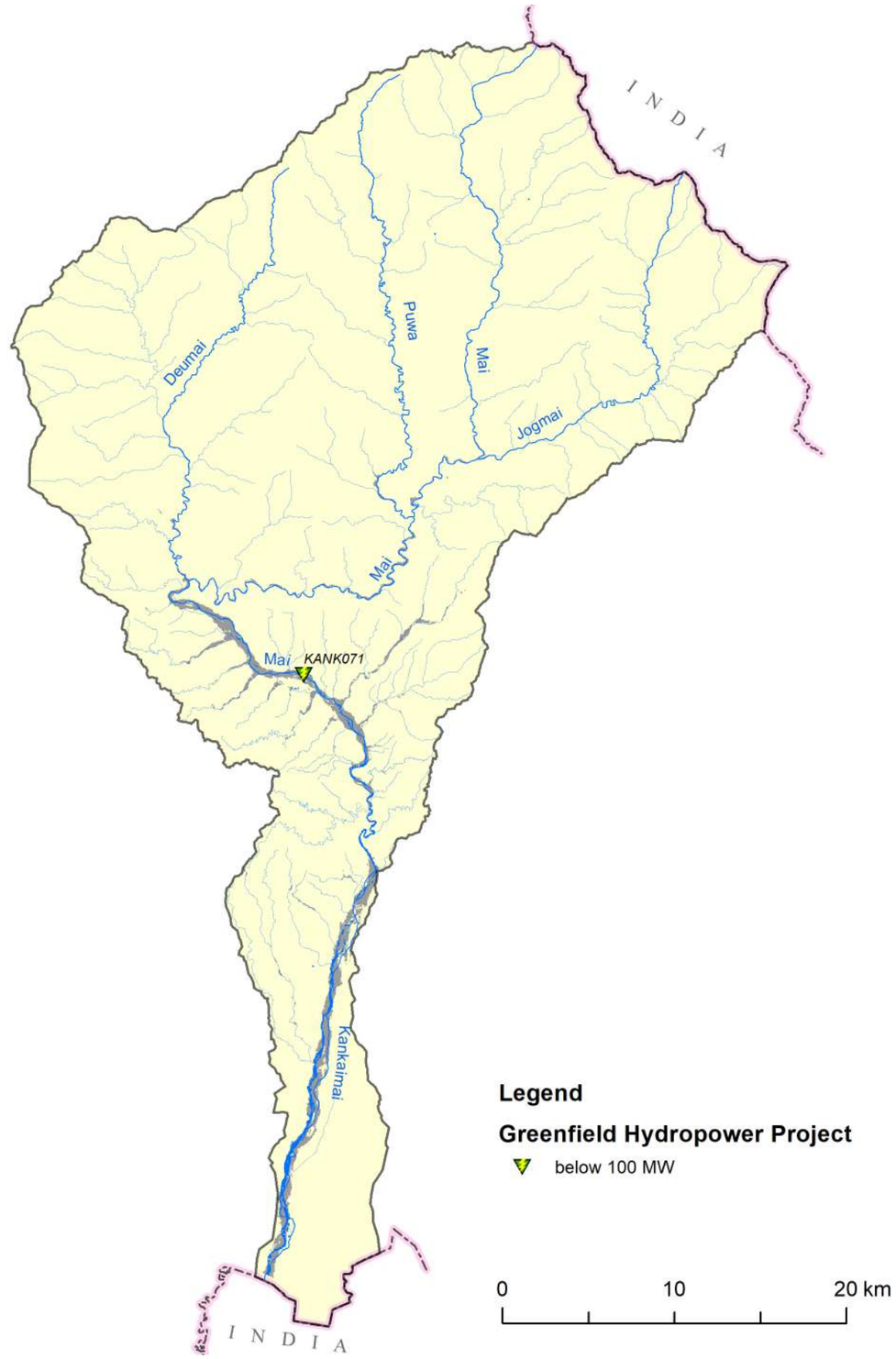
- Chure Hill
- Buffer - 1 km

Data Source: PCTMCDB, GoN, 2022.

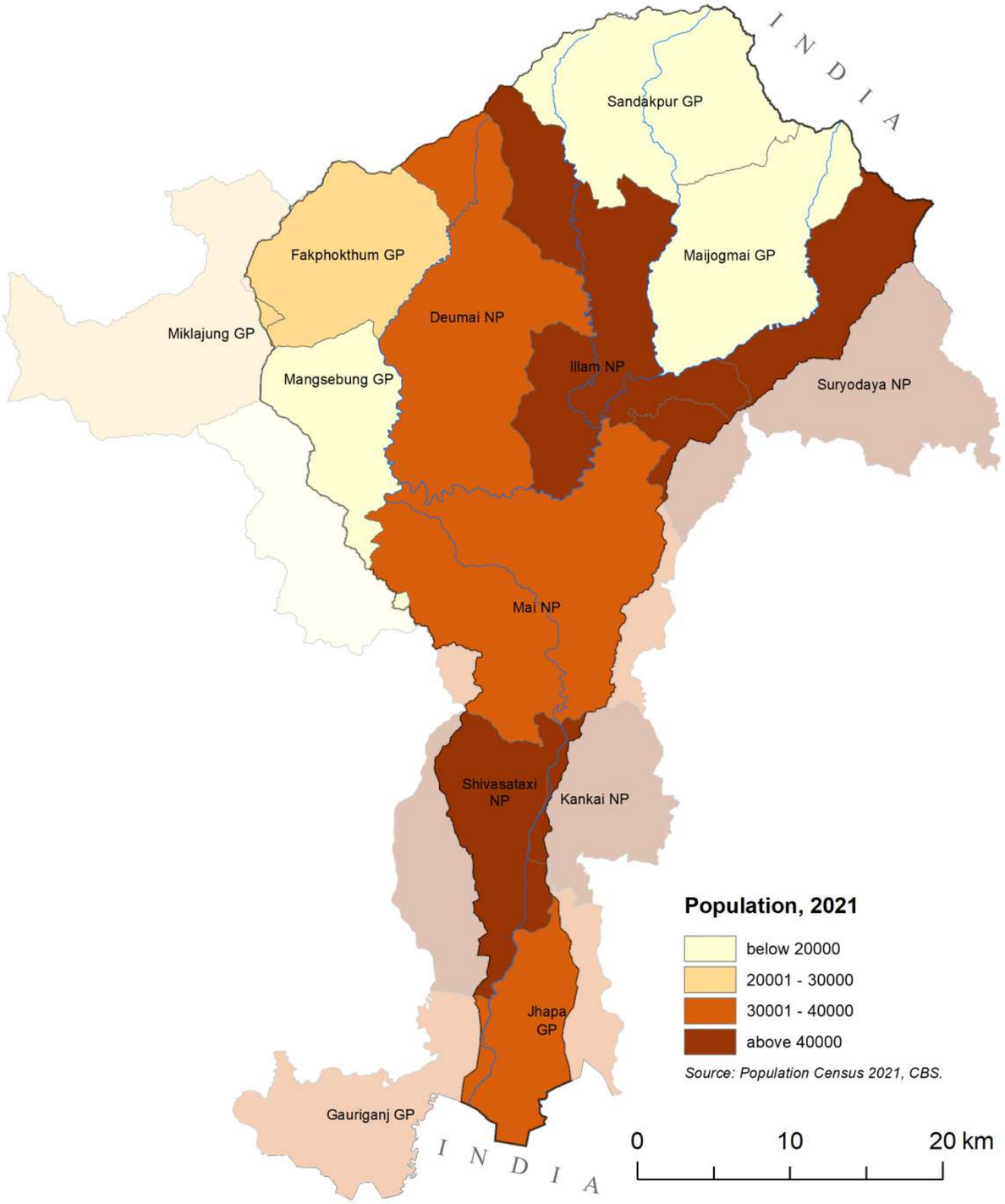
0 10 20 km

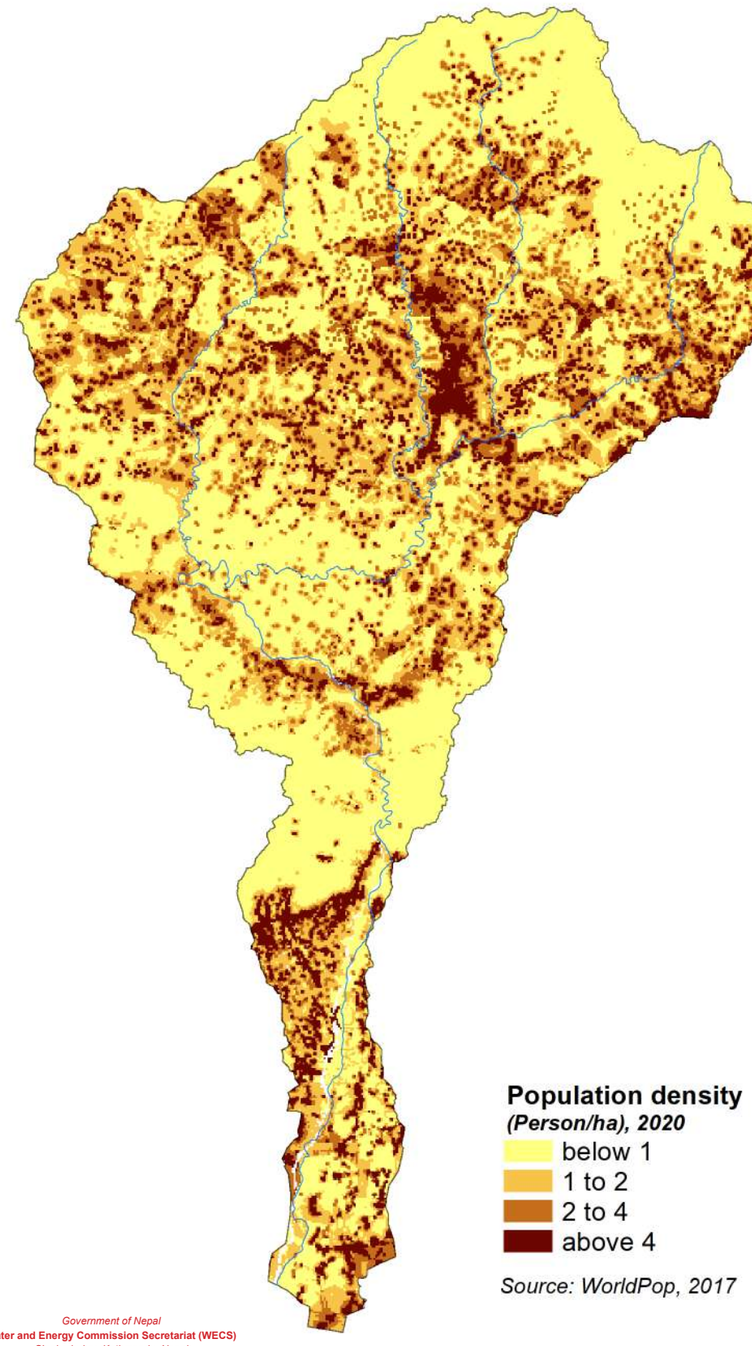
Hydropower Projects





Population Distribution and Density





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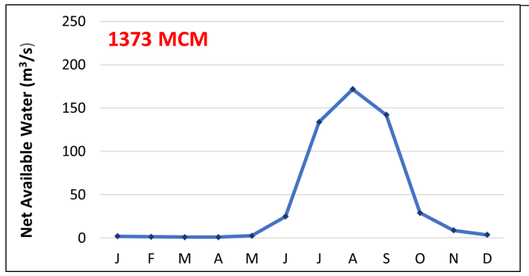
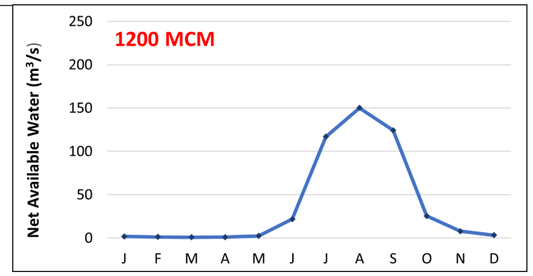
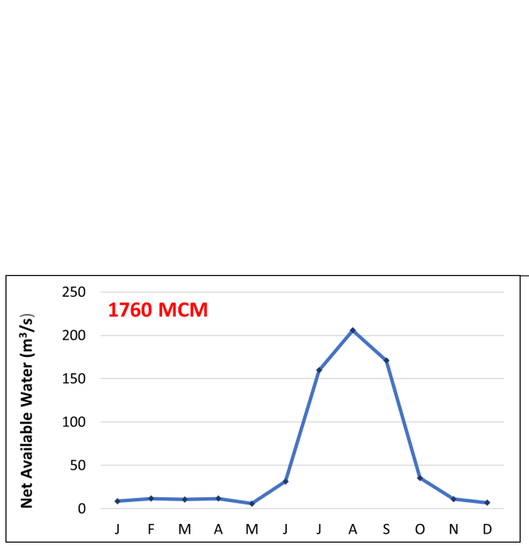
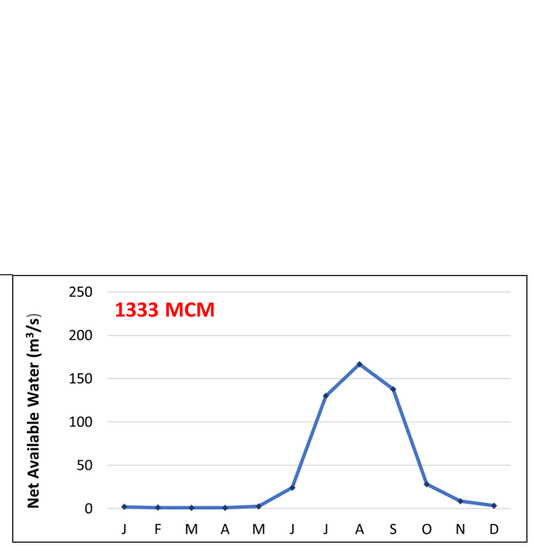
Hydrographs at Major River Nodes









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10. Mechi Basin

Mechi Basin

The Mechi River Basin is a border river basin located in the eastern Nepal in Koshi Pradesh. The basin extends from 87° 58' 35" to 88° 11' 17" East longitudes and 26° 21' 40" to 26° 57' 04" North latitudes in Nepal. The basin covers about 0.5 % land of the country. The total area of the basin up to Nepal-India Border is about 806 km², of which about 88% of the land (about 708 km²) lies in Nepal. The elevation of the river basin in Nepal ranges from 62 m to 2168 m. The Mechi River forms an international boundary with India along most of its stretches.

With an annual rainfall of 2,735 mm, it is the wettest river basin of Nepal. The lower reaches of the river basin suffer from floods and bank erosion due to flash floods. Being a border river harnessing the water resources of the mainstream Mechi depends on cooperation with India.

The Nepal part of the river basin lies in Ilam and Jhapa districts occupying about 24% and 76% of the basin area, respectively. Two local bodies, Mechinagar Sub-metropolitan city and Bhadrapur Municipality, are fully within the basin and 7 other municipalities are partly within the basin.

The Mechi River originates from the Mahabharat range near Pashupati Nagar area of Suryodaya Municipality in Ilam District. All major tributaries are from Nepal side of the river (from the west) while it also drains a narrow tract of land along the river in the Indian side. There exist no major tributaries into Mechi from India till it leaves Nepal. The river crosses Nepal-India border and enters the Indian State of Bihar and merges with Mahananda River in Kishangunj District (India), which ultimately drains into the Ganges.

The main stream of Mechi River is 62 km long. The major tributaries are Siddhi Khola, Paliya Khola, Ninda Khola and Deuniya Khola. Ninda Khola has the largest catchment 236.03 km² with a length of 35.02 km.

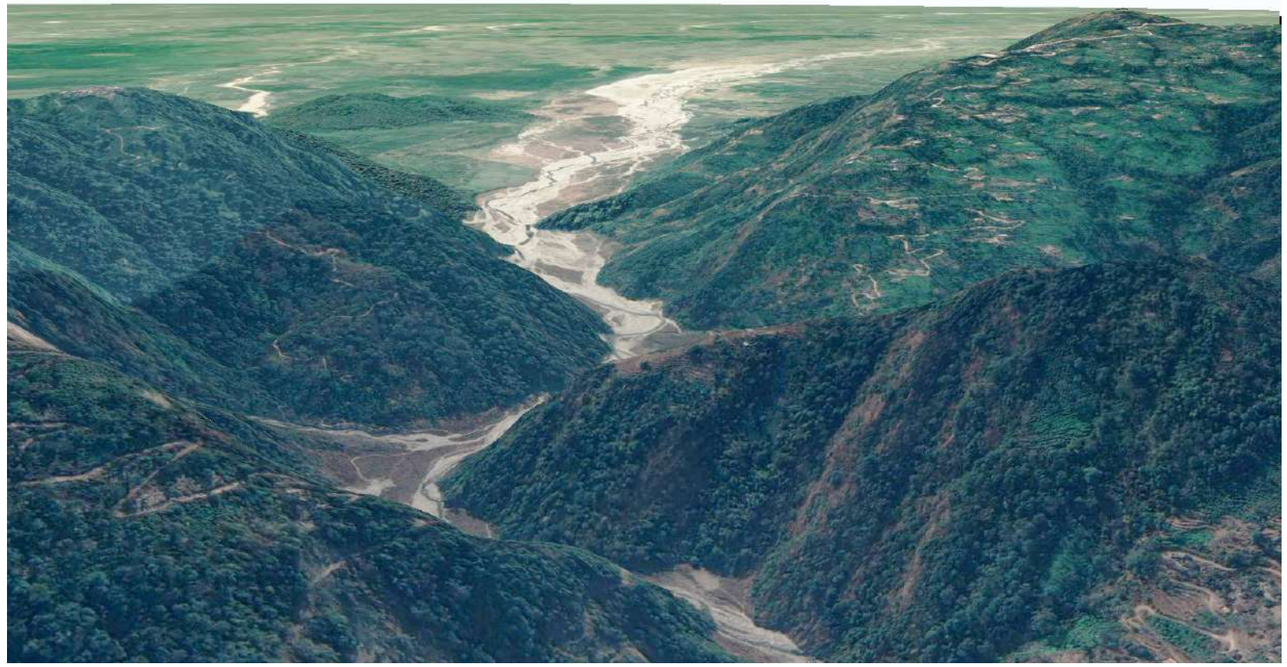

Figure 2.10: Mechi River flows down to Terai plain land

Salient Features of Mechi Basin

Basin location	*Latitudes: 26°21'40" to 26°57'04" N* *Longitudes: 87°58'35" to 88°11'17" E*
Catchment area	*708 sq.km. (Nepal); 98 sq.km. (India)*
Major rivers	*Siddi Khola (24 km), Ninda (35 km), Deuniya (36 km)*
River length	*62 km (up to Nepal-India border)*
Elevation	*Maximum - 2,169 m.* *Minimum - 59 m.*
Hydro-meteorological stations	*2 Meteorological stations* *0 Hydrological stations*
Flood forecasting stations	
Average annual rainfall	*2,735 mm*
Average river flow (Nepal - India border)	*40.8 cumec; 1,287 MCM (annual)*
Existing hydropower stations and Capacity (DOED, March 2023)	*0*
Agriculture land	*41,151 ha.*
Existing big irrigation systems	
Total irrigated area in basin (as per inventory of IMP, 2019)	*3,136 ha. (2025)* *14,140 ha. (2050)*
Total population (extimated from Population Census, 2021)	*381,049*
Forest land	*20,400 ha.*
Total water demand (for 2025)	*Irrigation demand: 67 MCM* *Domestic demand: 24 MLD*
Administrative units	*Pradesh: Koshi Lumbini* *Districts: 2* *Local Bodies:* *(4 Gaupalika; 5 Nagarpalika)*

Administrative Division of Mechi Basin

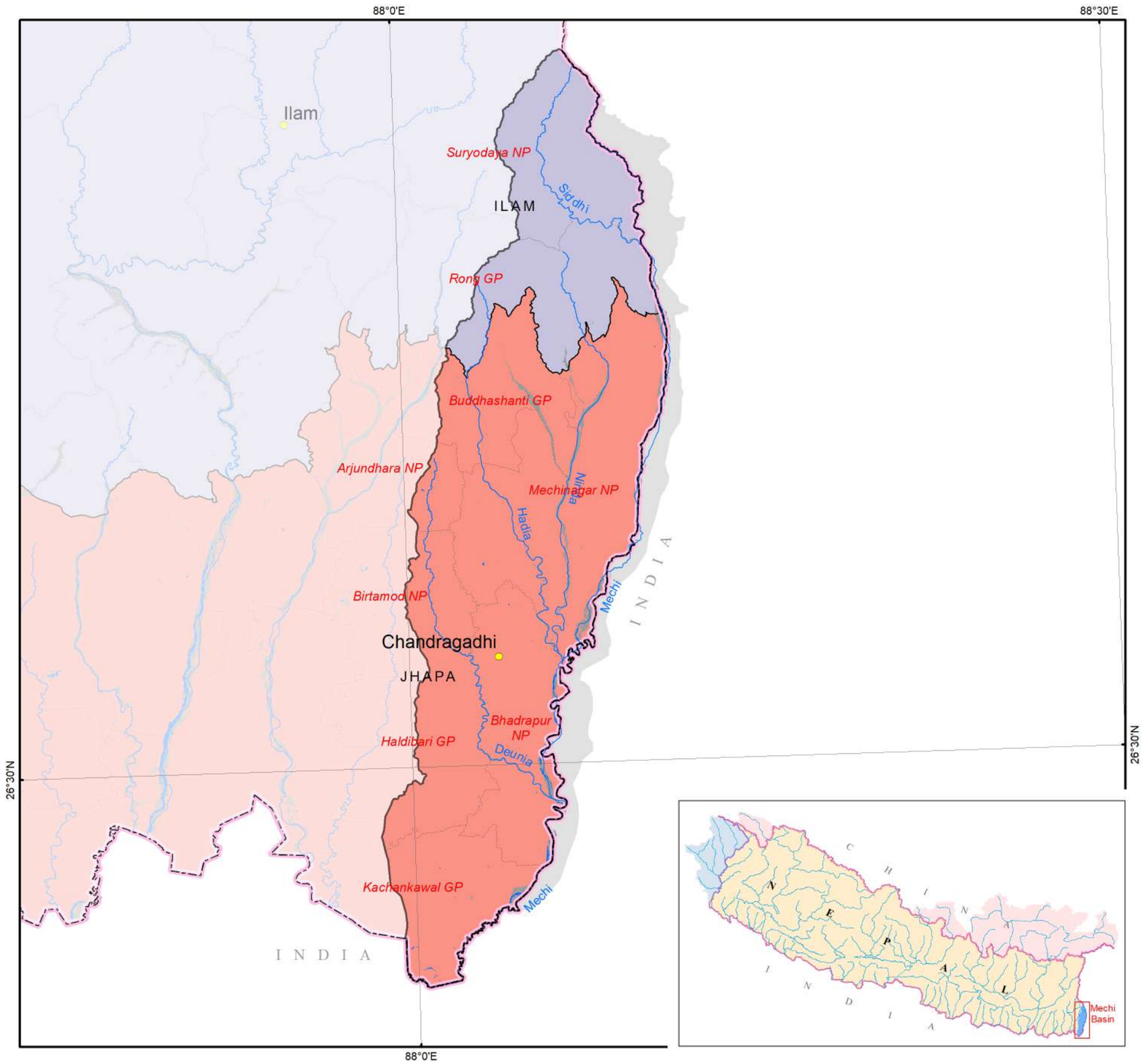

Table 2.10 List of Local Bodies in Mechi Basin

SN	Province	District	Name of Local Body	% of Area
1	Koshi	Ilam	Rong GP	54
2			Suryodaya NP	38
3		Jhapa	Arjundhara NP	15
4			Bhadrapur NP	100
5			Birtamod NP	37
6			Buddhashanti GP	89
7			Haldibari GP	54
8			Kachankawal GP	64
9			Mechinagar NP	100

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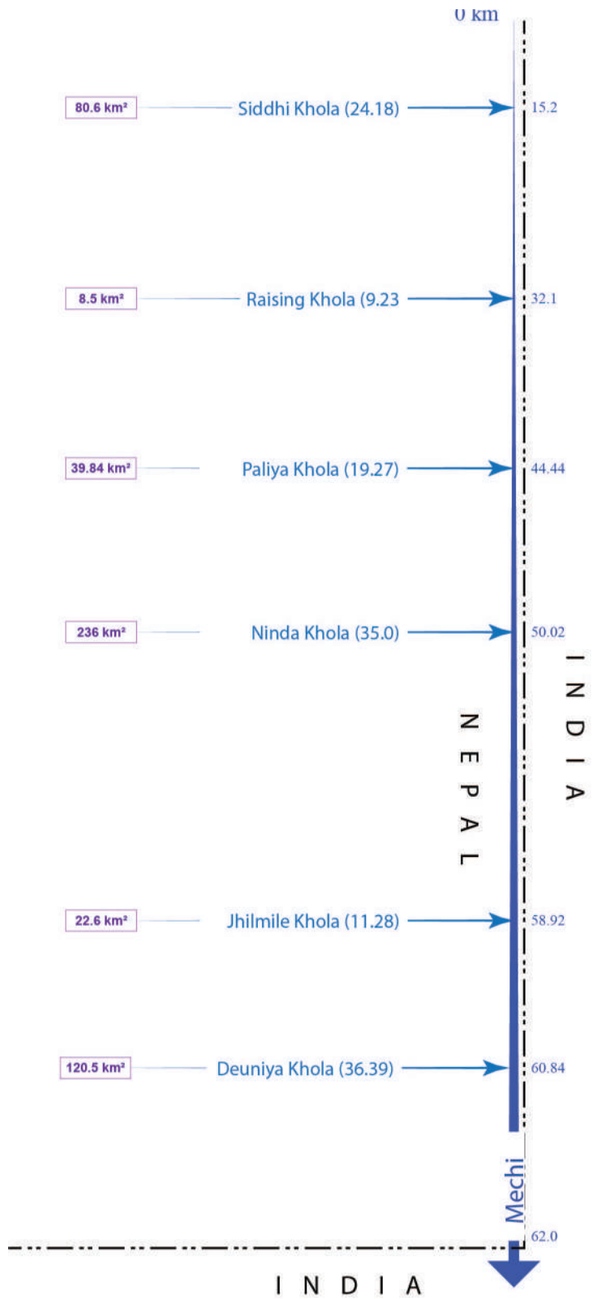
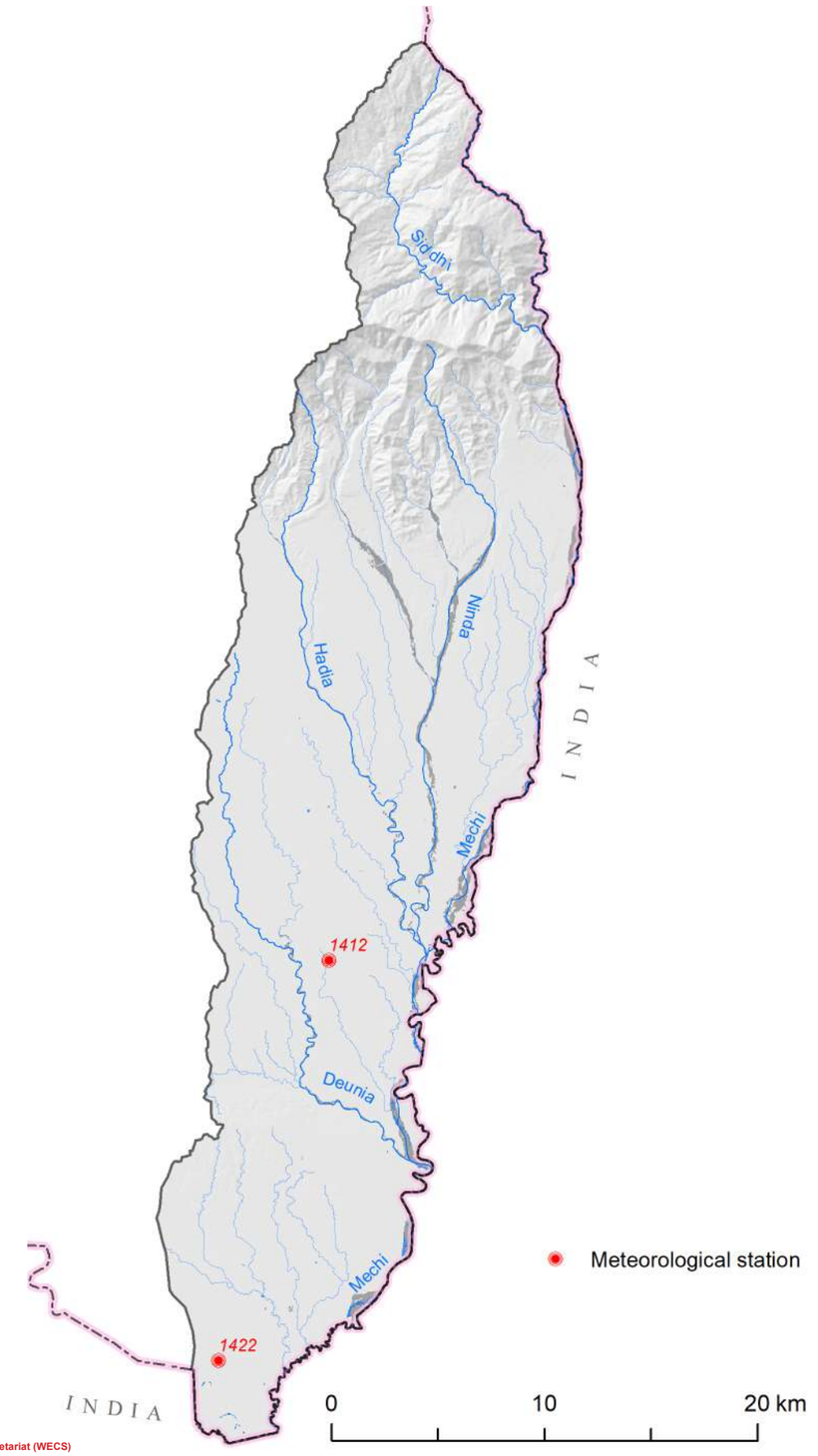
River Flow Line Diagram of Mechi River



Not in Scale

River System



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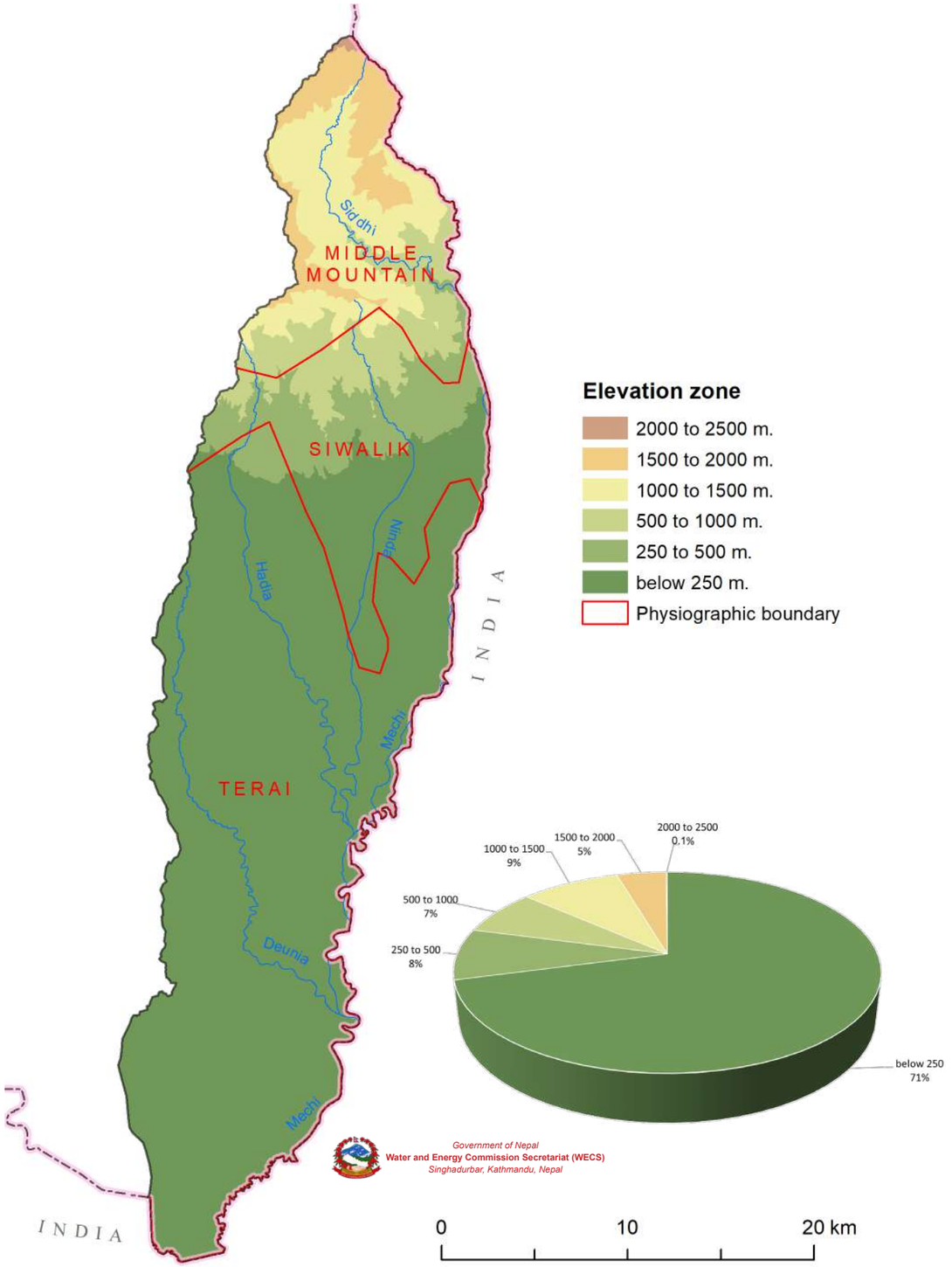
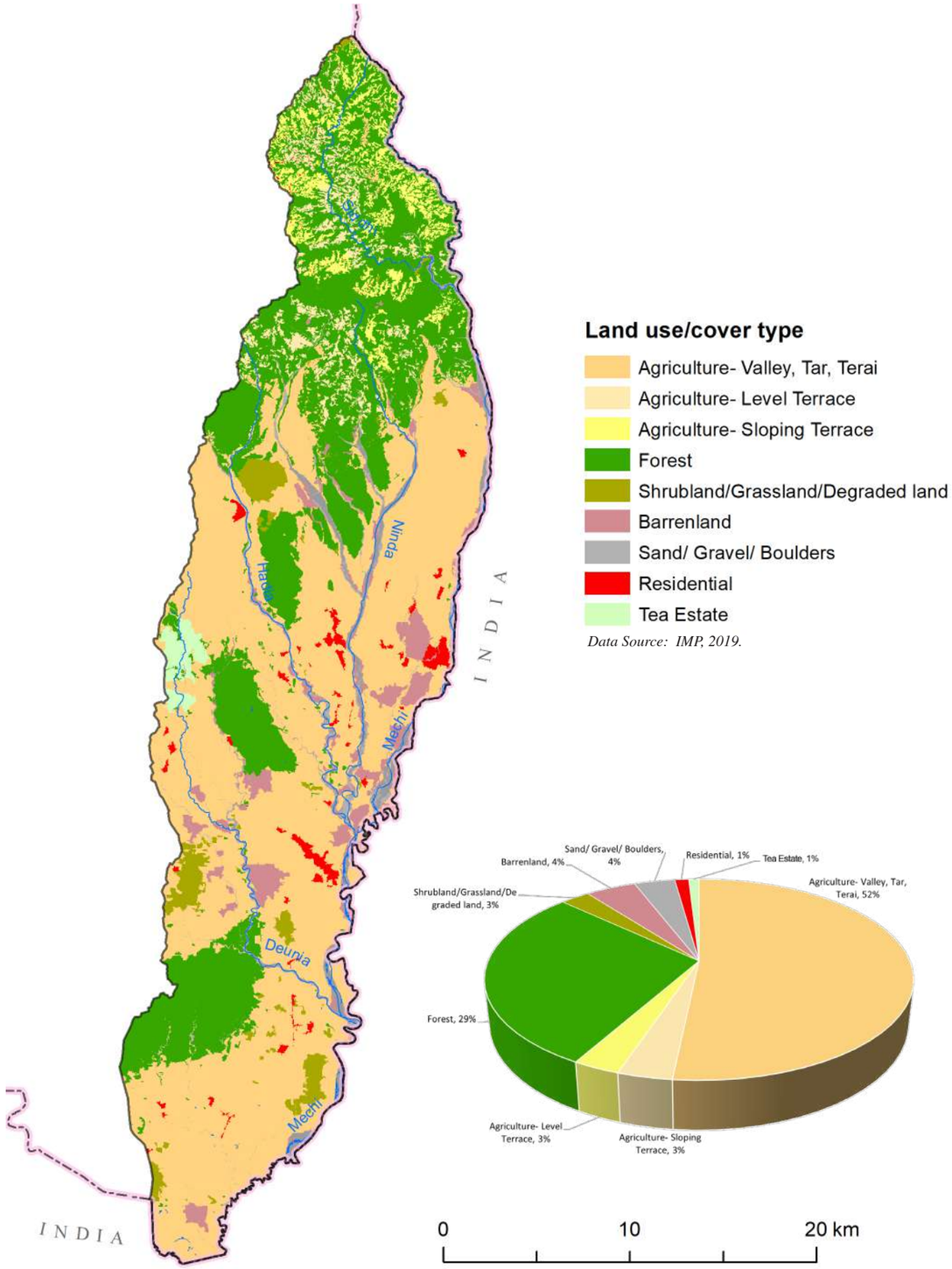
Elevation Zone



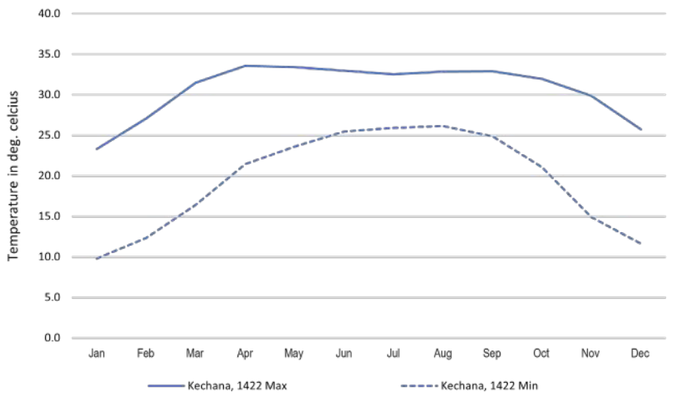
Data Source: DEM prepared from Topographic data.

Land Use/Cover



Data Source: IMP, 2019.

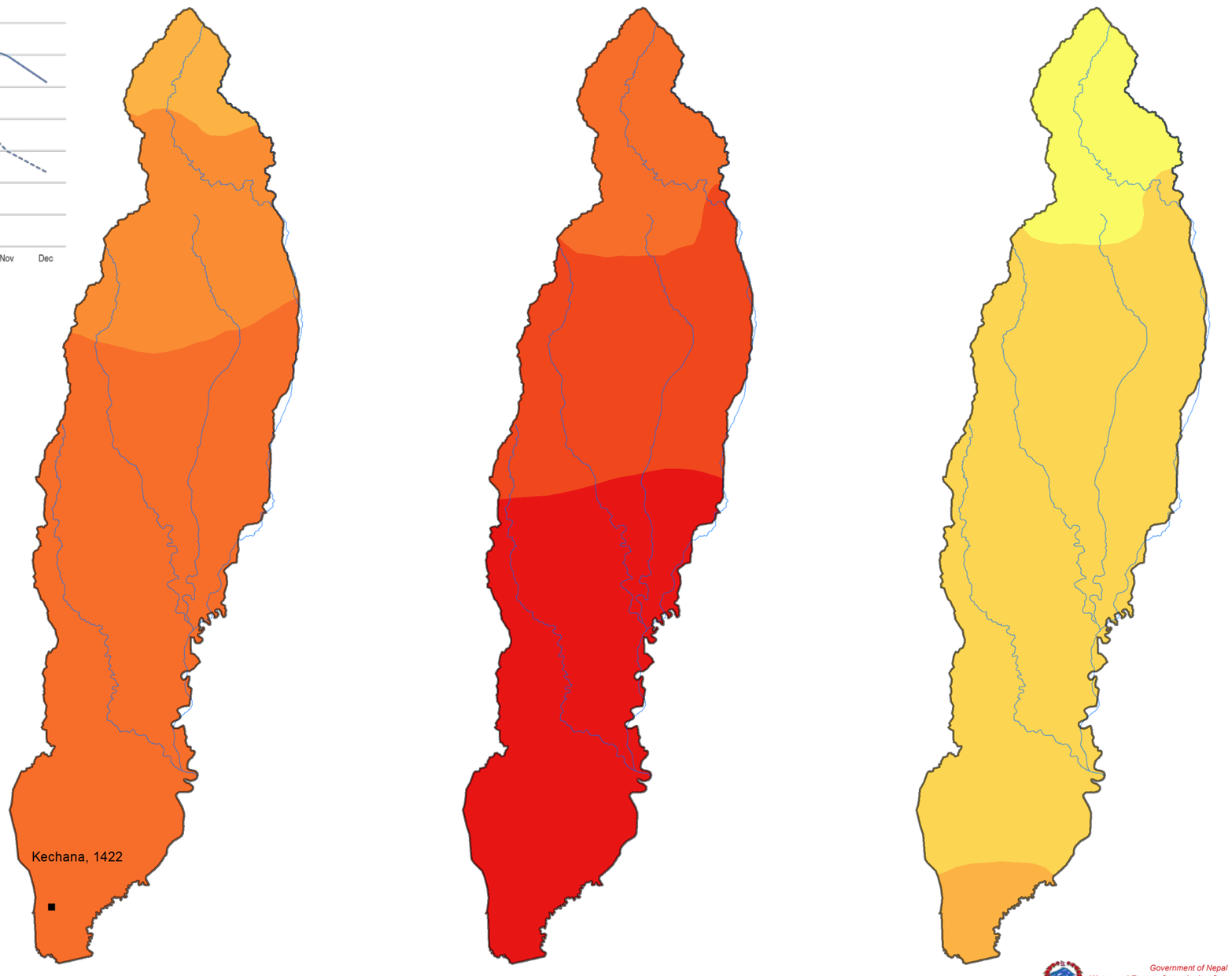
Average Temperature Distribution



Annual Average

Summer Average
(May-Jun-Jul)

Winter Average
(Dec-Jan-Feb)



Temperature in ° Celcius

- below -3
- -3 - 0
- 0 - 3
- 3 - 6
- 6 - 9
- 9 - 12
- 12 - 15
- 15 - 18
- 18 - 21
- 21 - 24
- 24 - 27
- 27 - 30
- above 30

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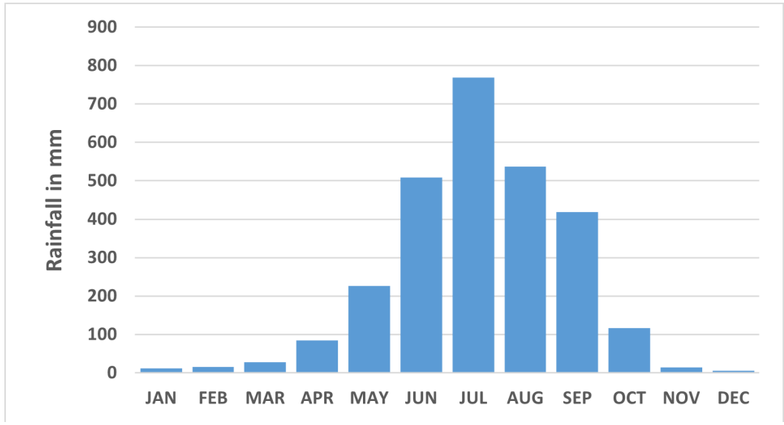
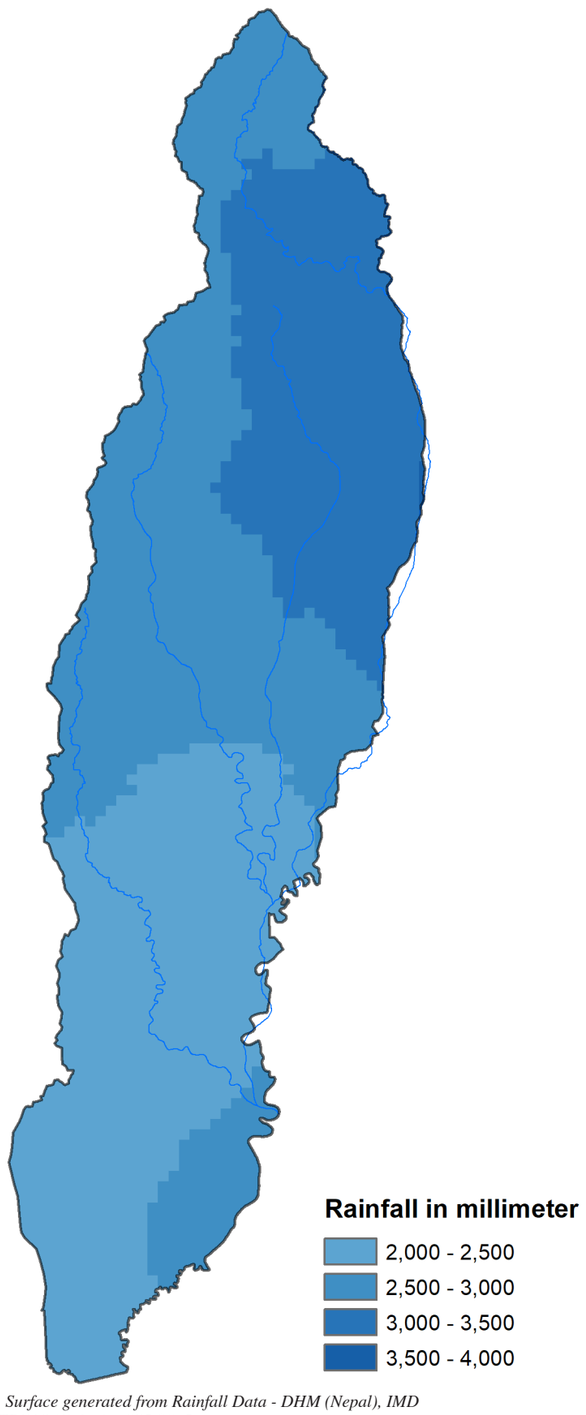
Data Source: Surface generated from DHM Temperature Data - 1985-2015.

Annual Average Rainfall Distribution





Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

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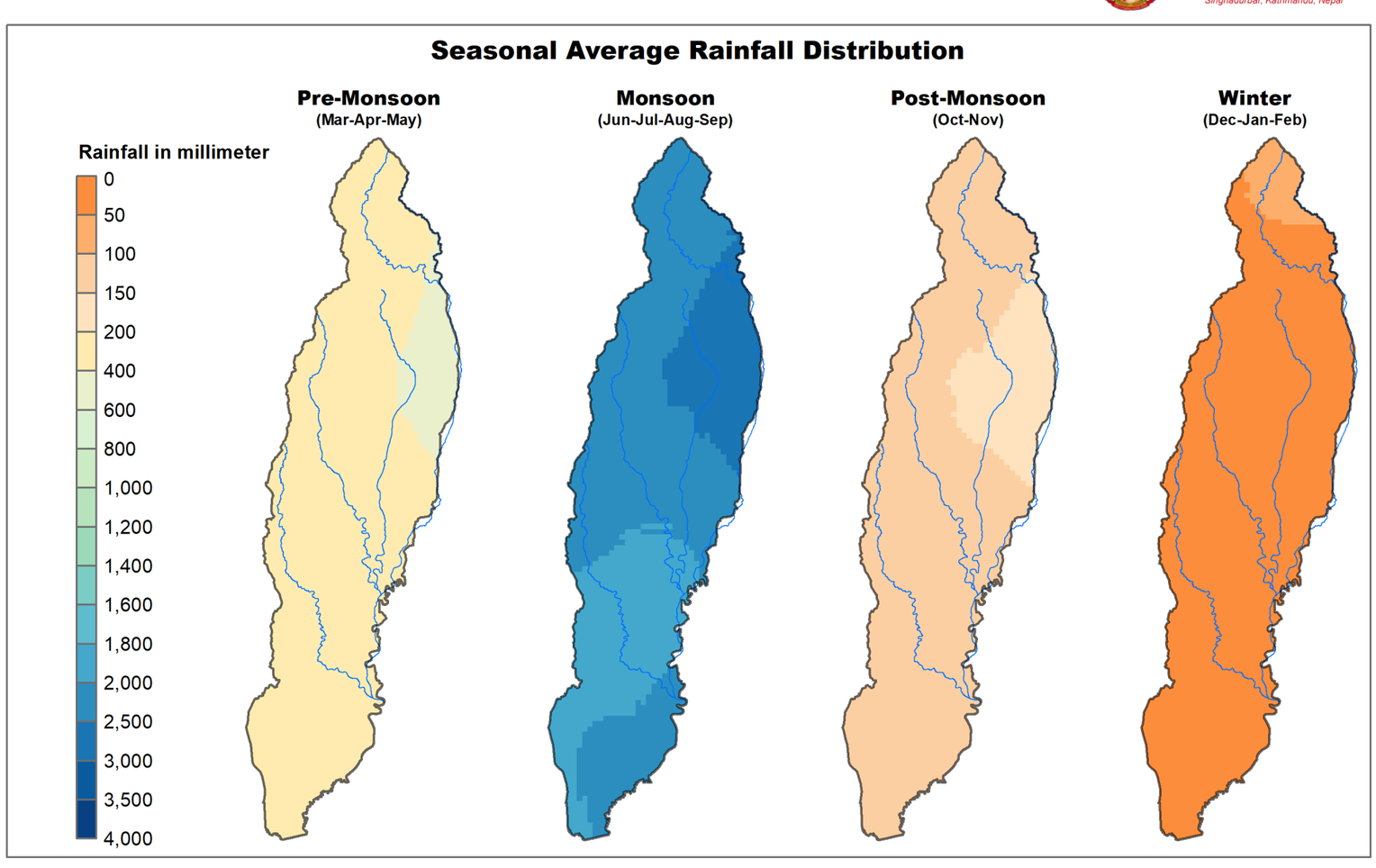
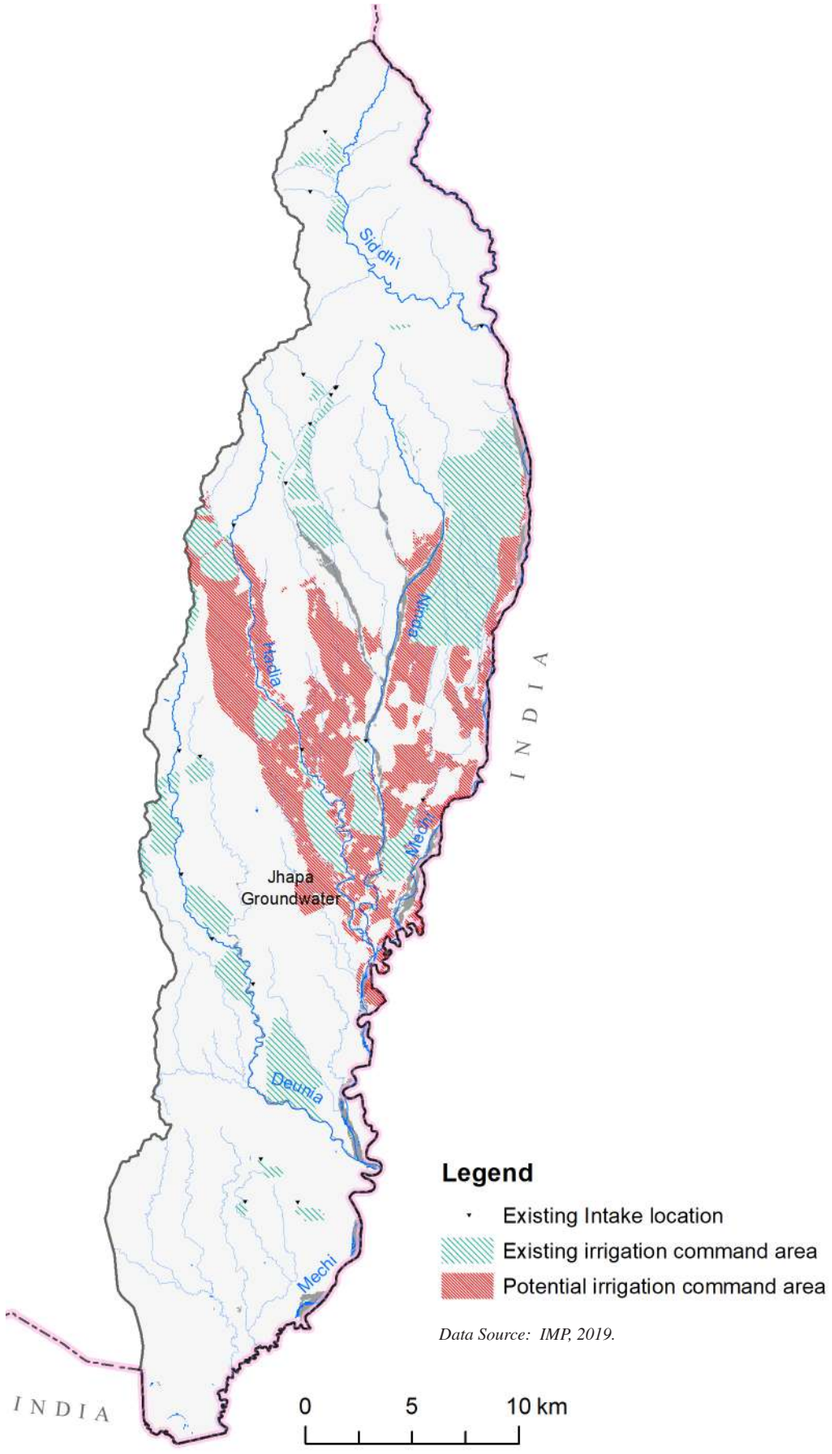
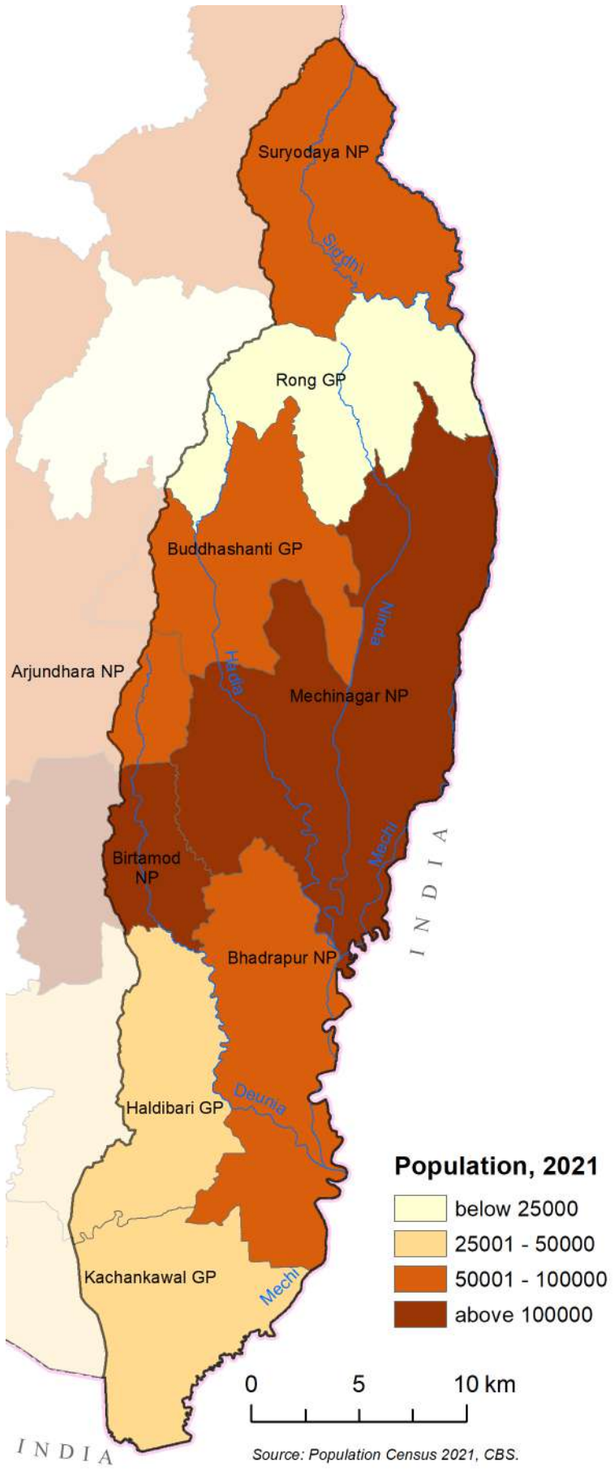
Seasonal Average Rainfall Distribution

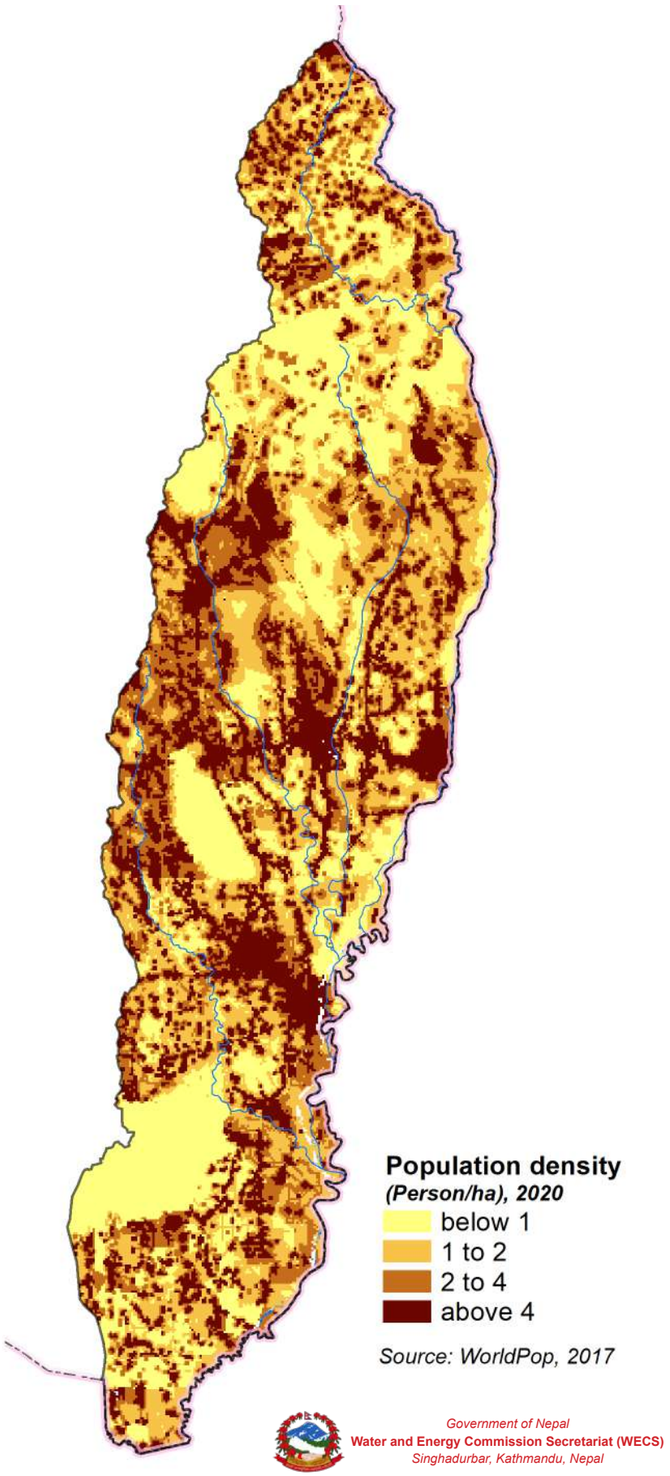


Irrigation Projects

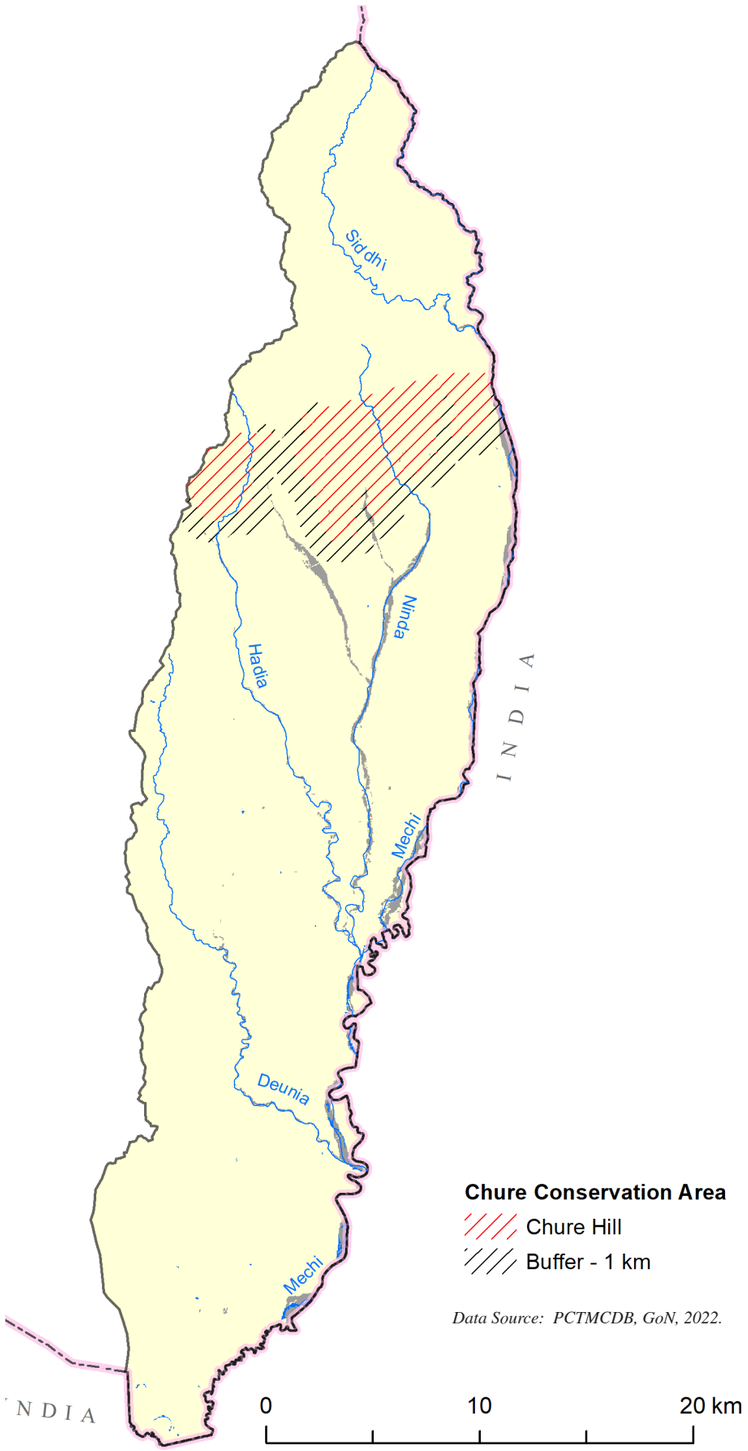


Population Distribution and Density

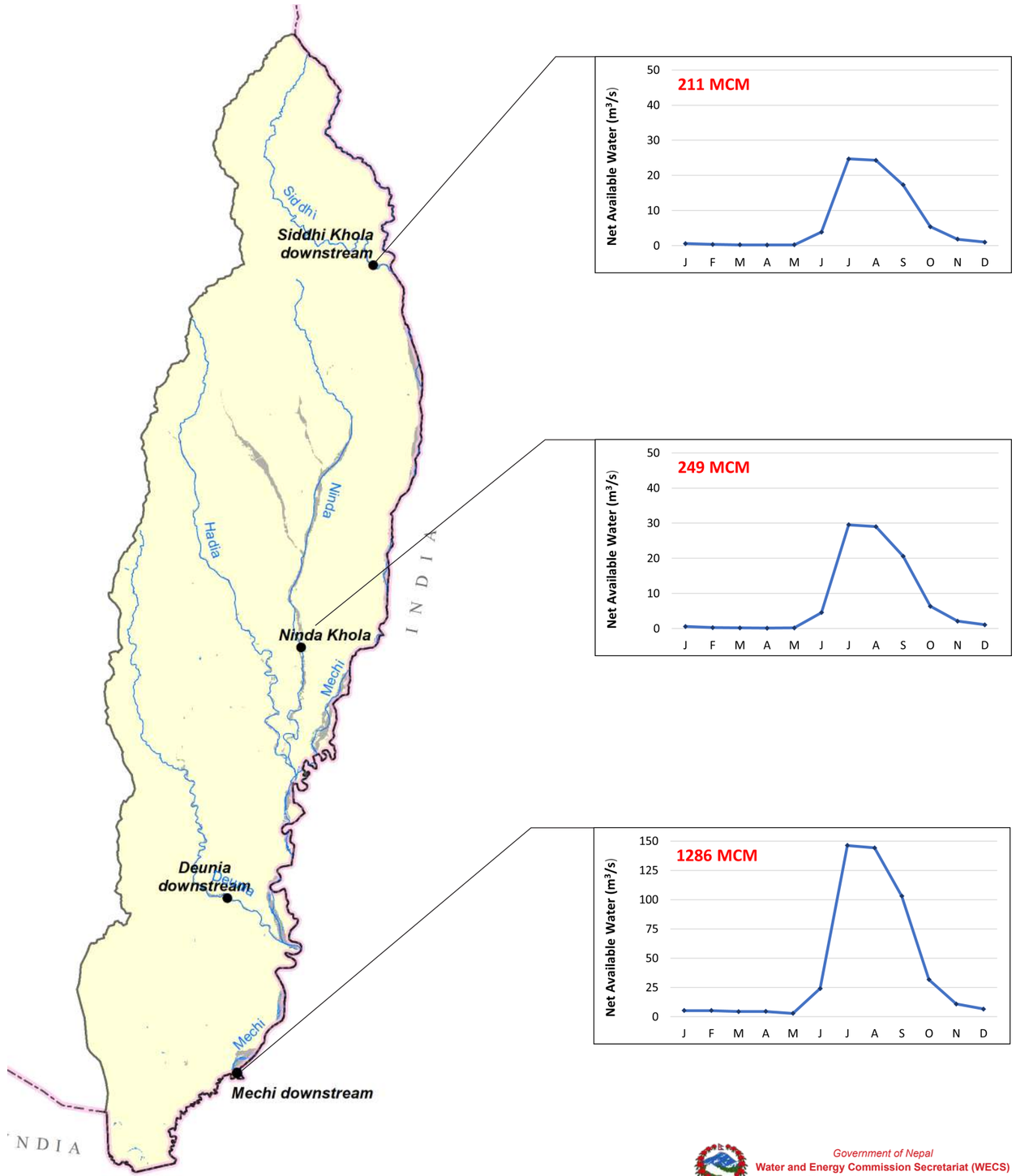




Protected Areas



Hydrographs at Major River Nodes



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Section 3 - Southern River Blocks

Southern Blocks

The drainage area originating from the Siwalik (Chure) range are categorized into four Southern Blocks. The drainage area between Mahakali Basin and West Rapti Basin is defined as Southern Block-1, which is located in the far-western part of Nepal. The Karnali Basin and Babai Basin separates the block into two parts. The total drainage area of the block up to Nepal-India Border is 4,821 km², which is about 3.3 % land of the country. The elevation of the area in Nepal ranges from 125 m to 1959 m. About 78.5% of the area of Southern Block-1 lies in Terai region whereas the Siwalik region covers about 21.5 percent land.

The main rivers in Southern Block-1 are Mohana and Khutiya in Kailali and Dodha in Kanchanpur districts. Other rivers are: Chaudhara, Shyali, Banhara, Surmi, Godavari and Manohara (tributaries of Mohana), Shivaganga (Tributary of Khutia) and Godkhola-Karha nadi. There are two small river systems namely, Kiran and Jethan nala in the eastern sub-block in Banke district.

The drainage area originating from Mahabharat and Siwalik (Chure) range between West Rapti Basin and Gandaki Basin in Lumbini Province is defined as Southern Block 2A The total drainage area of the block up to Nepal-India Border is about 4,395 km². which is about 3.0% land of the country. The elevation of the area in Nepal ranges from 79 m to 2268 m.

About 69.4% of the area of Southern Block-2A lies in Terai region, whereas the Middle Mountain and Siwalik region cover about 9.9% and 20.7% land, respectively.

The main rivers in Southern Block-2A are Banganga, Tinau, Dano, Rohini Mahao and Jharahi. Tinau and Banganga originate from the Mahabharat range and other smaller rivers originate from the Chure hills.

The drainage area originating from Mahabharat and Siwalik (Chure) range between Gandaki Basin and Bagmati Basin in Madhesh and Bagmati Provinces is defined as Southern Block-2B. Districts in the block are Bara, Parsa, Makwanpur and Rautahat. The total drainage area of the block up to Nepal-India Border is about 3,397 km², which is about 2.3% land

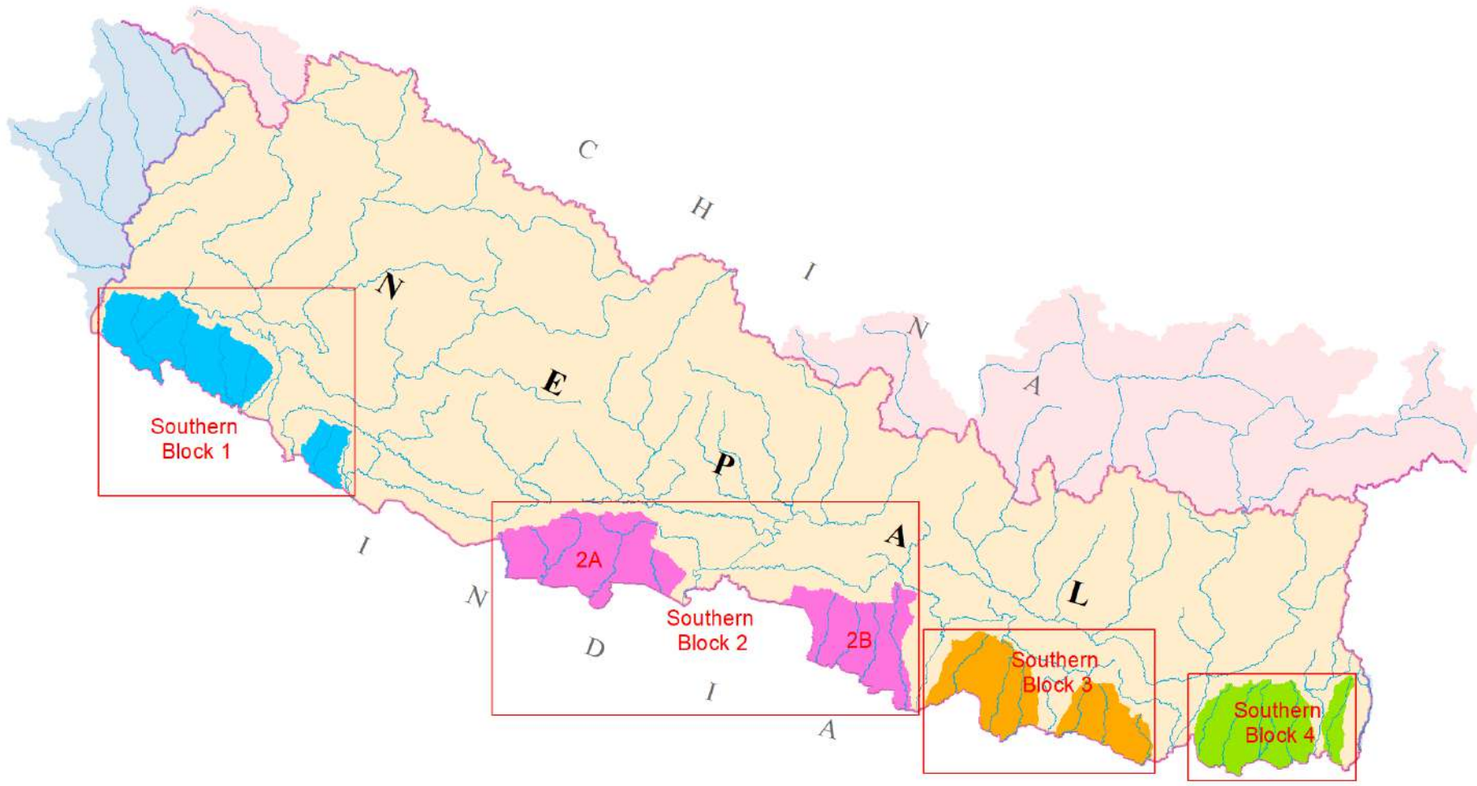


Figure 3.1: Location of Southern Blocks

of the country. The elevation ranges from 70 meter to 2135 meter.

The main rivers in Southern Block-2B are Lal Bakeya, Pasaha, Tilabe and Sirsiya. Except the Lal Bakeya, which originates from the Mahabharat range, all other smaller rivers originate from the Chure hills.

The drainage area originating from Siwalik (Chure) range in between Bagmati Basin and Koshi Basin is defined as Southern Block-3. It is in the central part of Nepal in Sarlahi, Mahottari, Dhanusa, Siraha and Saptari Districts in Madhesh Pradesh. The Kamala Basin separates the block into two parts. The total drainage area of the block up to Nepal-India Border is about 4,425 km², which is about 3% land of the country. The elevation ranges from 60 m to 964 m. About 81% of the area of Southern Block-3 lies in Terai region, whereas the Siwalik region covers 19 % land.

The drainage area originating from Mahabharat and Siwalik (Chure) range between Koshi Basin and Mechi Basin is defined as Southern Block 4, which is located in Koshi Province. Districts in the block are SunsintoMorang, Ilam, Jhapa, Panchthar and Dhankuta. The Kankai Basin separates the block in to two parts. The total drainage area of the block up to Nepal-India Border is about 3,978 km² , which is about 2.7 % land of the country. The elevation ranges from 60 meter to 2410 meter.

About 81.4 % of the area of Southern Block-4 lies in Terai region whereas the Middle Mountain and Siwalik region cover about 7.5% and 11.1% land, respectively. The main rivers in Southern Block-4 are Budhi, Lohandra, Chisang, Bakraha, Ratuwa, Kamal and Biring.

Administrative Division of Southern Block - 1

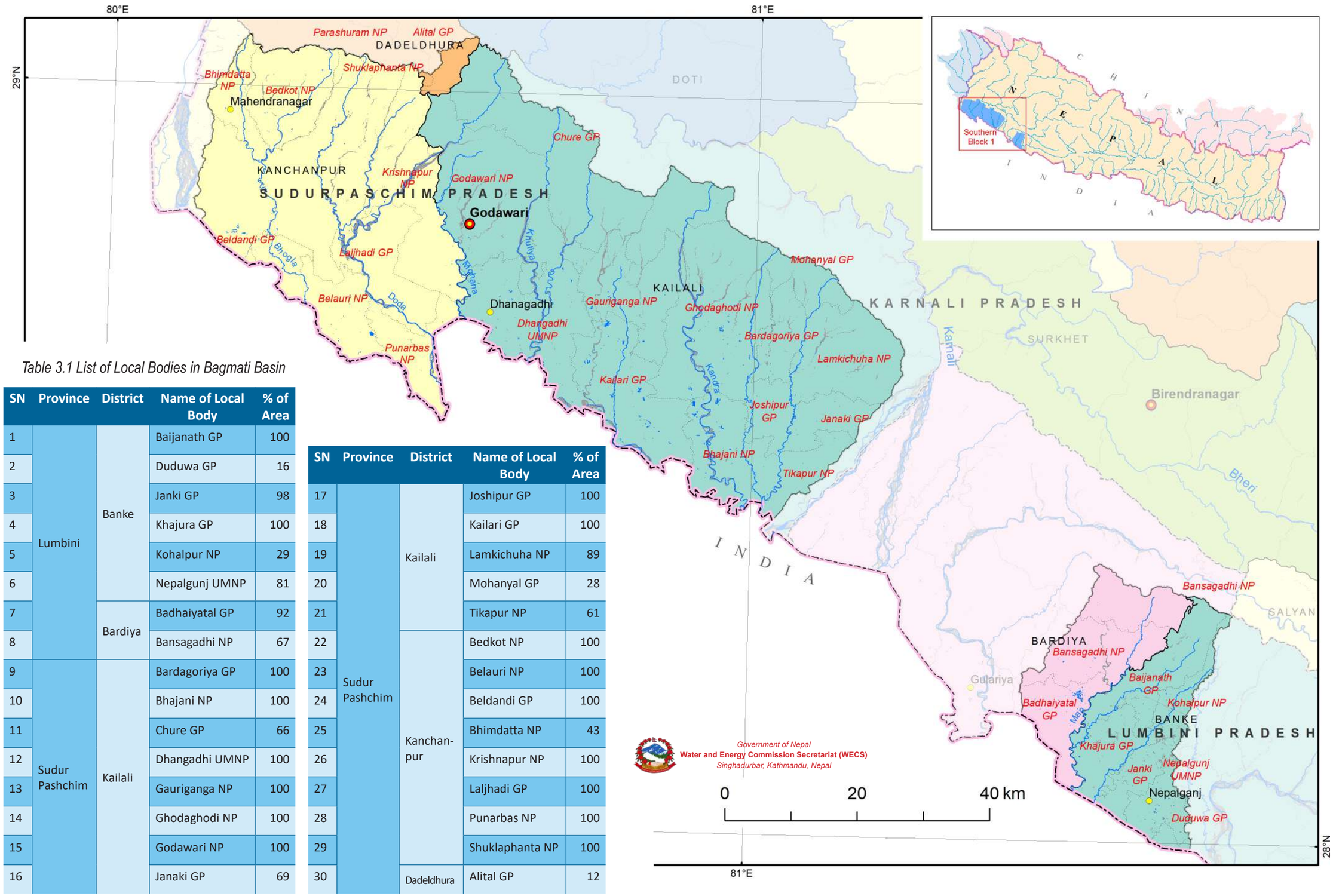
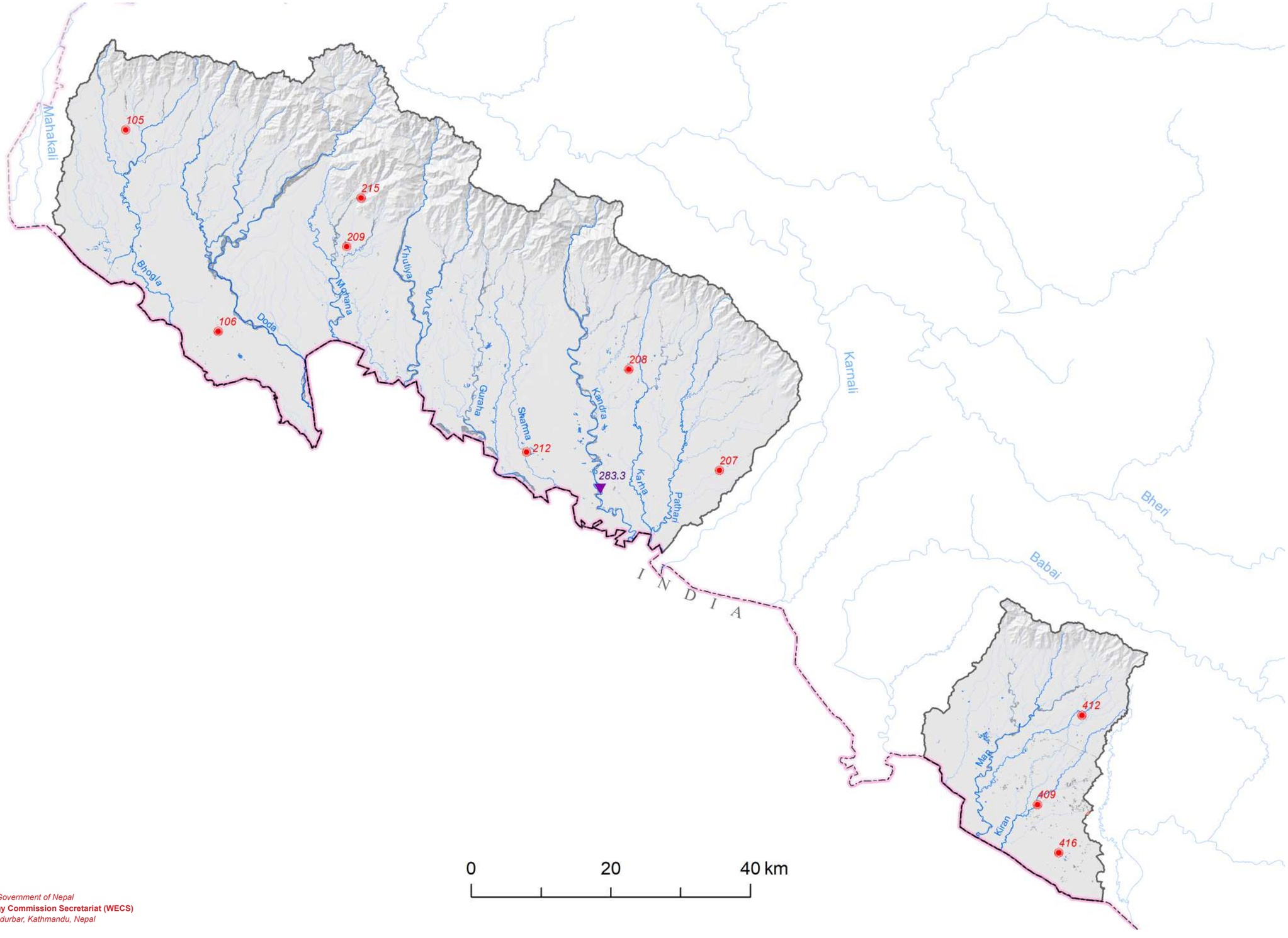


Table 3.1 List of Local Bodies in Bagmati Basin

SN	Province	District	Name of Local Body	% of Area
1	Lumbini	Banke	Baijanath GP	100
2			Duduwa GP	16
3			Janki GP	98
4			Khajura GP	100
5			Kohalpur NP	29
6			Nepalgunj UMNP	81
7		Bardiya	Badhaiyatal GP	92
8			Bansagadhi NP	67
9	Sudur Pashchim	Kailali	Bardagoriya GP	100
10			Bhajani NP	100
11			Chure GP	66
12			Dhangadhi UMNP	100
13			Gauriganga NP	100
14			Ghodaghodi NP	100
15			Godawari NP	100
16			Janaki GP	69
17	Sudur Pashchim	Kailali	Joshipur GP	100
18			Kailari GP	100
19			Lamkichuha NP	89
20			Mohanyal GP	28
21			Tikapur NP	61
22		Kanchan-pur	Bedkot NP	100
23			Belauri NP	100
24			Beldandi GP	100
25			Bhimdatta NP	43
26			Krishnapur NP	100
27			Laljhadi GP	100
28			Punarbas NP	100
29			Shuklaphanta NP	100
30		Dadeldhura	Alital GP	12

Southern Block 1: River System



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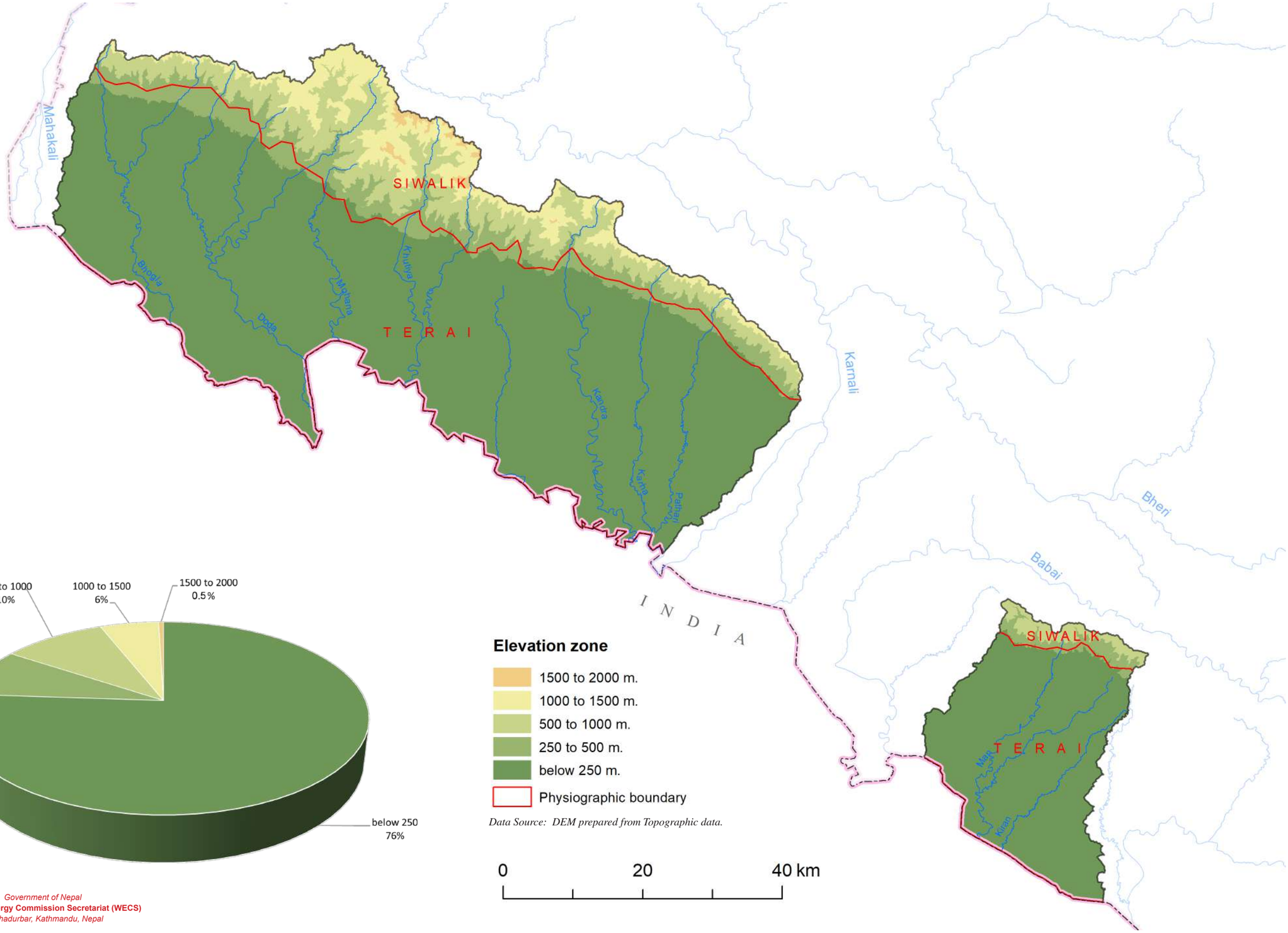
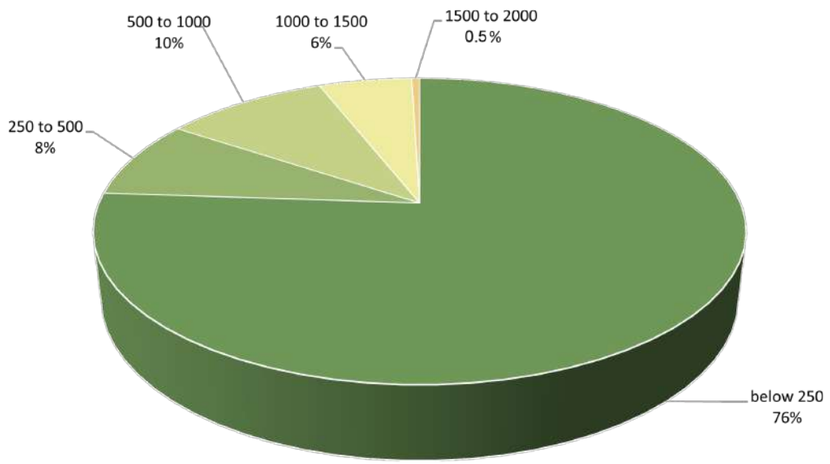
Southern Block 1: Elevation Zone





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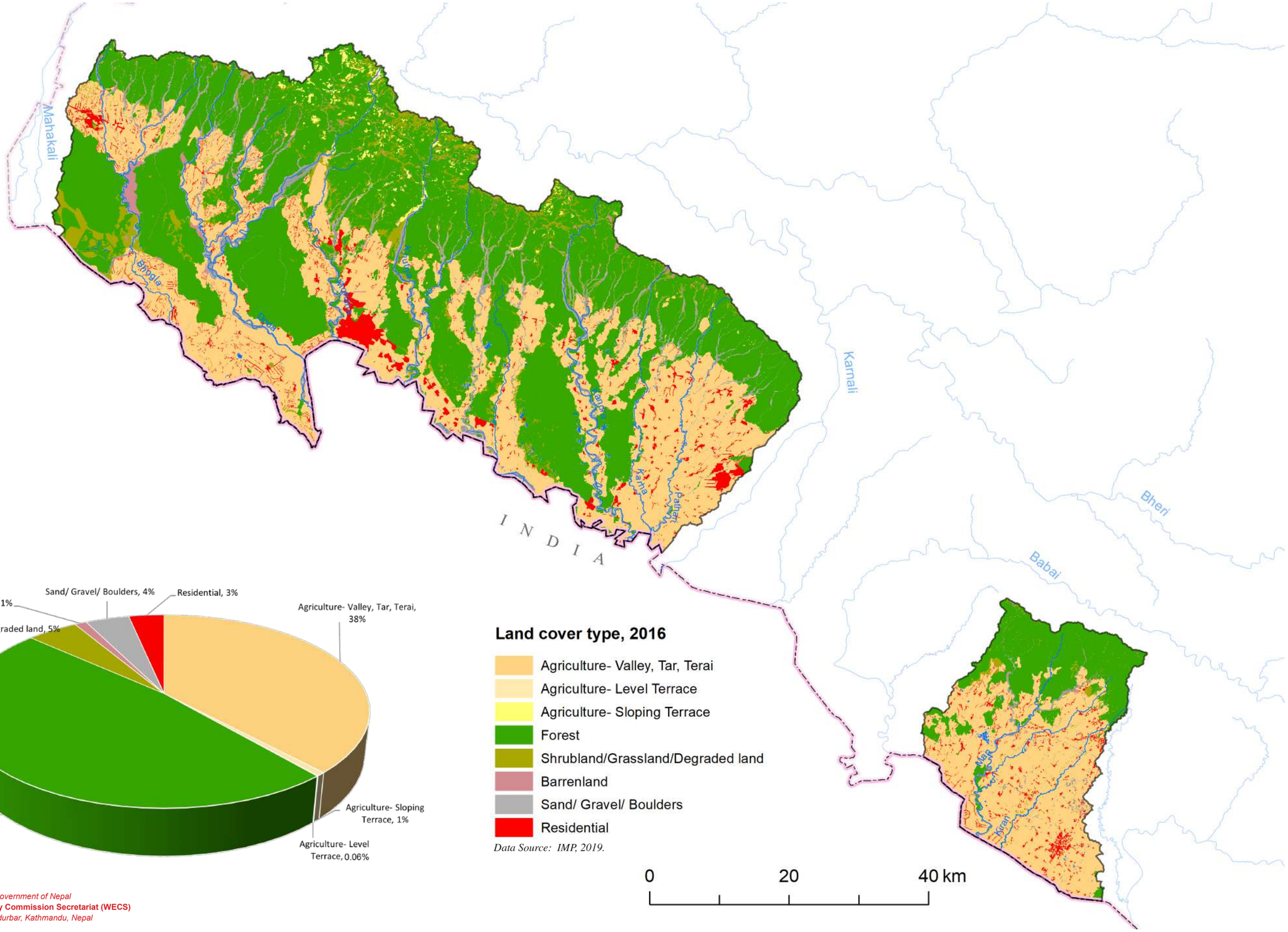
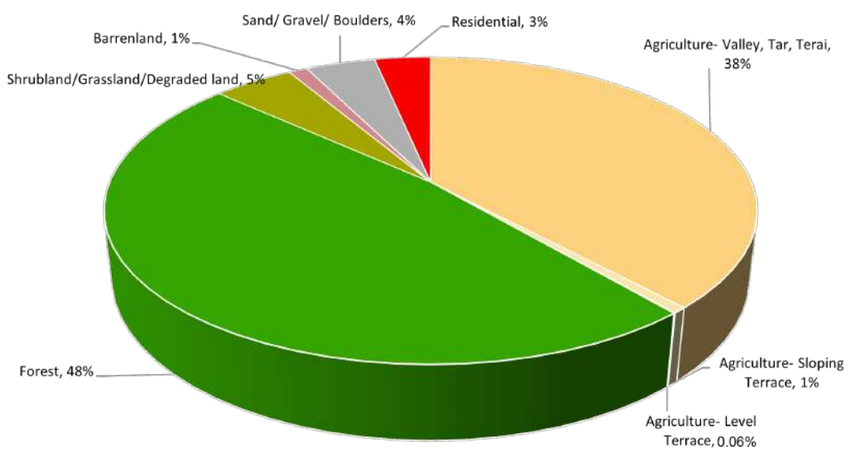
Southern Block 1: Land Use/Cover



Data Source: IMP, 2019.



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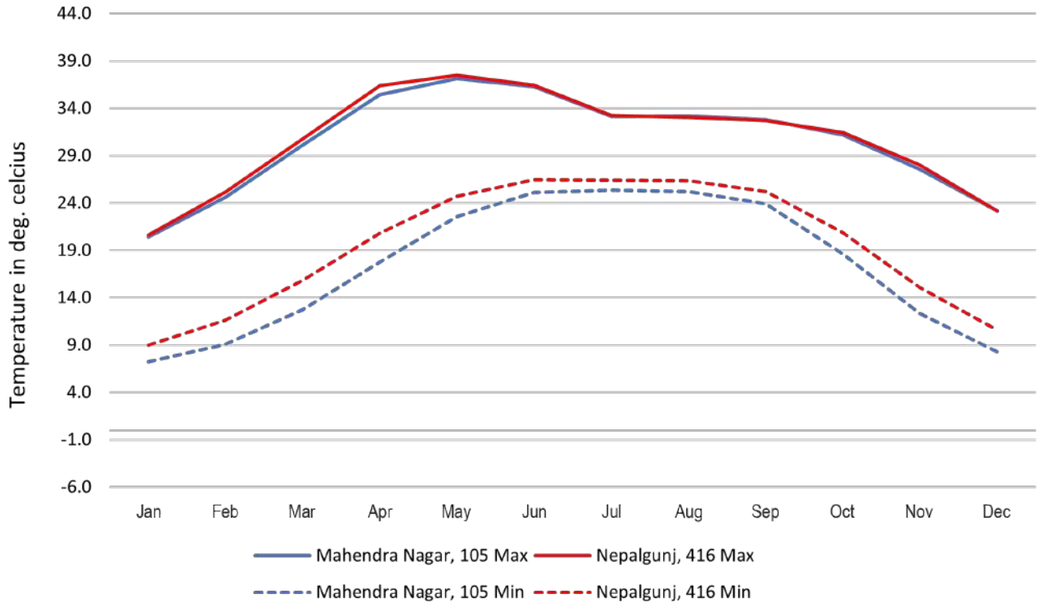
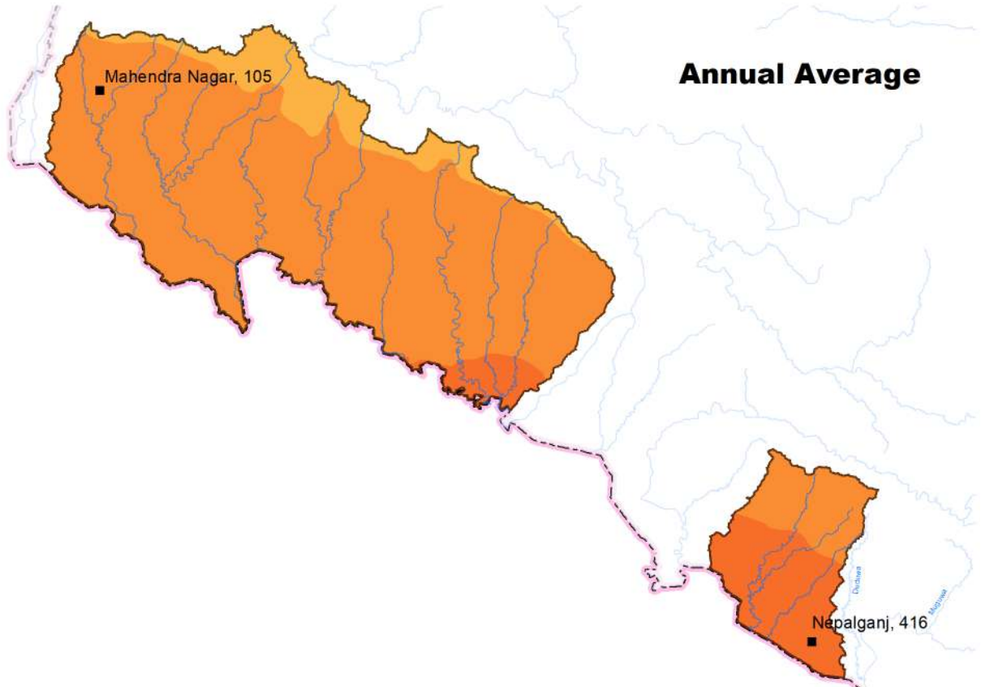
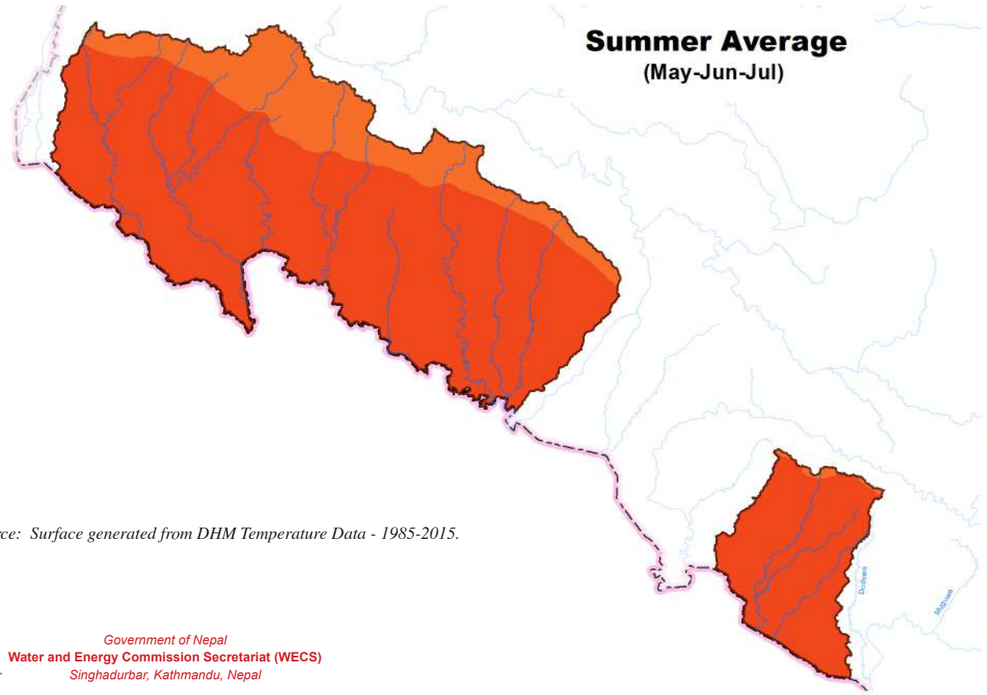
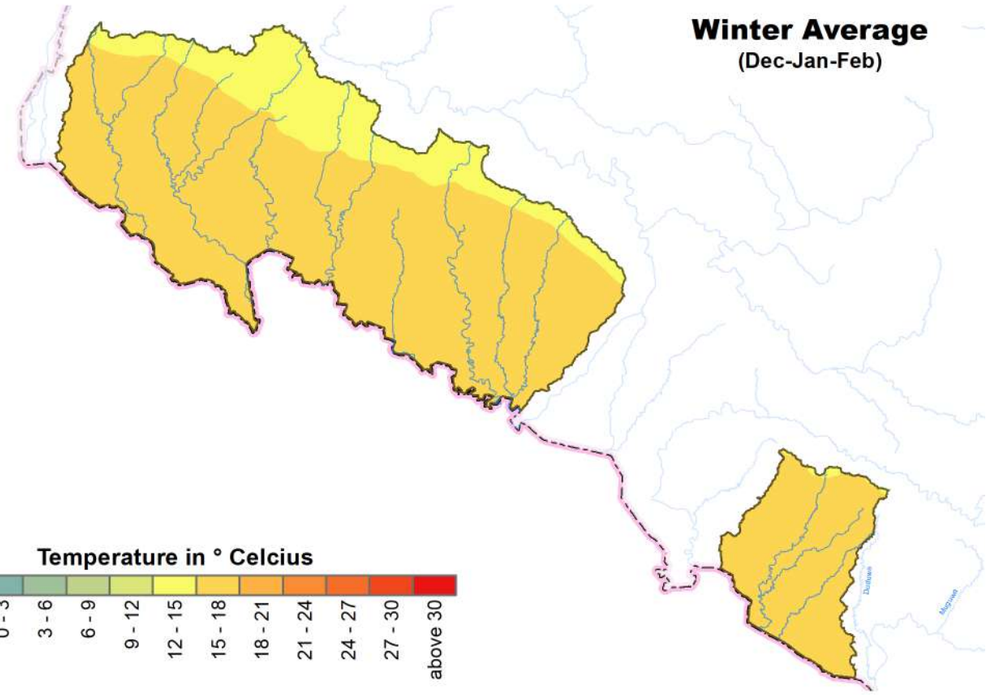
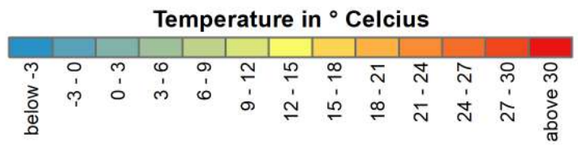
Southern Block 1: Average Temperature Distribution











Data Source: Surface generated from DHM Temperature Data - 1985-2015.

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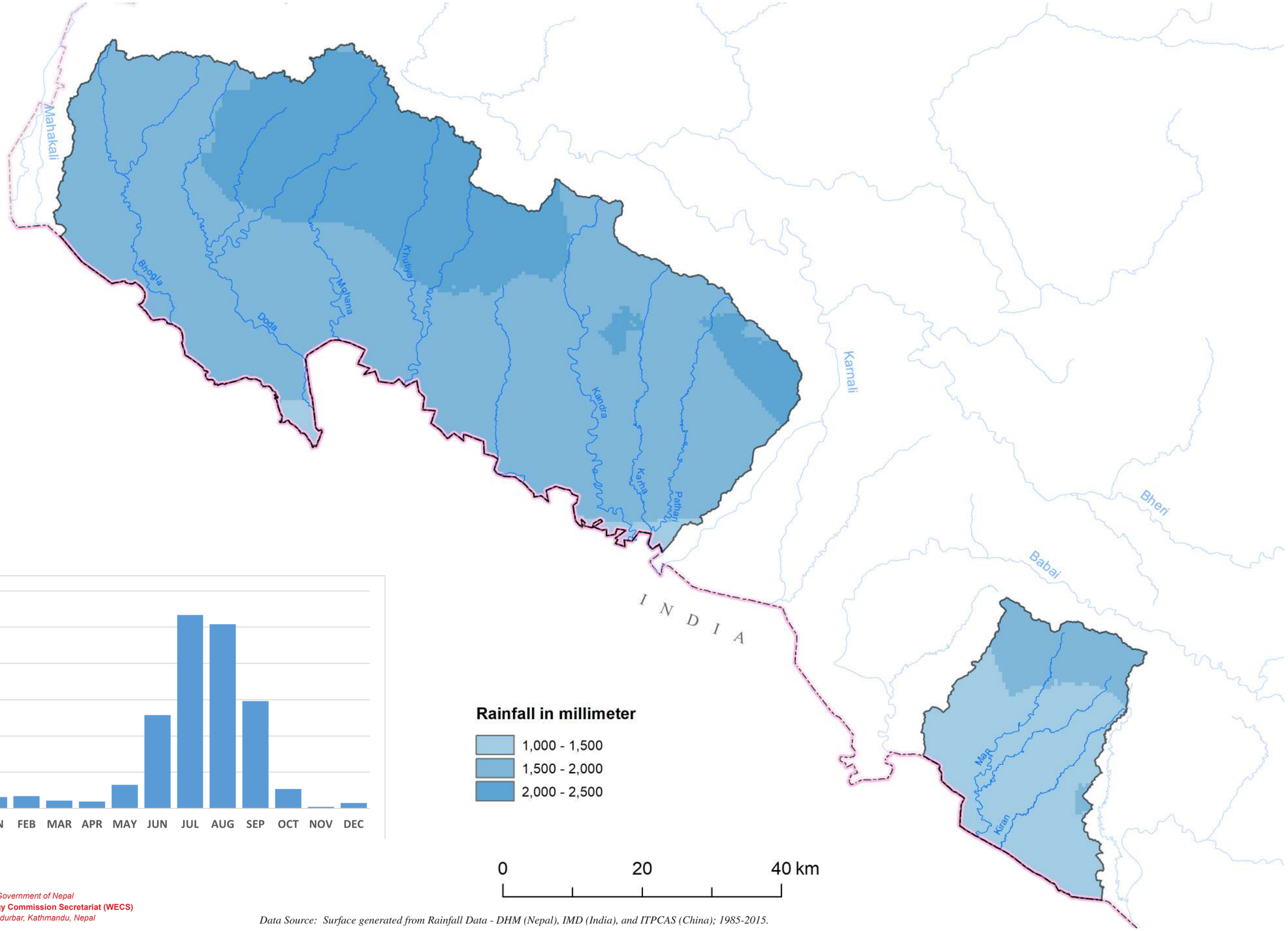
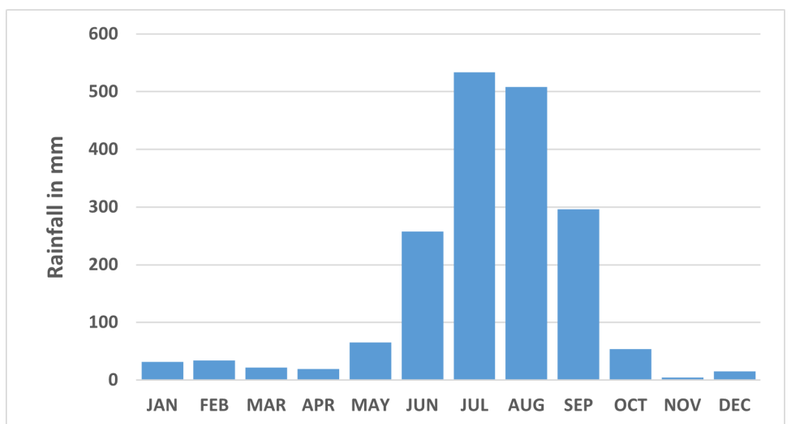
Southern Block 1: Annual Average Rainfall Distribution





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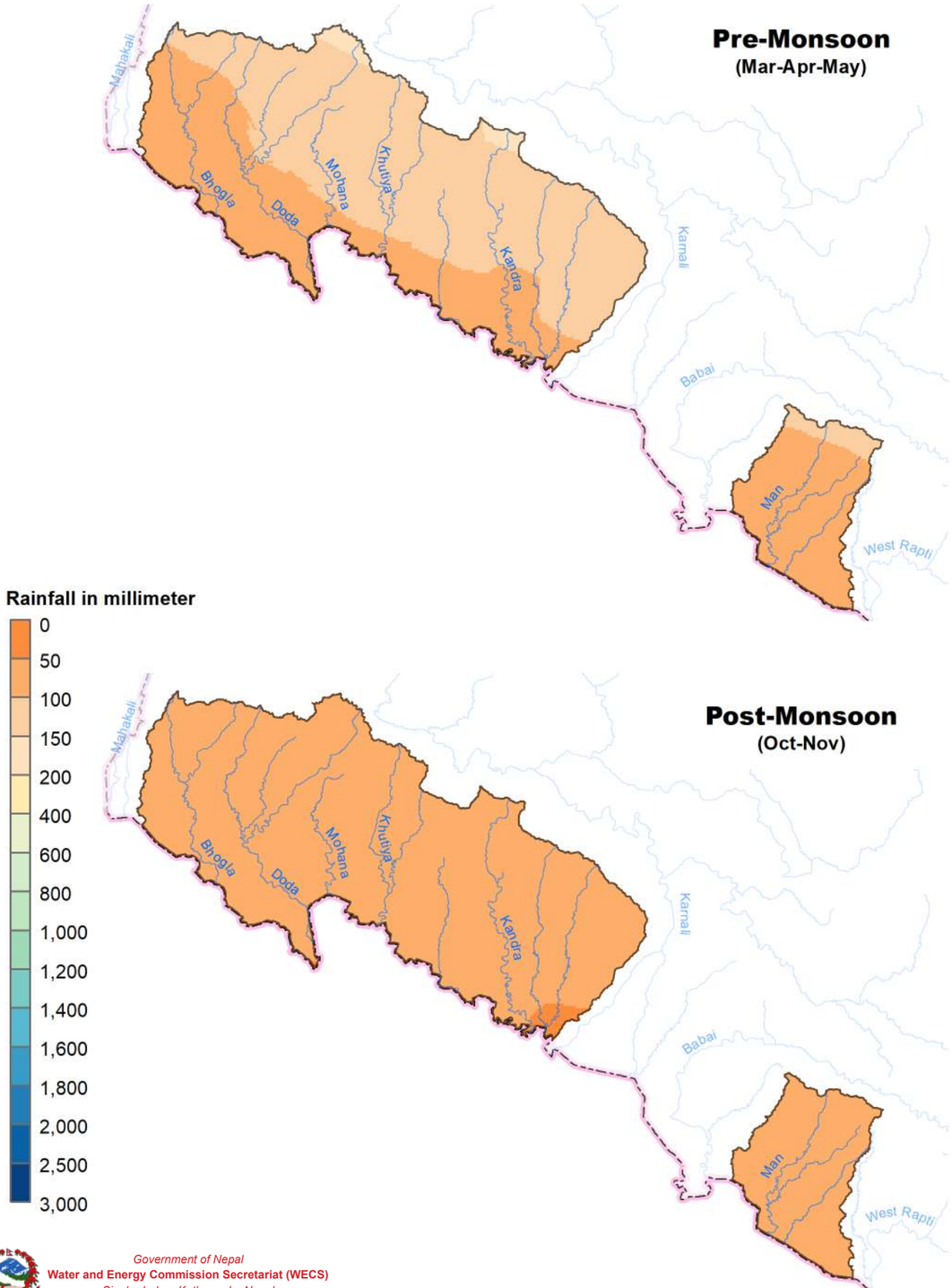
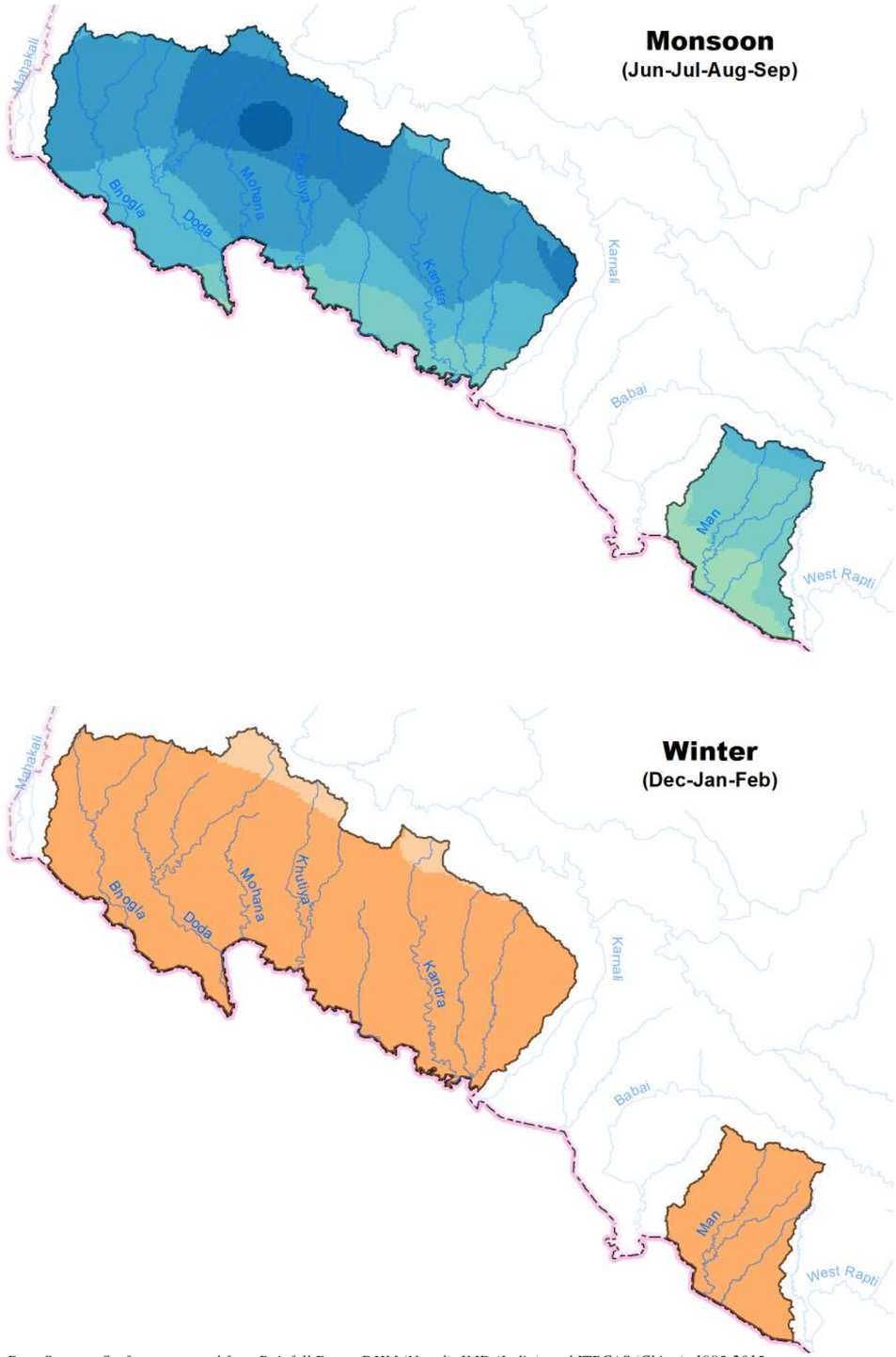
Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

Southern Block 1: Seasonal Average Rainfall Distribution





Rainfall in millimeter

0
50
100
150
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000
2,500
3,000

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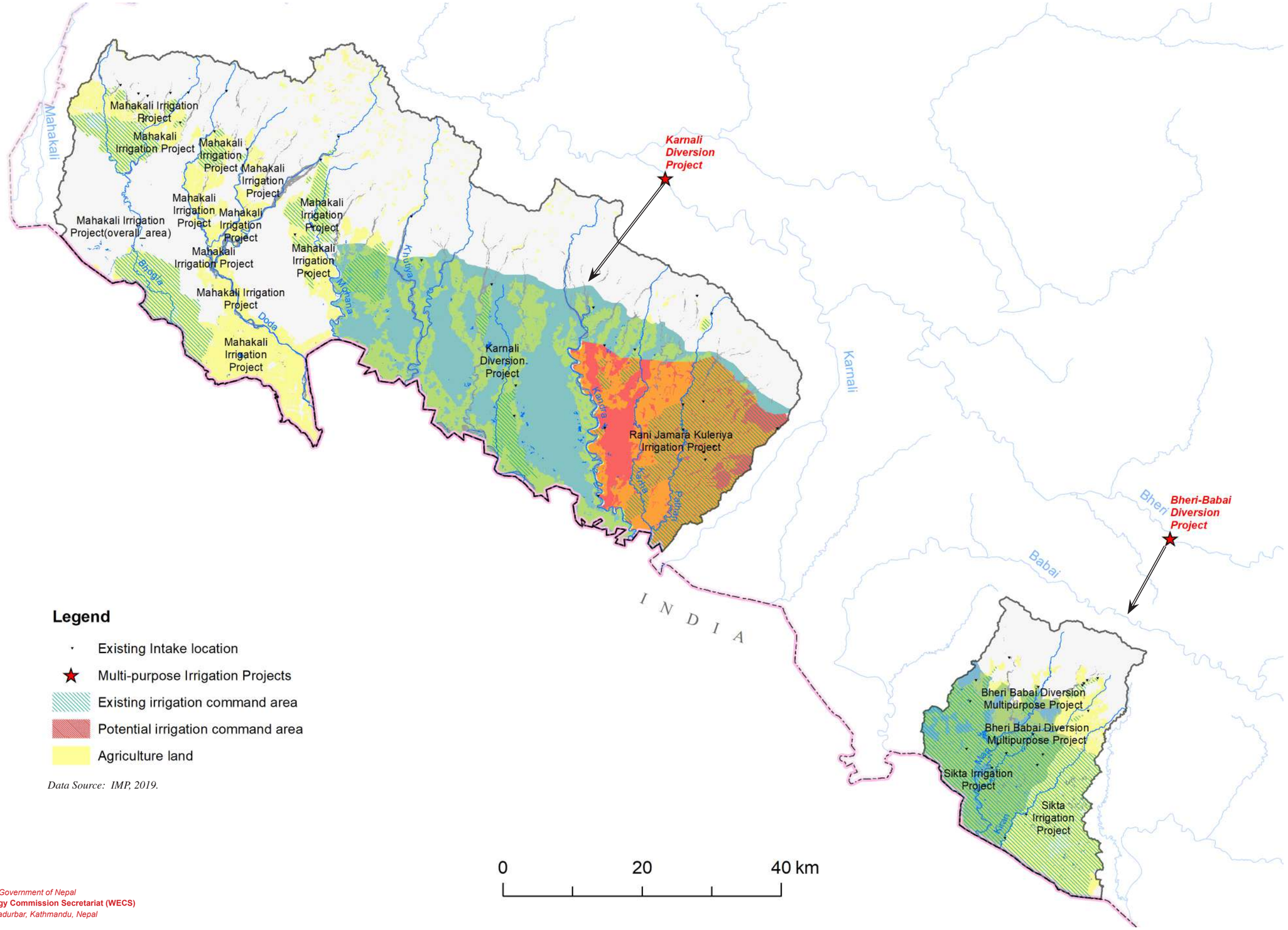
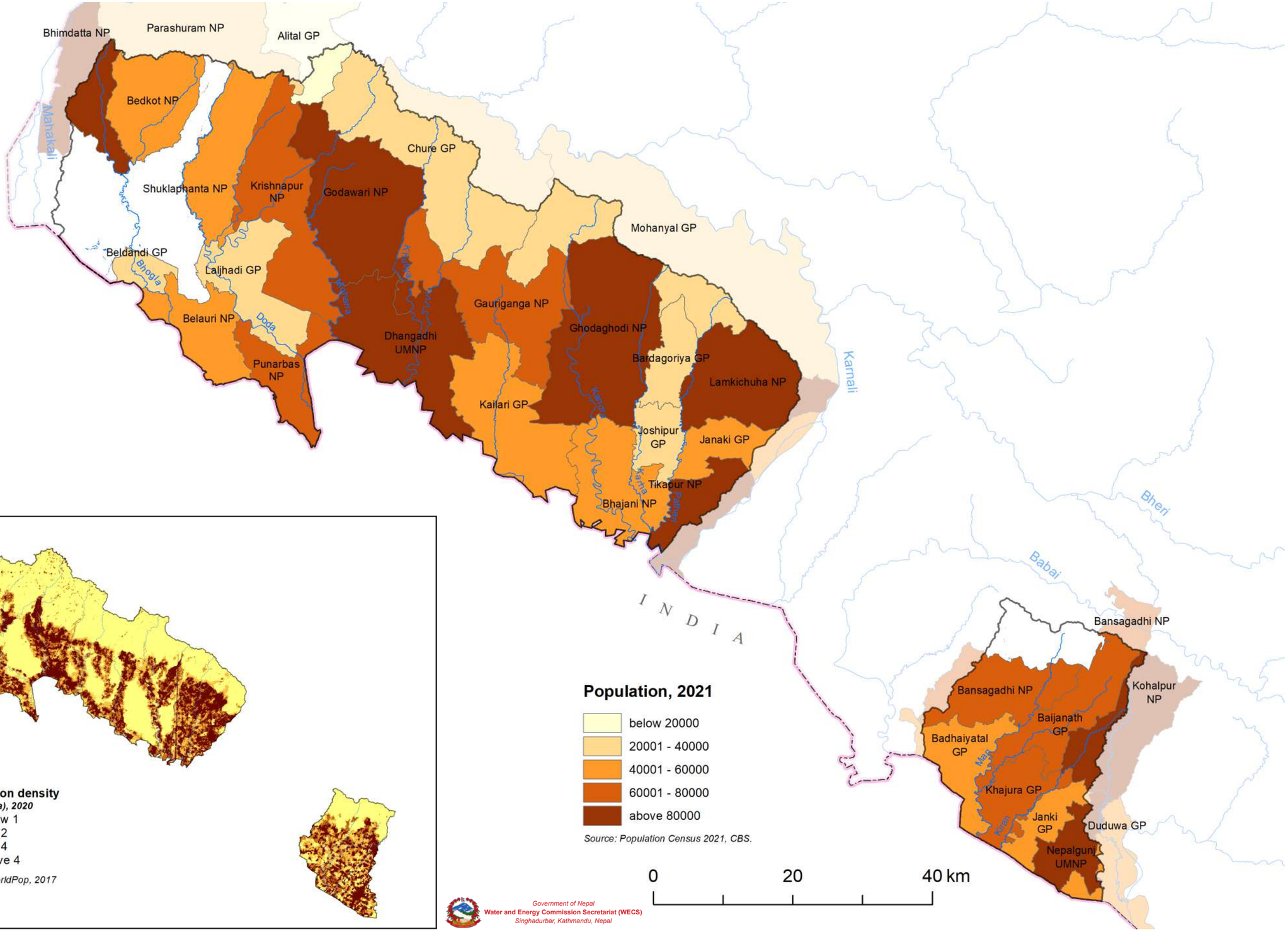
Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

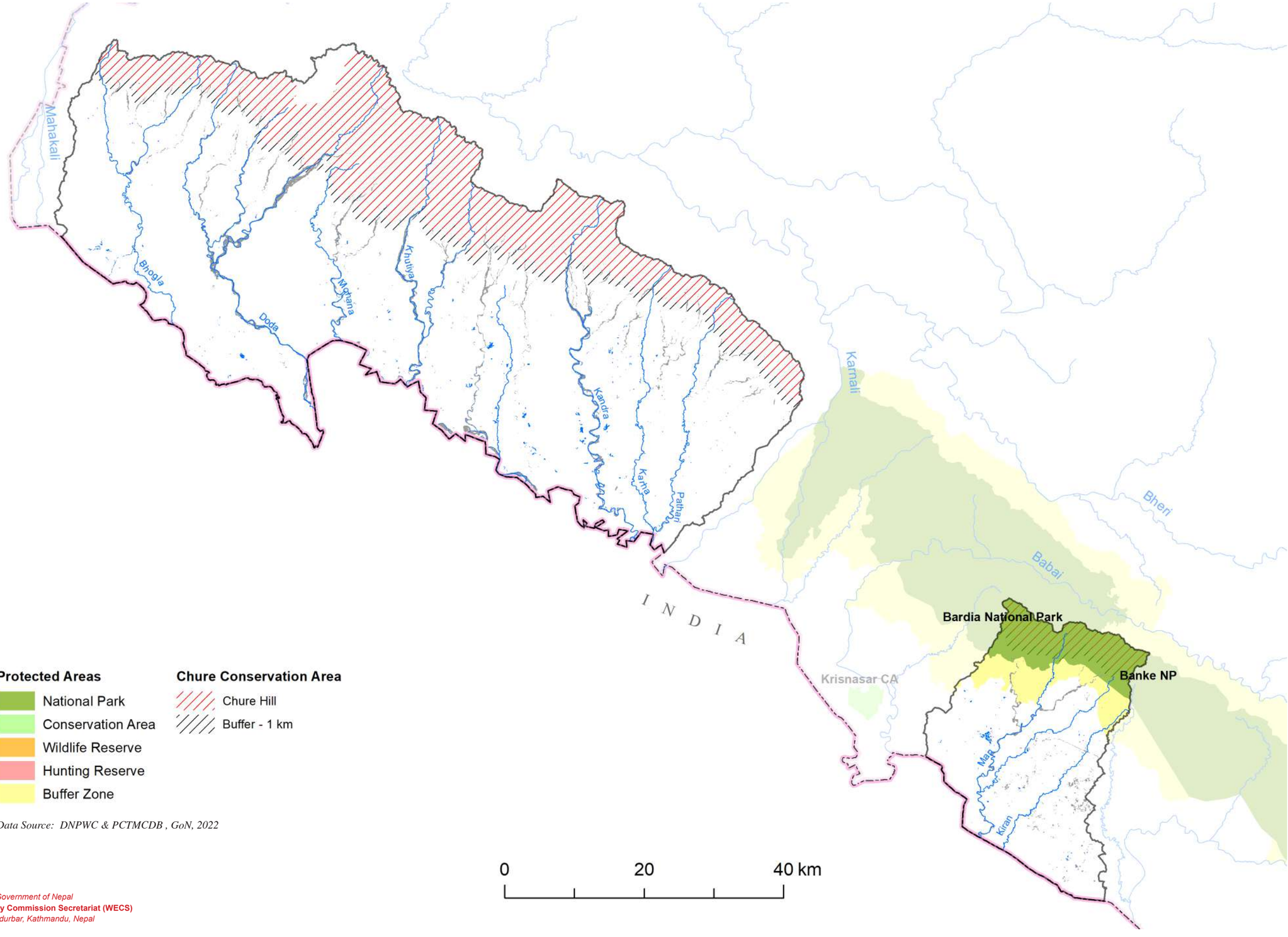
Southern Block 1: Irrigation Projects



Southern Block 1: Population Distribution and Density



Southern Block 1: Protected Areas



Data Source: DNPWC & PCTMCDB , GoN, 2022

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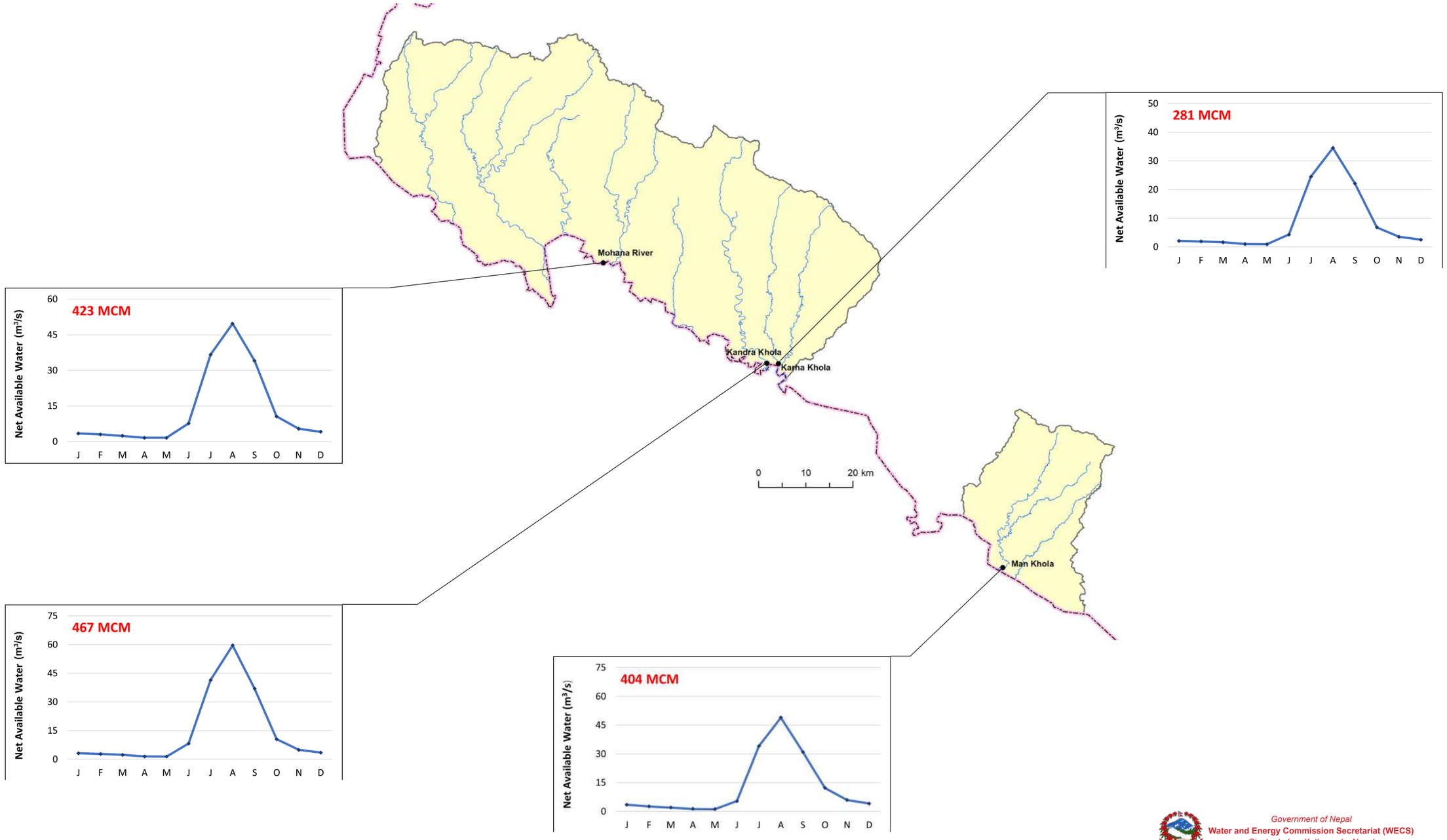
Hydrographs at Major River Nodes



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Administrative Division of Southern Block - 2

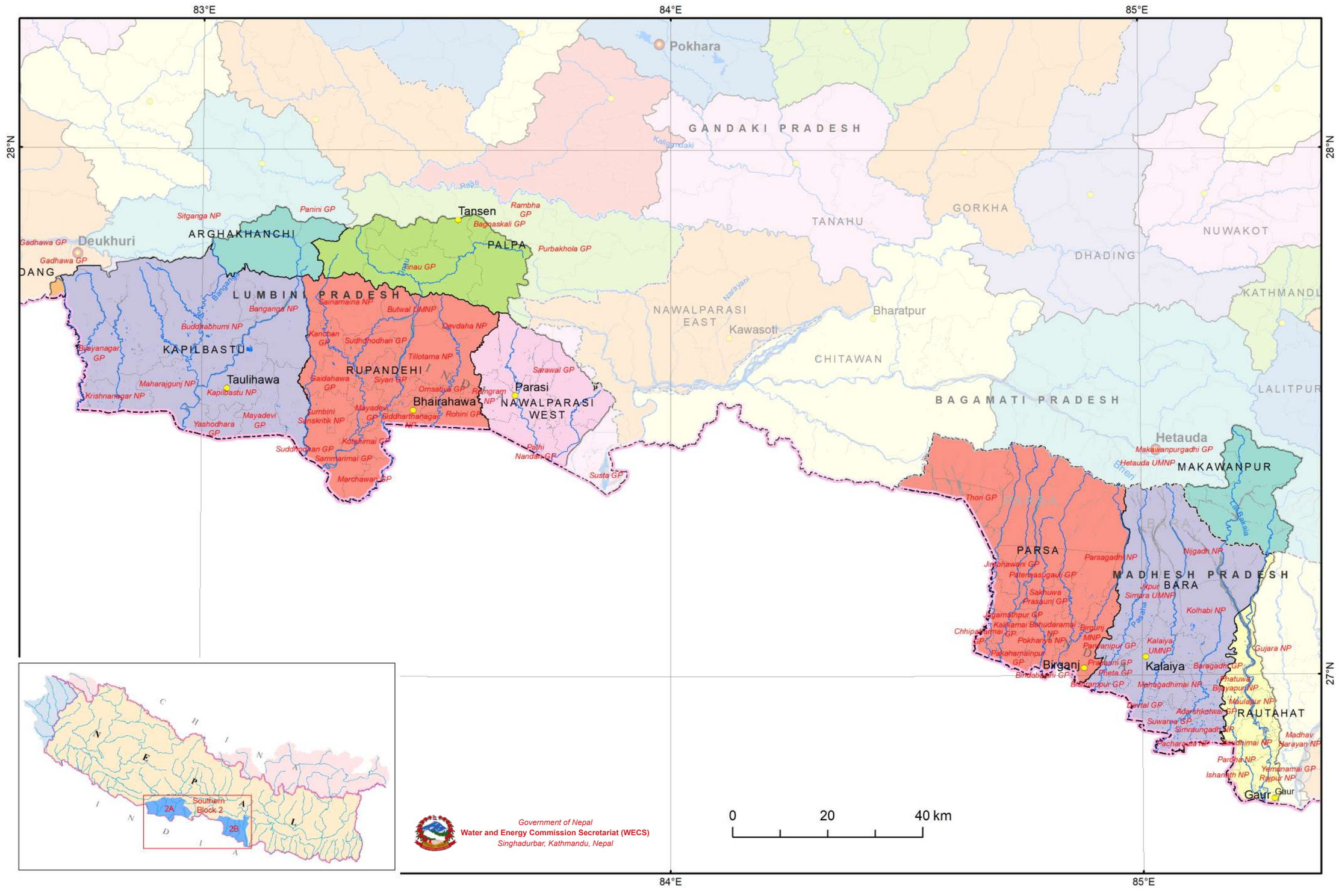


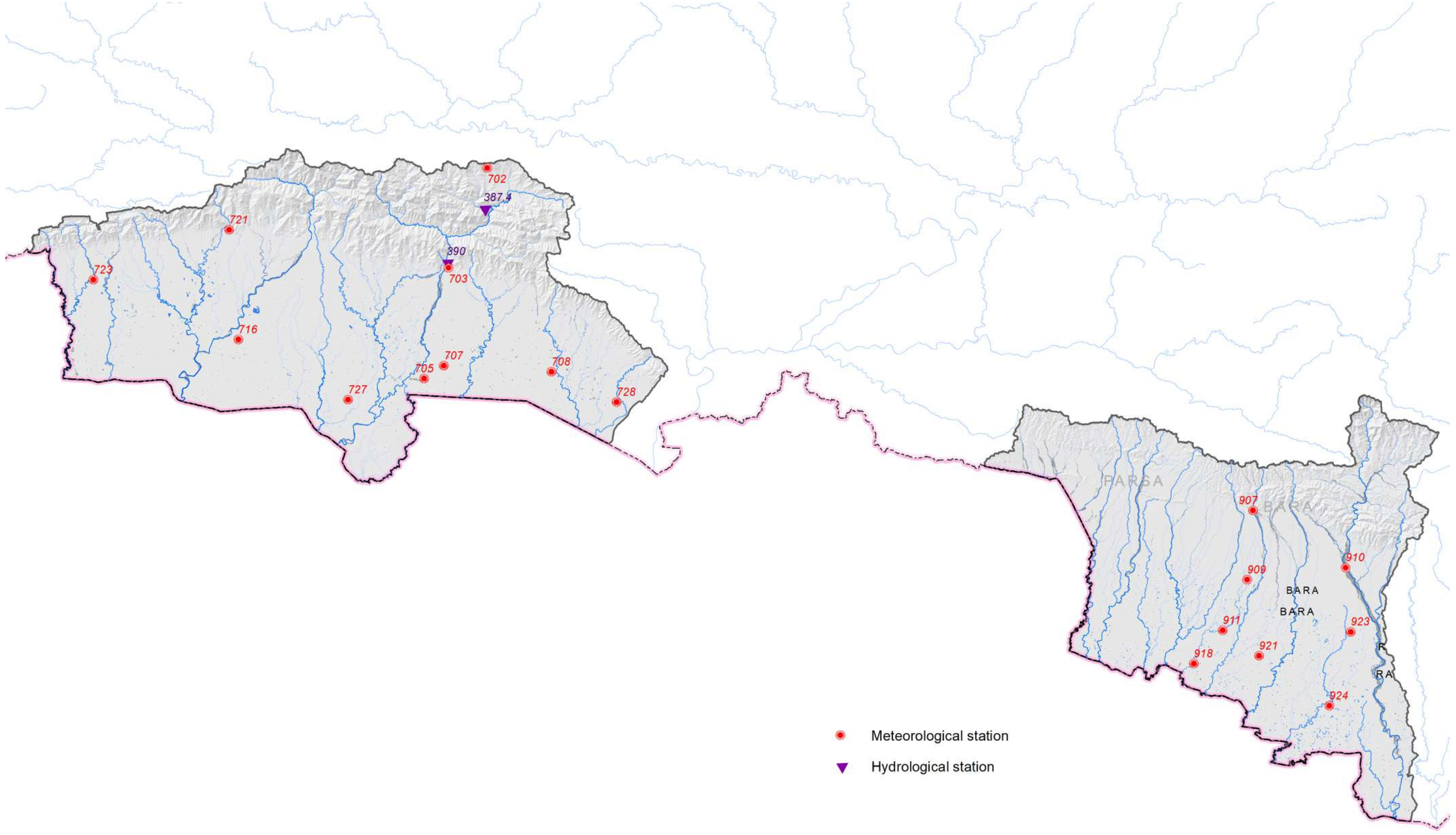
Table 3.2 List of Local Bodies in Southern Block 2A

SN	Province	District	Name of Local Body	% of Area
1	Lumbini	Palpa	Bagnaskali GP	26
2			Mathagadhi GP	64
3			Purbakhola GP	3
4			Rainadevi Chhahara GP	55
5			Rambha GP	6
6			Ribdikot GP	62
7			Tansen NP	55
8			Tinau GP	100
9		Nawal-parasi West	Bardaghat NP	80
10			Palhi Nandan GP	100
11			Pratappur GP	58
12			Ramgram NP	100
13			Sarawal GP	100
14			Sunwal NP	95
15			Susta GP	4
16		Rupandehi	Butwal UMNP	100
17			Devdaha NP	100
18			Gaidahawa GP	100
19			Kanchan GP	100
20			Kotahimai GP	100
21			Lumbini Sanskritik NP	100
22			Marchawari GP	100
23	Lumbini	Rupandehi	Mayadevi GP	100
24			Omsatiya GP	100
25			Rohini GP	100
26			Sainamaina NP	100
27			Sammarimai GP	100
28			Siddharthanagar NP	100
29			Siyari GP	100
30			Sudhdhodhan GP	100
31			Tillotama NP	100
32		Kapilbastu	Banganga NP	100
33			Bijayanagar GP	100
34			Buddhabhumi NP	100
35			Kapilbastu NP	100
36			Krishnanagar NP	100
37			Maharajgunj NP	100
38			Mayadevi GP	100
39			Shivaraj NP	97
40			Suddhodhan GP	100
41			Yashodhara GP	100
42		Ar-ghakhan-chi	Panini GP	28
43			Sitganga NP	37
44		Dang	Gadhawa GP	3

Table 3.3 List of Local Bodies in Southern Block 2B

SN	Province	District	Name of Local Body	% of Area
1	Madhesh	Rautahat	Baudhimai NP	100
2			Dewahhi Gonahi NP	94
3			Gaur NP	89
4			Gujara NP	18
5			Ishanath NP	100
6			Katahariya NP	75
7			Madhav Narayan NP	13
8			Maulapur NP	100
9			Paroha NP	100
10			Phatuwa Bijayapur NP	100
11			Rajpur NP	100
12			Yemunamai GP	21
13		Bara	Adarshkotwal GP	100
14			Baragadhi GP	100
15			Bishrampur GP	100
16			Devtal GP	100
17			Jitpur Simara UMNP	100
18			Kalaiya UMNP	100
19			Karaiyamai GP	100
20			Kolhabi NP	100
21			Mahagadhimai NP	100
22			Nijgadh NP	100
23			Pacharauta NP	100
24	Madhesh	Bara	Parwanipur GP	100
25			Pheta GP	100
26			Prasauni GP	100
27			Simraungadh NP	100
28			Suwarna GP	100
29		Parsa	Bahudaramai NP	100
30			Bindabasini GP	100
31			Birgunj MNP	100
32			Chhipaharmai GP	100
33			Dhobini GP	100
34			Jagarnathpur GP	100
35			Jirabhawani GP	100
36			Kalikamai GP	100
37			Pakahamainpur GP	100
38			Parsagadhi NP	100
39			Paterwasugauli GP	100
40			Pokhariya NP	100
41			Sakhuwa Prasauni GP	100
42			Thori GP	100
43	Bagamati	Makawan-pur	Bakaiya GP	81
44			Hetauda UMNP	7
45			Makawanpurgadhi GP	15

Southern Block 2: River System



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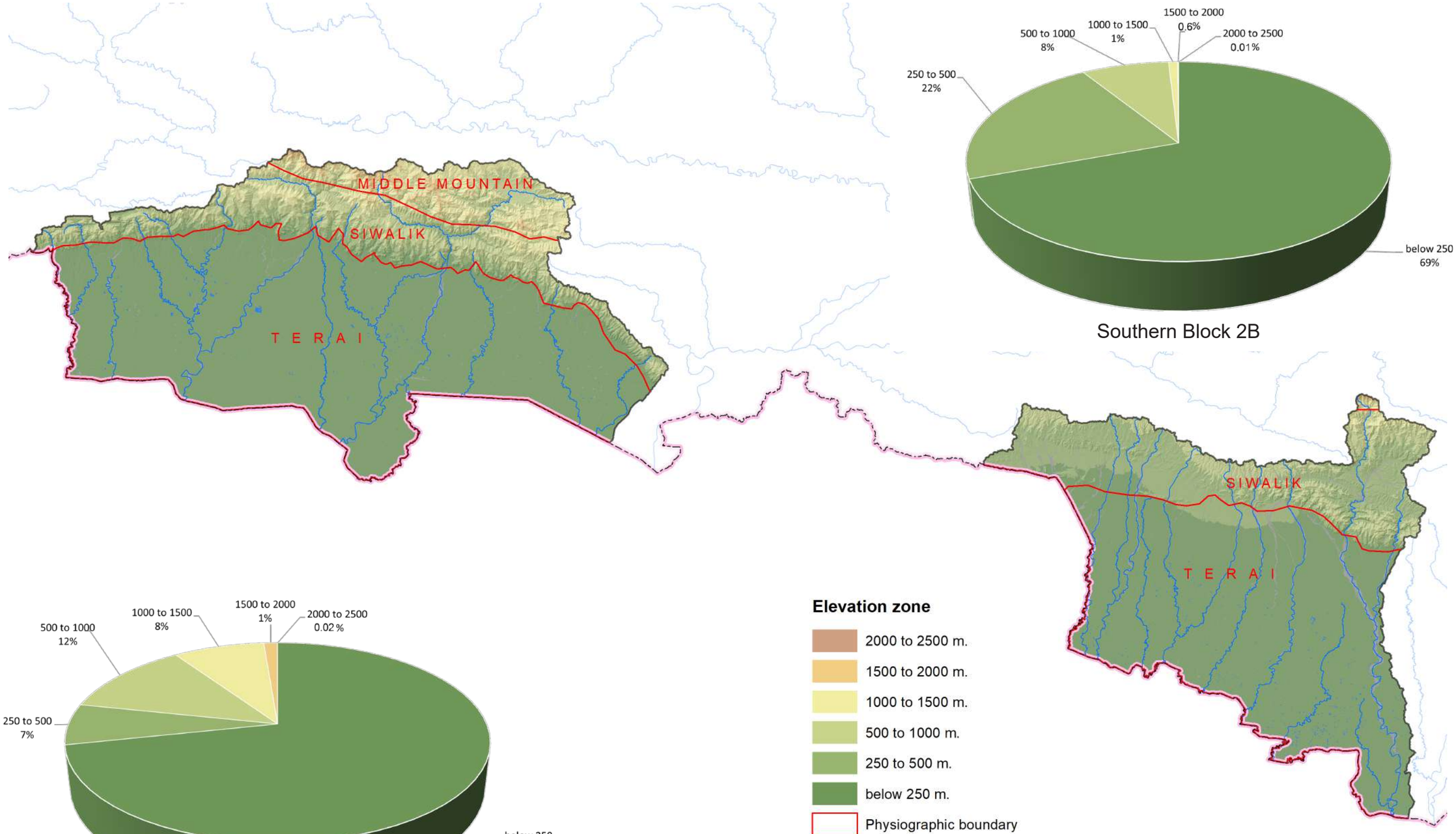
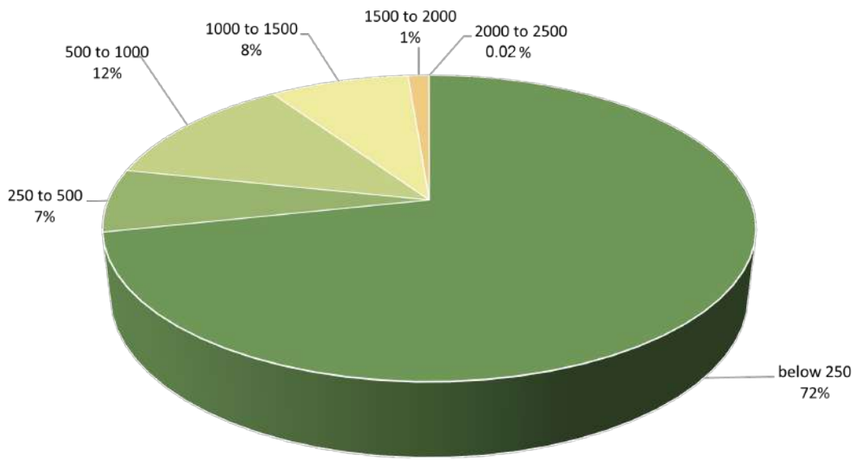
Southern Block 2: Elevation Zone



Southern Block 2B



Southern Block 2A

Data Source: DEM prepared from Topographic data.

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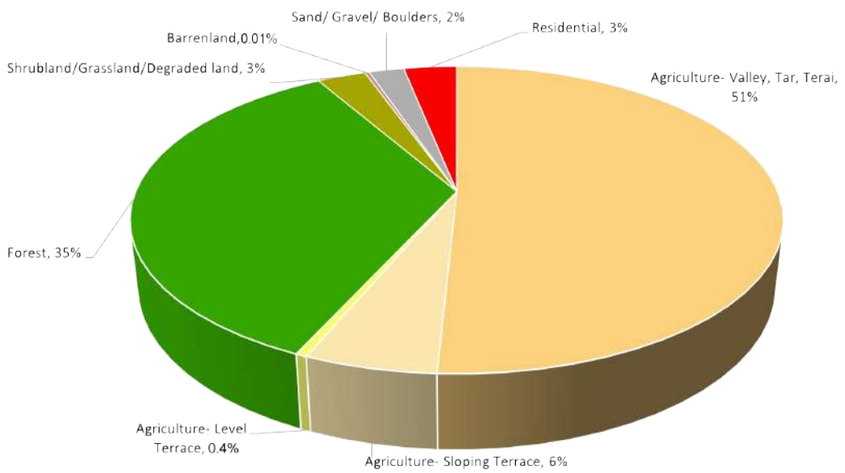
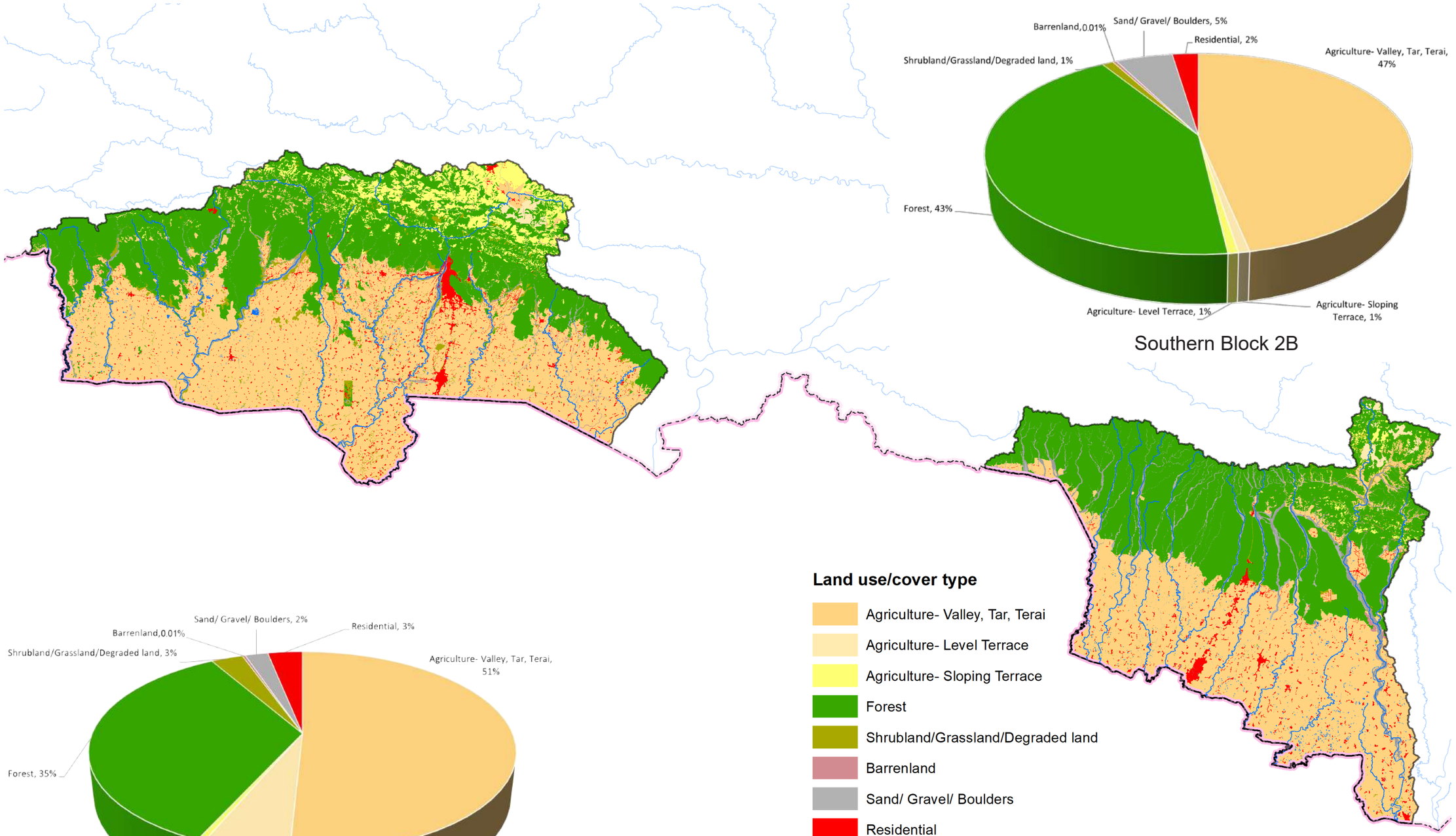
Southern Block 2: Land Use/Cover

Southern Block 2B



Southern Block 2A



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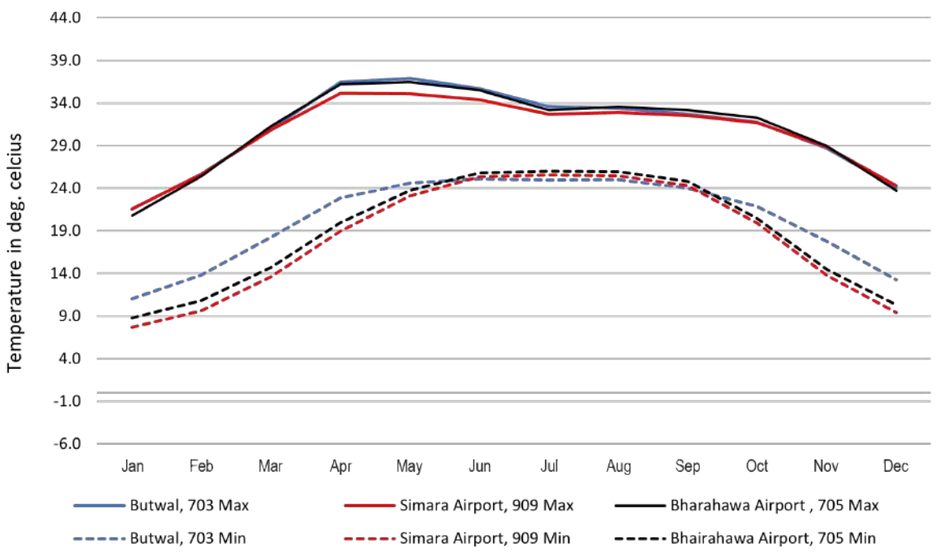
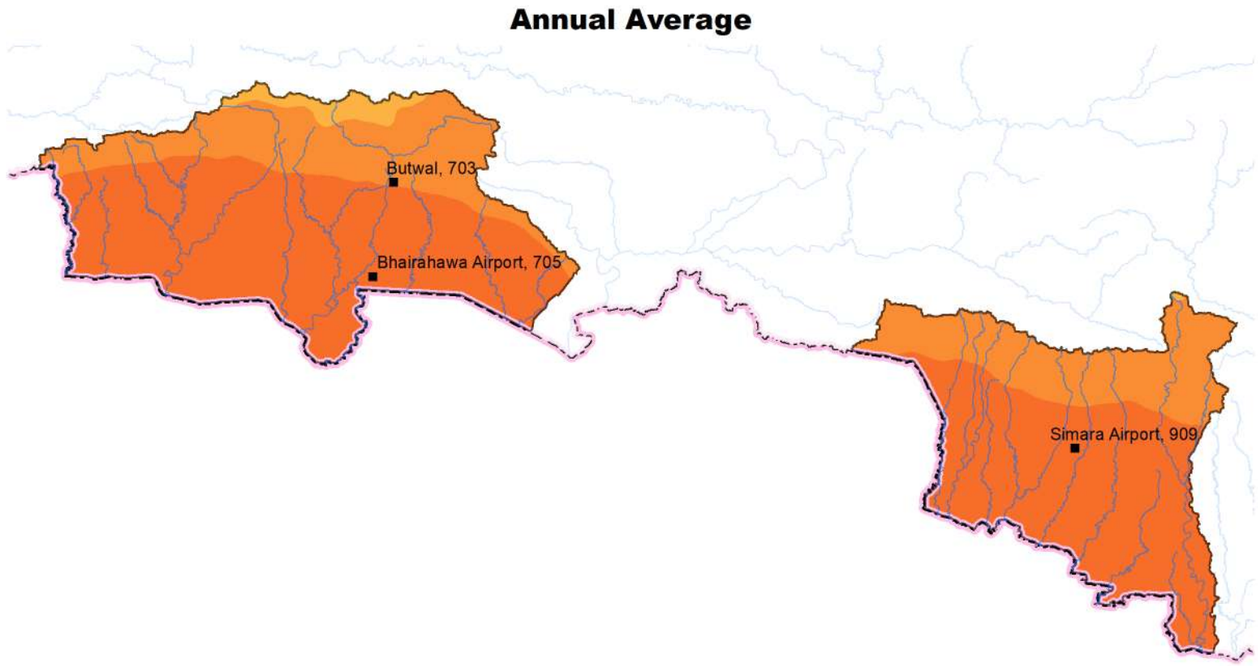
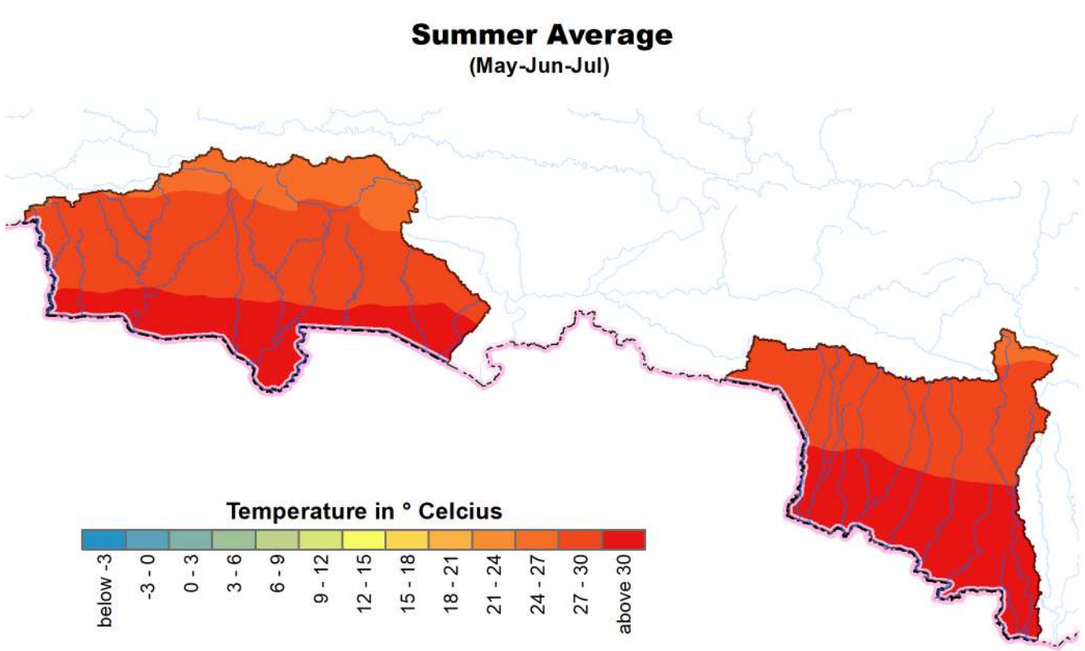
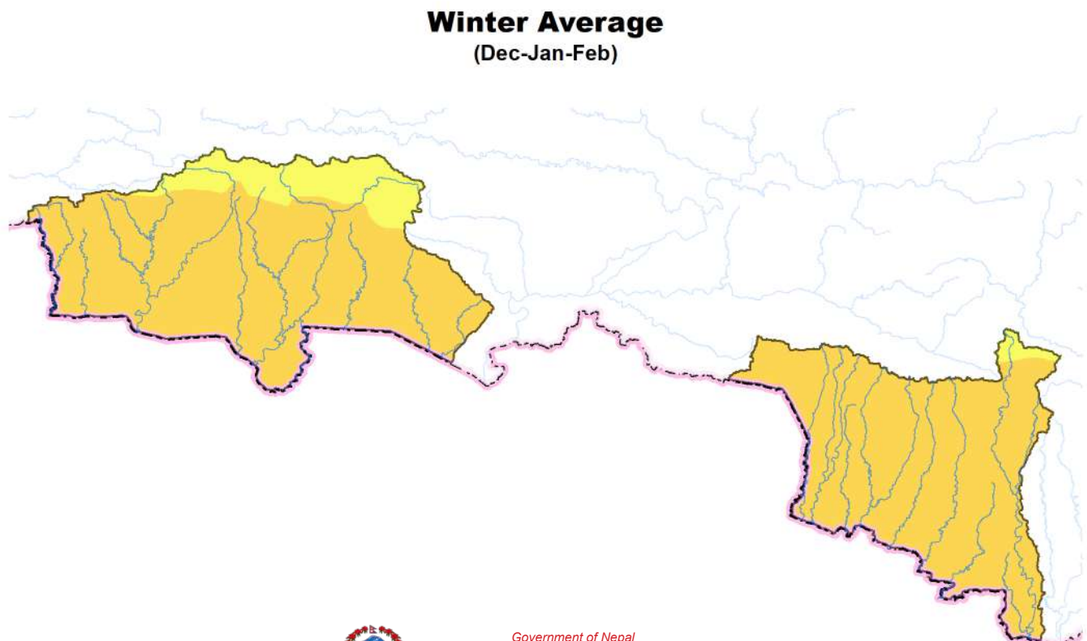
Singhadurbar, Kathmandu, Nepal

Southern Block 2: Average Temperature Distribution









Data Source: Surface generated from DHM Temperature Data - 1985-2015.

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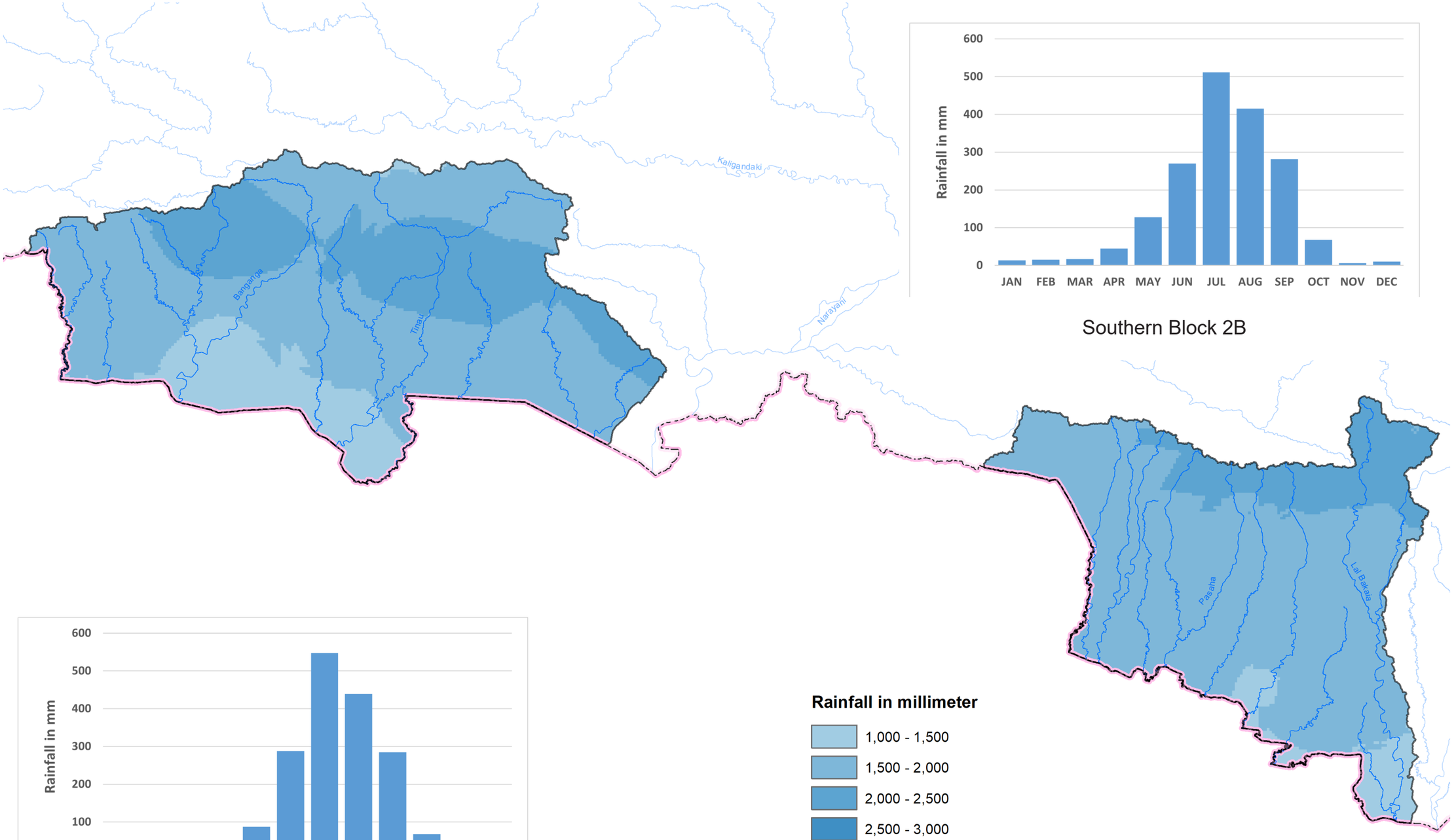
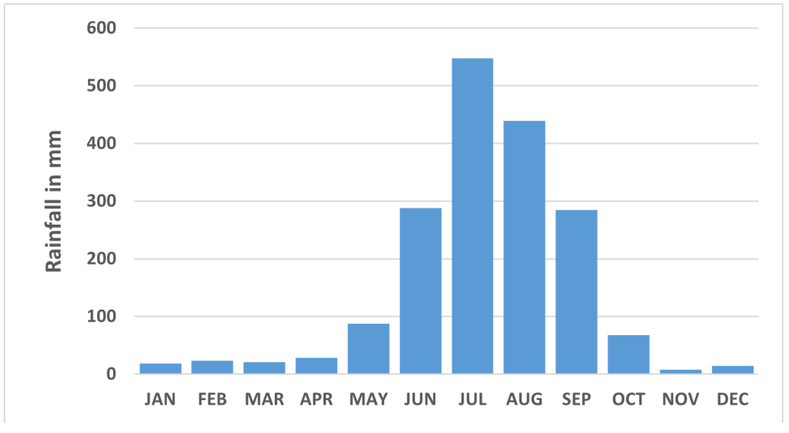
Southern Block 2: Annual Average Rainfall Distribution

Southern Block 2B





Southern Block 2A

Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

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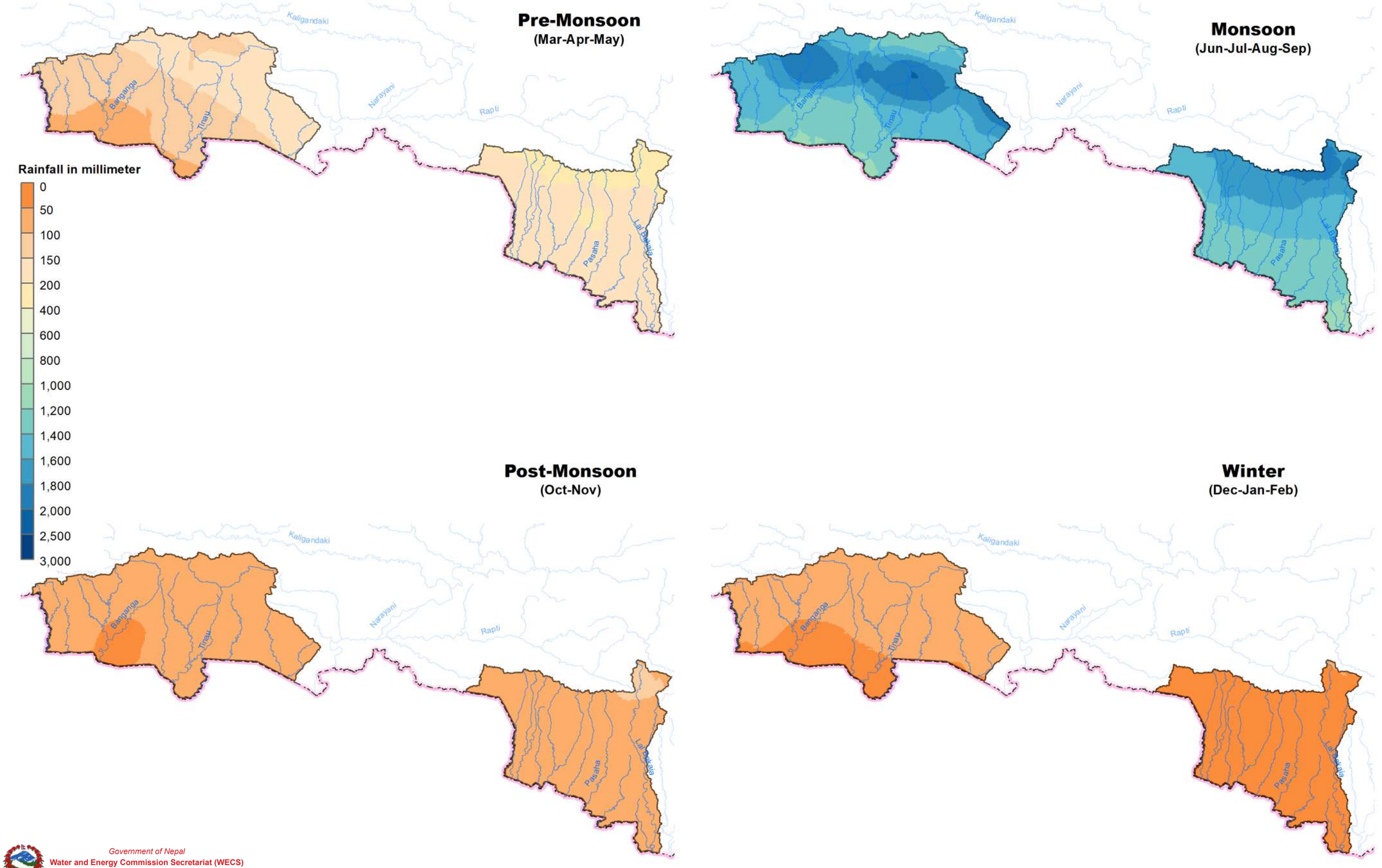
Southern Block 2: Seasonal Average Rainfall Distribution



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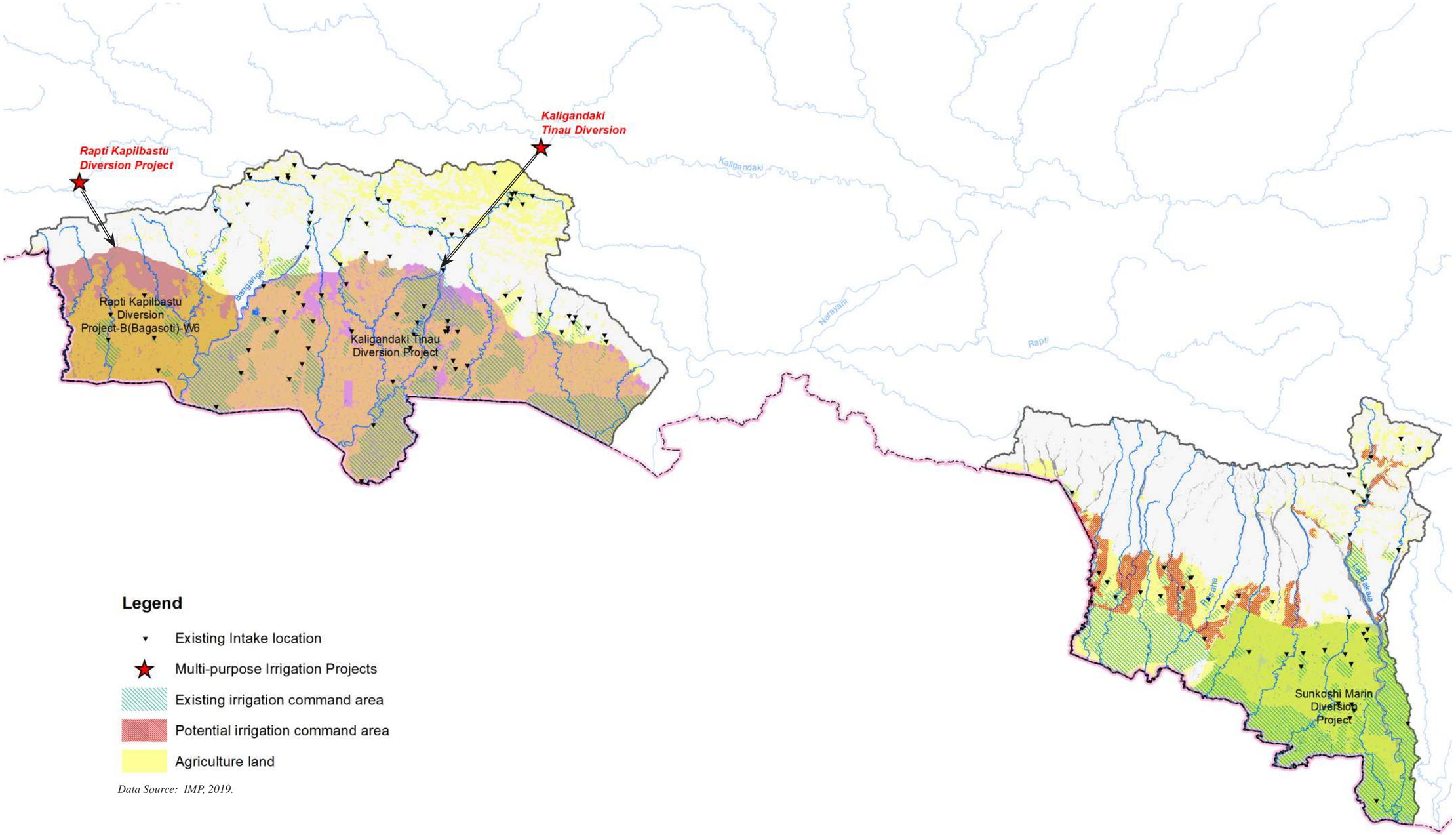
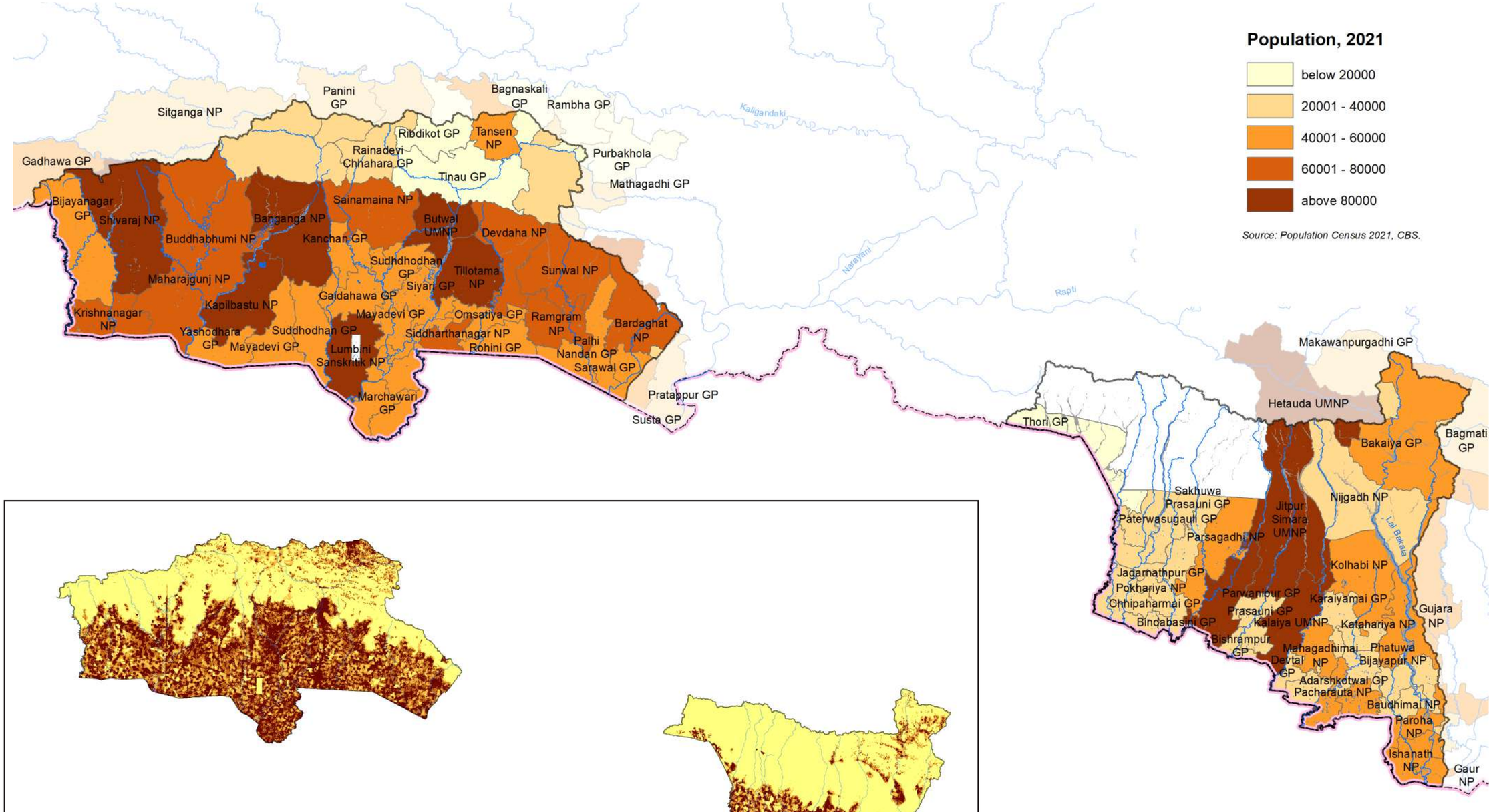
Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

Southern Block 2: Irrigation Projects

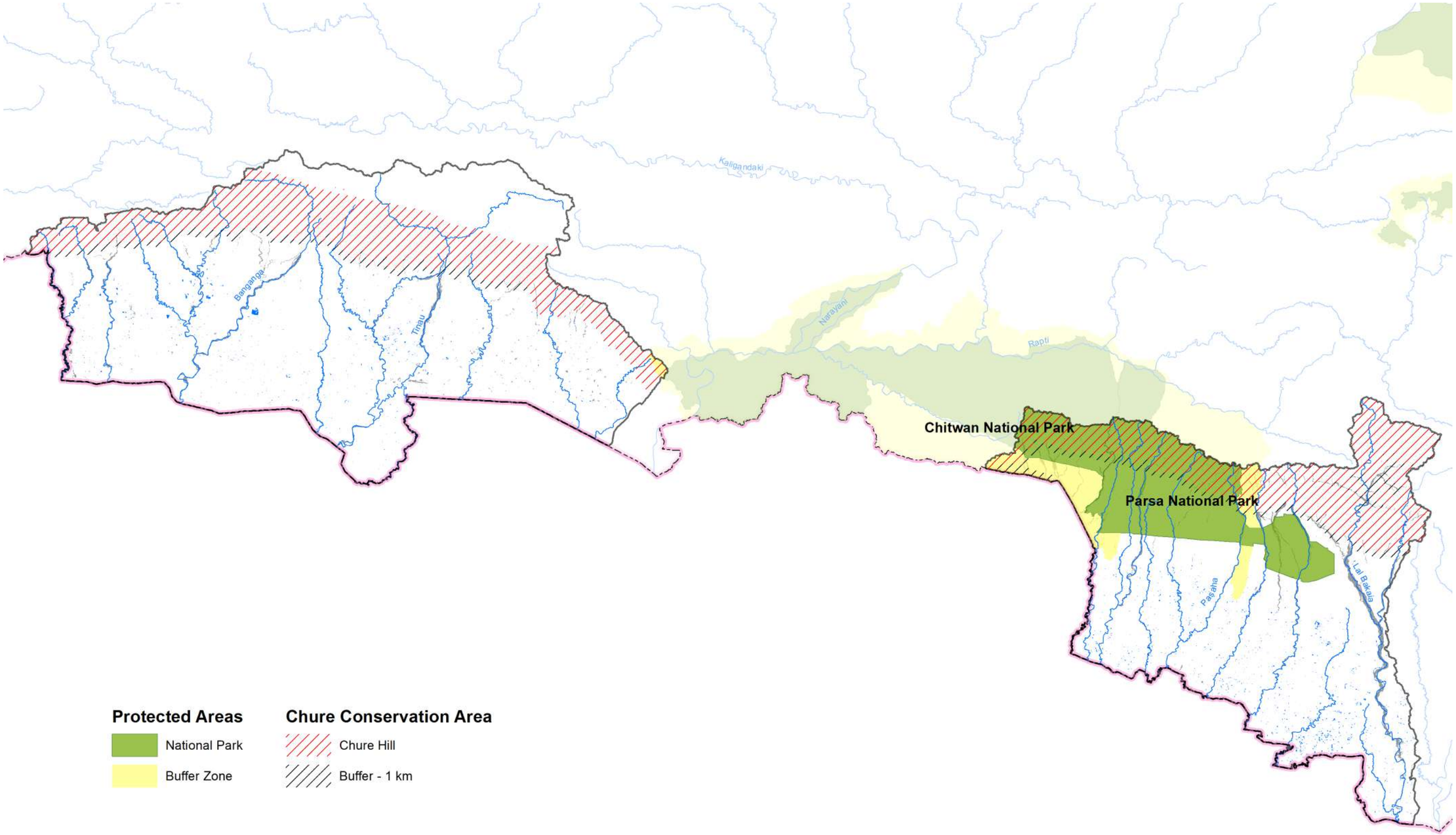


Data Source: IMP, 2019.

Southern Block 2: Population Distribution and Density



Southern Block 2: Protected Areas



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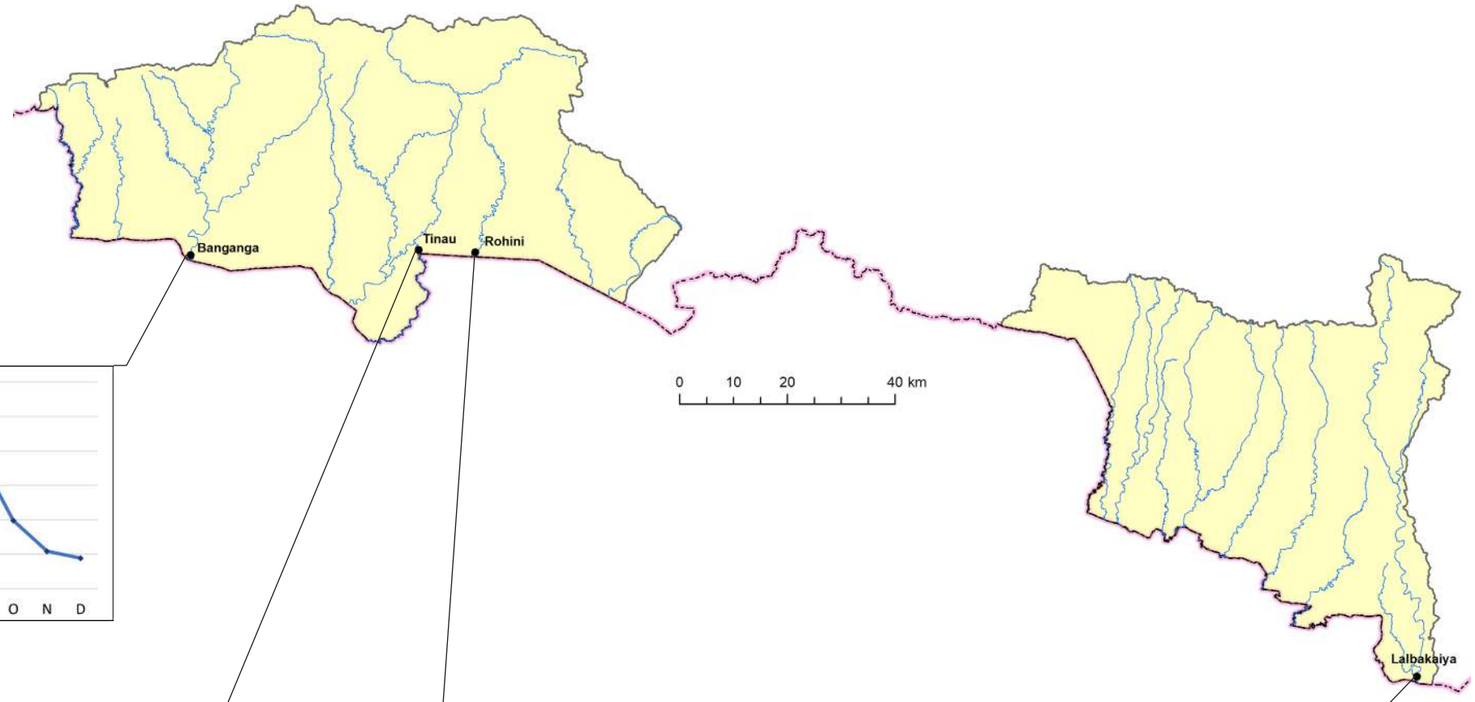
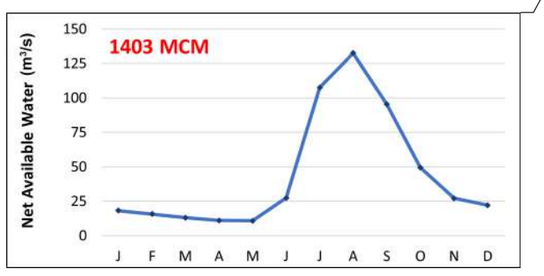
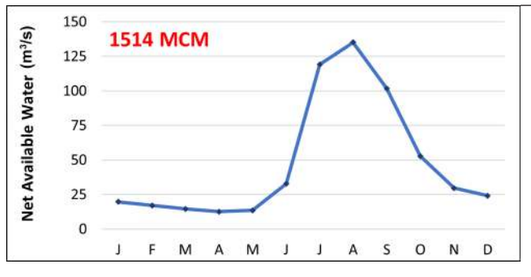
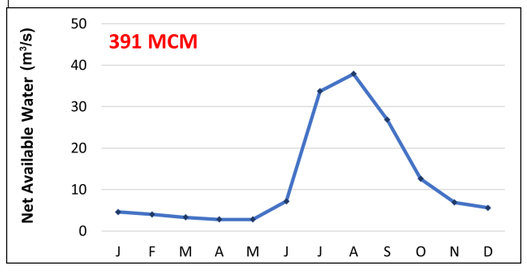
Data Source: DNPWC & PCTMCDB , GoN, 2022

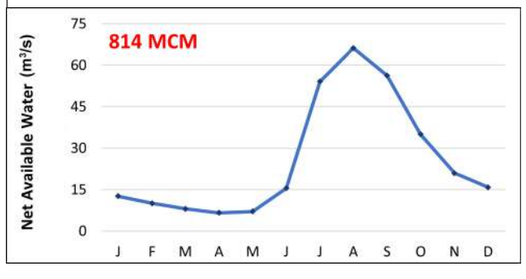
Hydrographs at Major River Nodes











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Administrative Division of Southern Block - 3

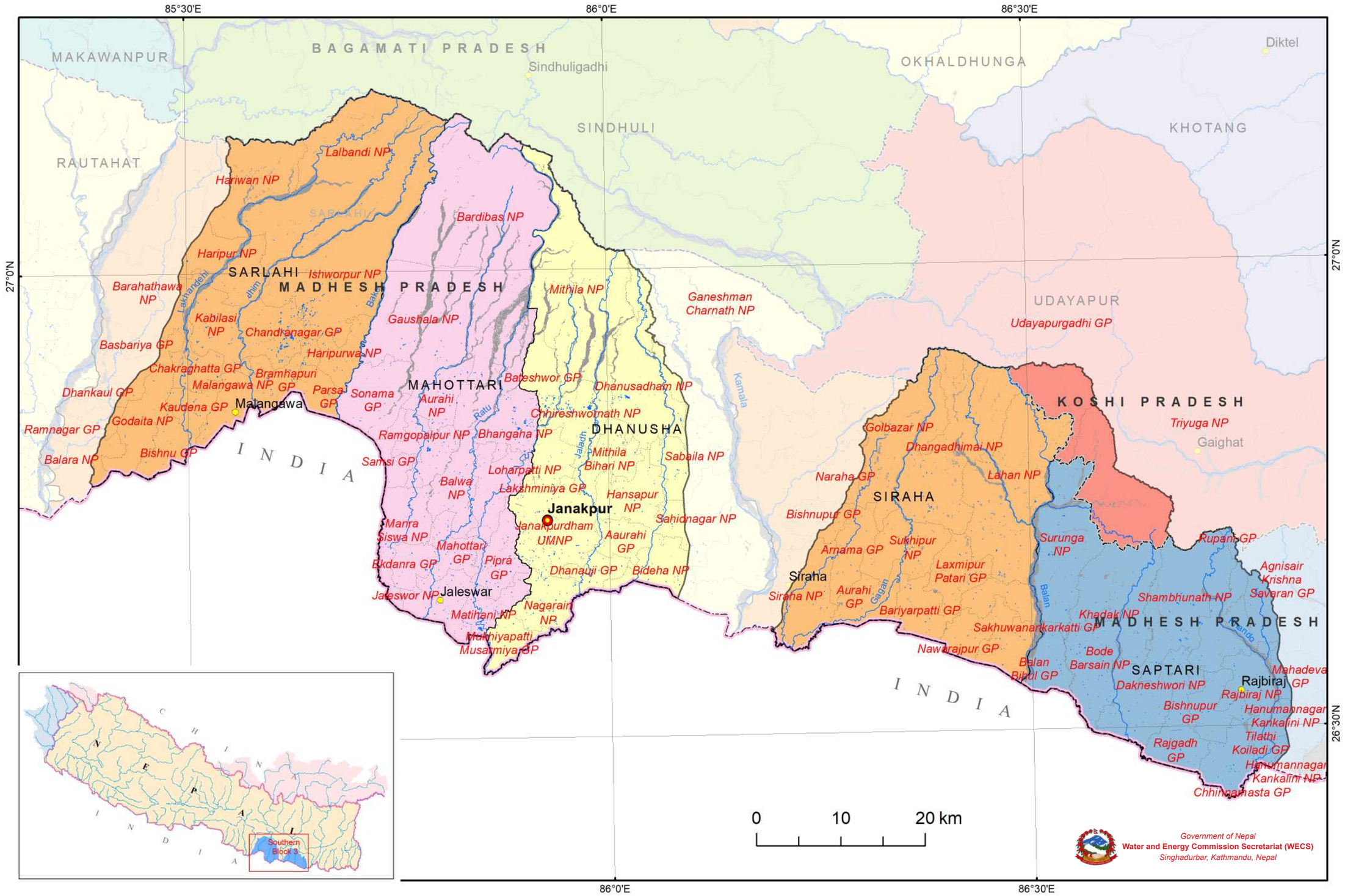
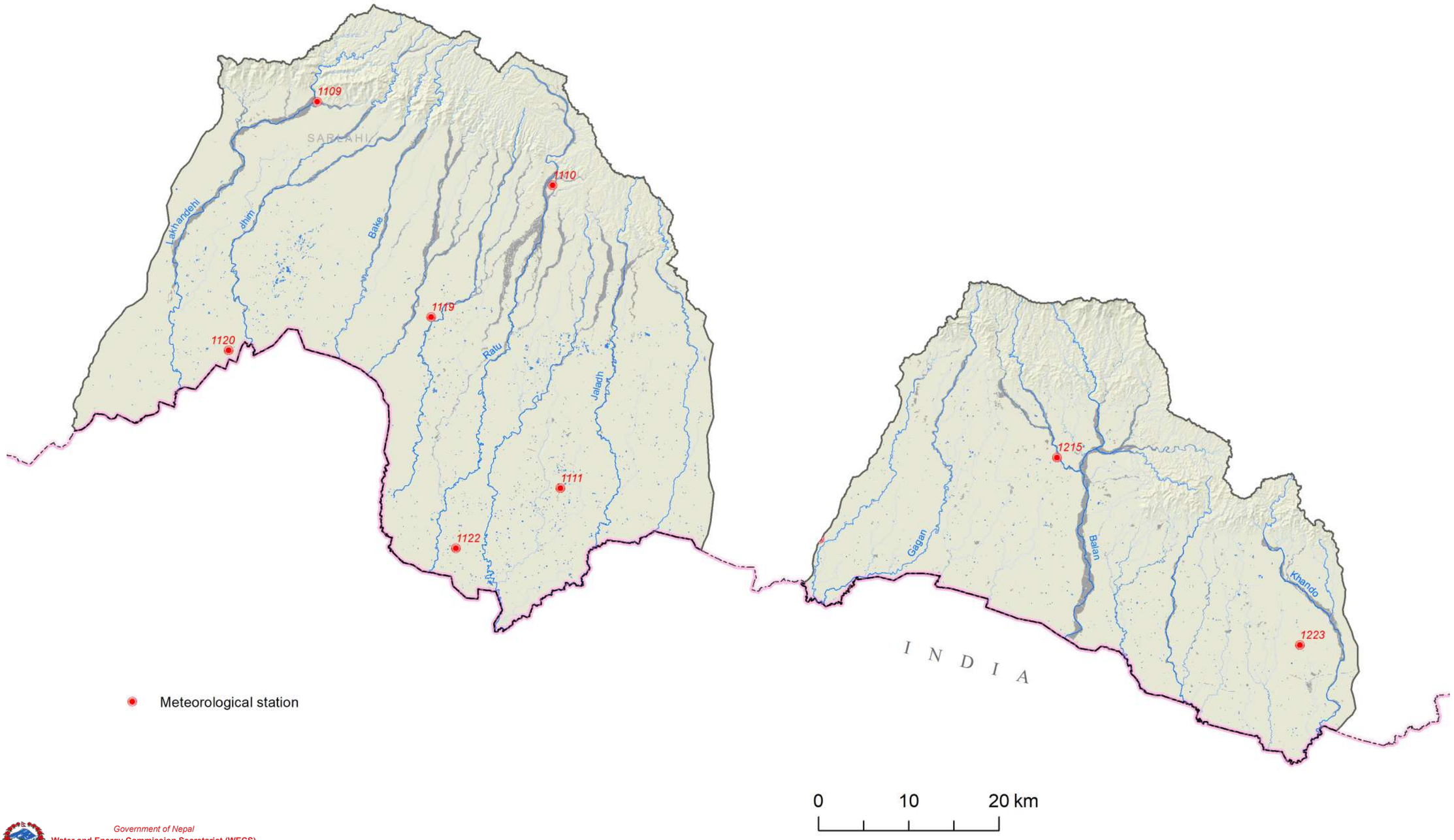


Table 3.4 List of Local Bodies in Southern Block 3

SN	Province	District	Name of Local Body	% of Area
1	Koshi	Udayapur	Triyuga NP	19
2			Udayapurgadhi GP	20
3	Madhesh	Saptari	Agnisair Krishna Savaran GP	25
4			Balan Bihul GP	100
5			Rajgadh GP	100
6			Bishnupur GP	100
7			Bode Barsain NP	100
8			Chhinnamasta GP	100
9			Dakneshwori NP	100
10			Khadak NP	100
11			Mahadeva GP	23
12			Rajbiraj NP	98
13			Rupani GP	98
14			Shambhunath NP	100
15			Surunga NP	100
16			Tilathi Koiladi GP	40
17		Siraha	Arnama GP	100
18			Aurahi GP	100
19			Bariyarpatti GP	100
20			Bhagawanpur GP	100
21			Bishnupur GP	30
22			Dhangadhimai NP	100
23	Madhesh	Siraha	Golbazar NP	88
24			Lahan NP	100
25			Laxmipur Patari GP	100
26			Naraha GP	17
27			Nawarajpur GP	100
28			Sakhuwanankarkatti GP	100
29			Siraha NP	60
30			Sukhipur NP	100
31		Dhanusha	Aaurahi GP	100
32			Bateshwor GP	100
33			Bideha NP	86
34			Chhireshwornath NP	100
35			Dhanauji GP	100
36			Dhanusadham NP	98
37			Ganeshman Charnath NP	9
38			Hansapur NP	100
39			Janakpurdham UMNP	100
40			Lakshminiya GP	100
41			Mithila NP	100
42			Mithila Bihari NP	100
43			Mukhiyapatti Musarmiya GP	100
44			Nagarain NP	100
45	Madhesh	Dhanusha	Sabaila NP	40
46			Sahidnagar NP	25
47		Mahottari	Aurahi NP	100
48			Balwa NP	100
49			Bardibas NP	100
50			Bhangaha NP	100
51			Ekdanra GP	100
52			Gaushala NP	100
53			Jaleswor NP	100
54			Loharpatti NP	100
55			Mahottari GP	100
56			Manra Siswa NP	100
57			Matihani NP	100
58			Pipra GP	100
59			Ramgopalpur NP	100
60			Samsi GP	100
61			Sonama GP	100
62		Sarlahi	Balara NP	26
63			Barahathawa NP	18
64			Basbariya GP	27
65			Bishnu GP	100
66			Bramhapuri GP	100
67	Madhesh	Sarlahi	Chakraghatta GP	100
68			Chandranagar GP	100
69			Dhankaul GP	18
70			Godaita NP	100
71			Haripur NP	94
72			Haripurwa NP	100
73			Hariwan NP	78
74			Ishworpur NP	100
75			Kabilasi NP	100
76			Kaudena GP	100
77			Lalbandi NP	100
78			Malangawa NP	100
79			Parsa GP	100
80			Ramnagar GP	17

Southern Block 3: River System



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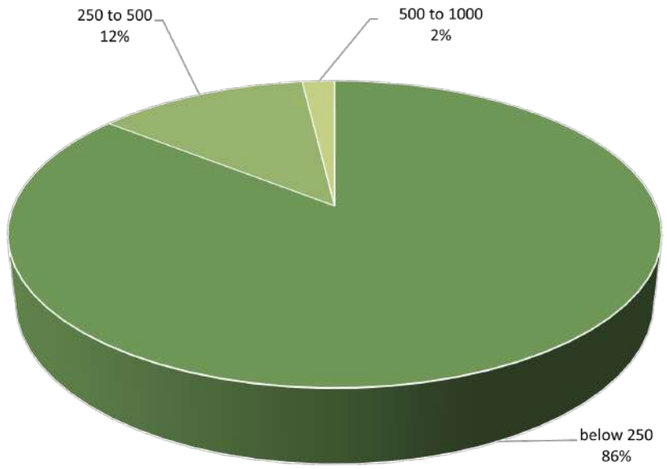
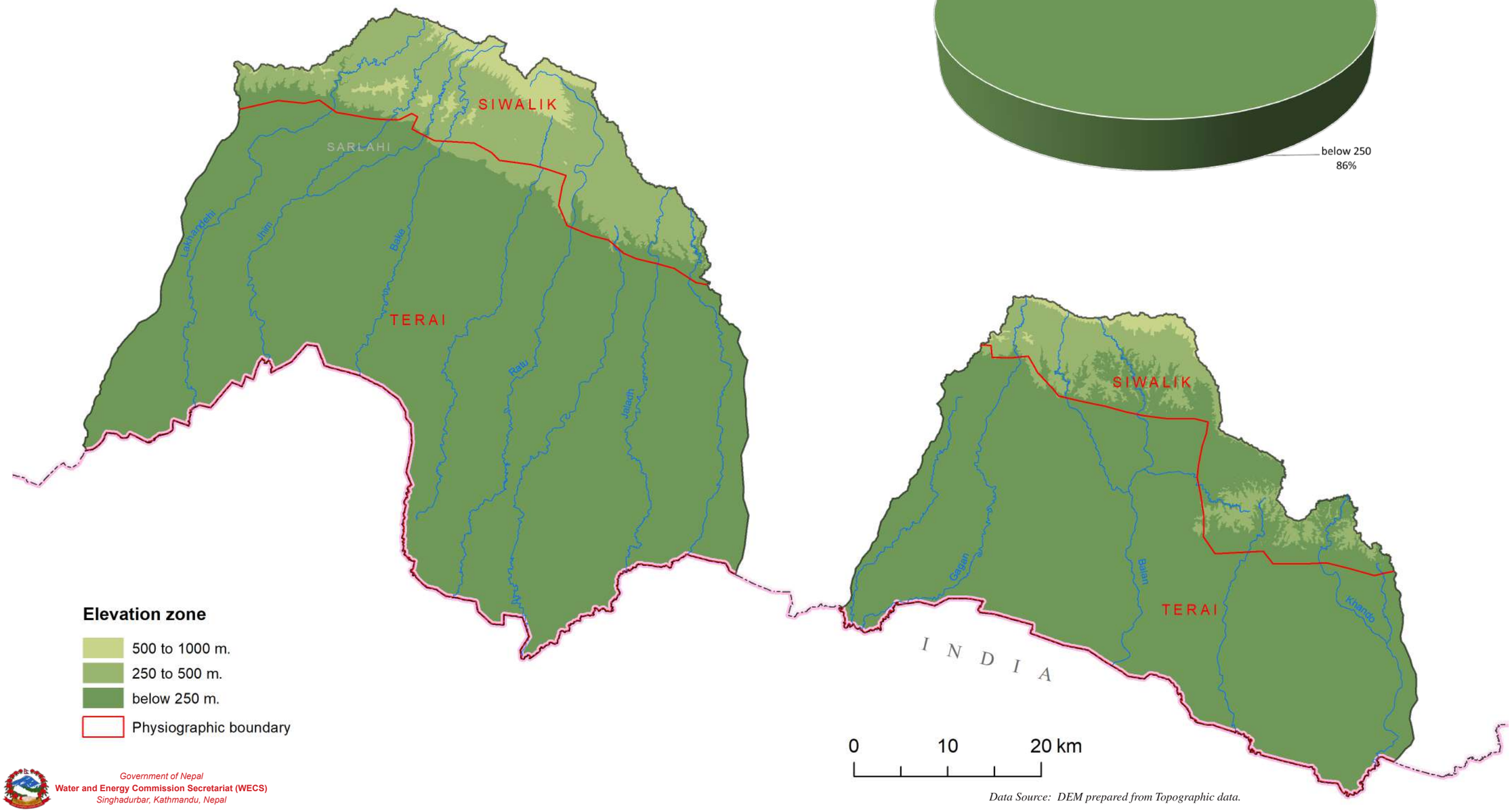
Southern Block 3: Elevation Zone

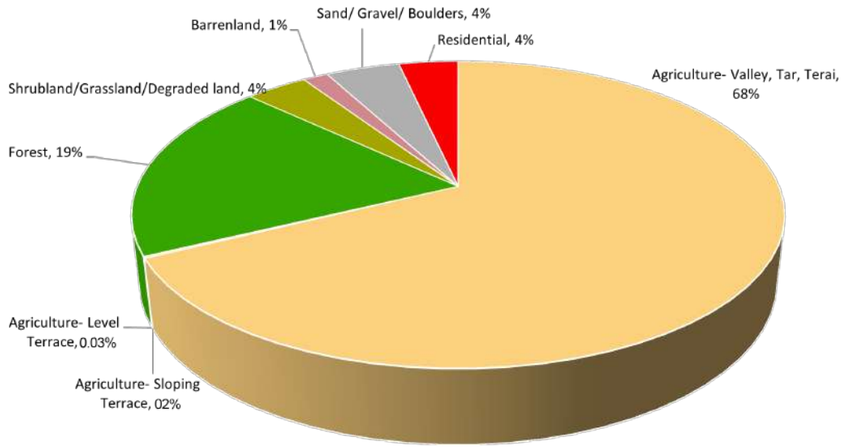


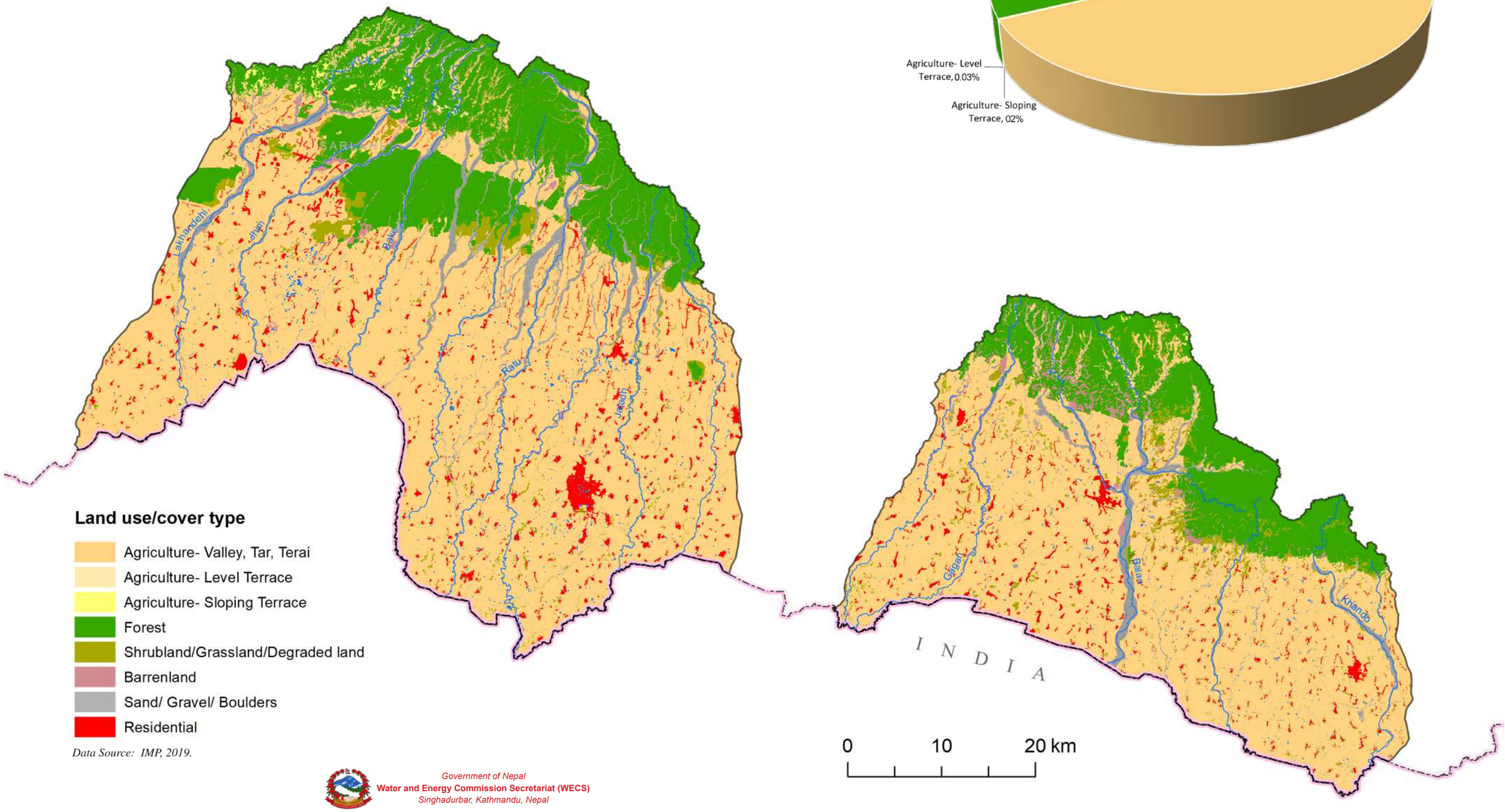


Government of Nepal
Water and Energy Commission Secretariat (WECS)
Singhadurbar, Kathmandu, Nepal

Data Source: DEM prepared from Topographic data.

Southern Block 3: Land Use/Cover

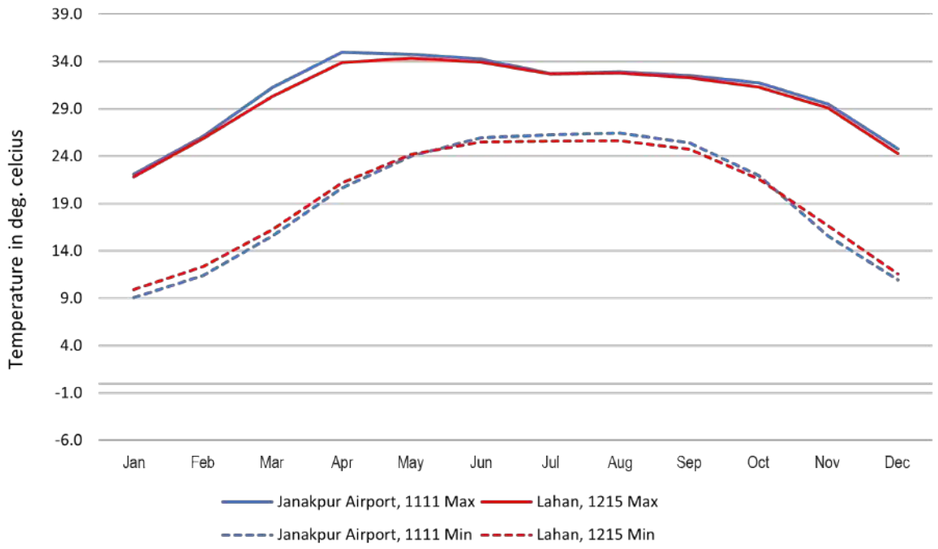


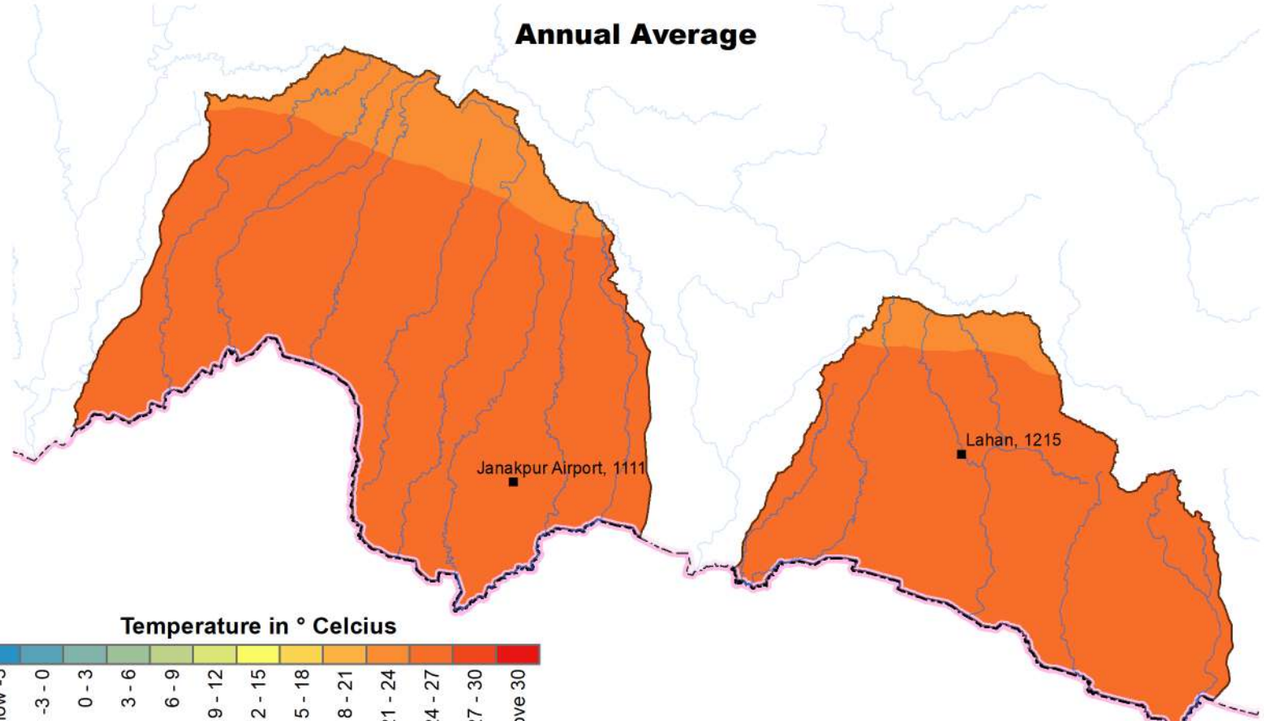


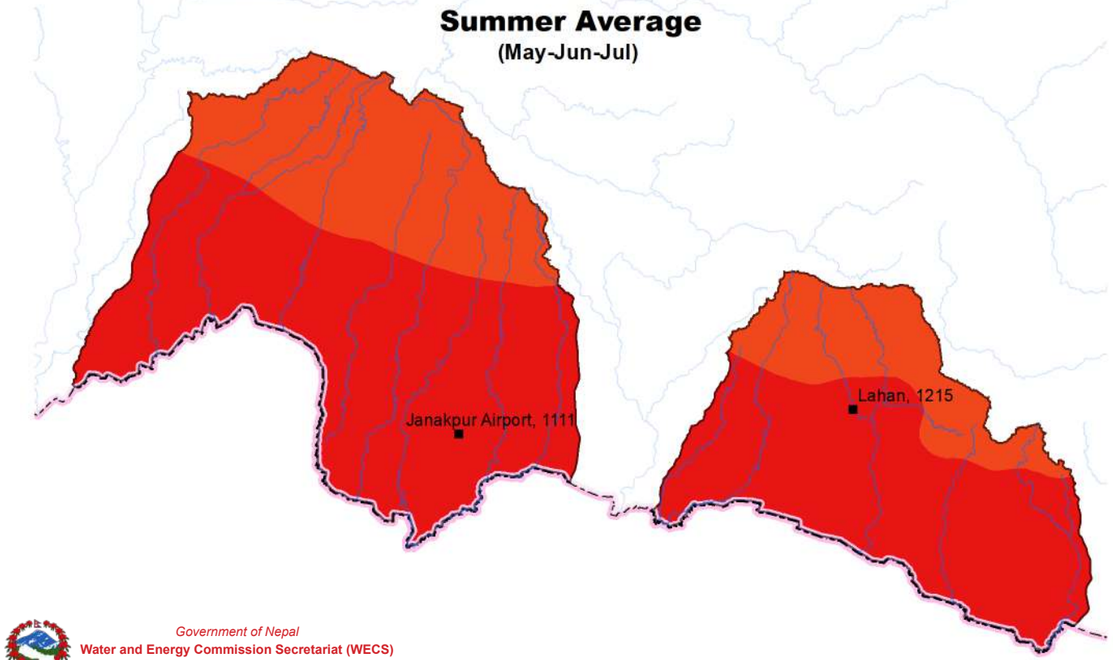
Data Source: IMP, 2019.

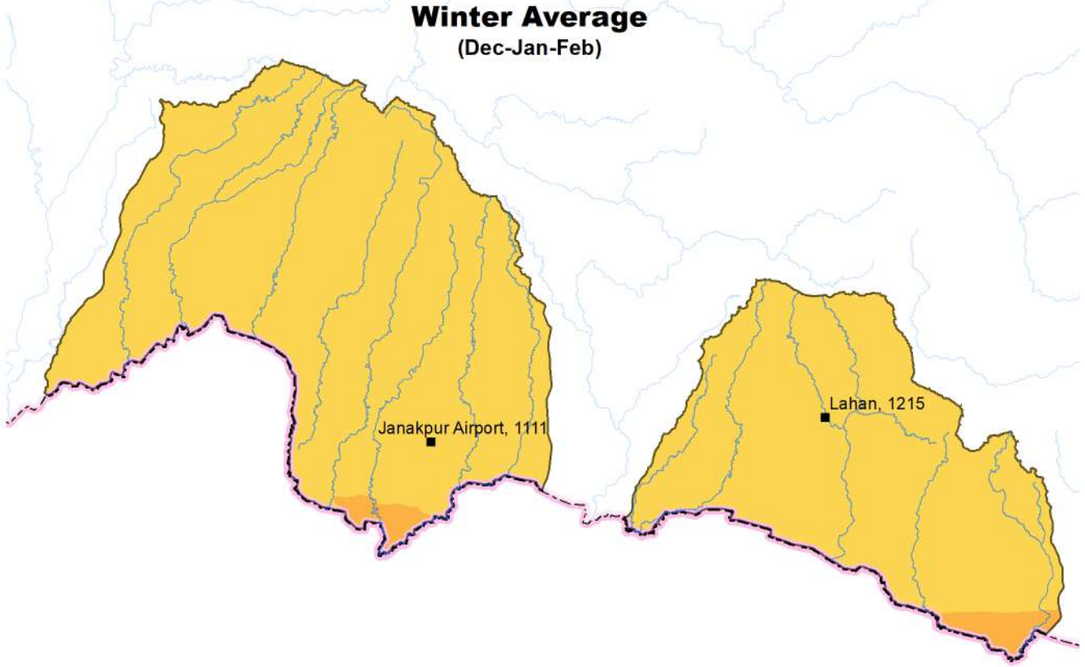
Government of Nepal
Water and Energy Commission Secretariat (WECS)
Singhadurbar, Kathmandu, Nepal

Southern Block 3: Average Temperature Distribution









Government of Nepal
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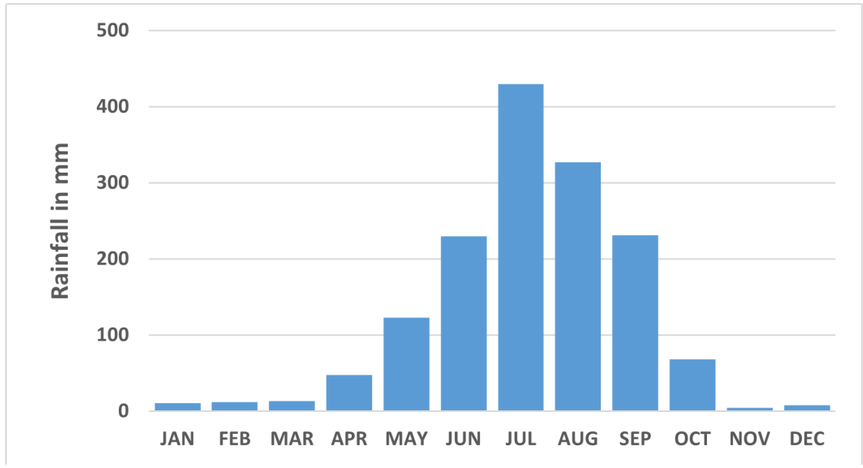
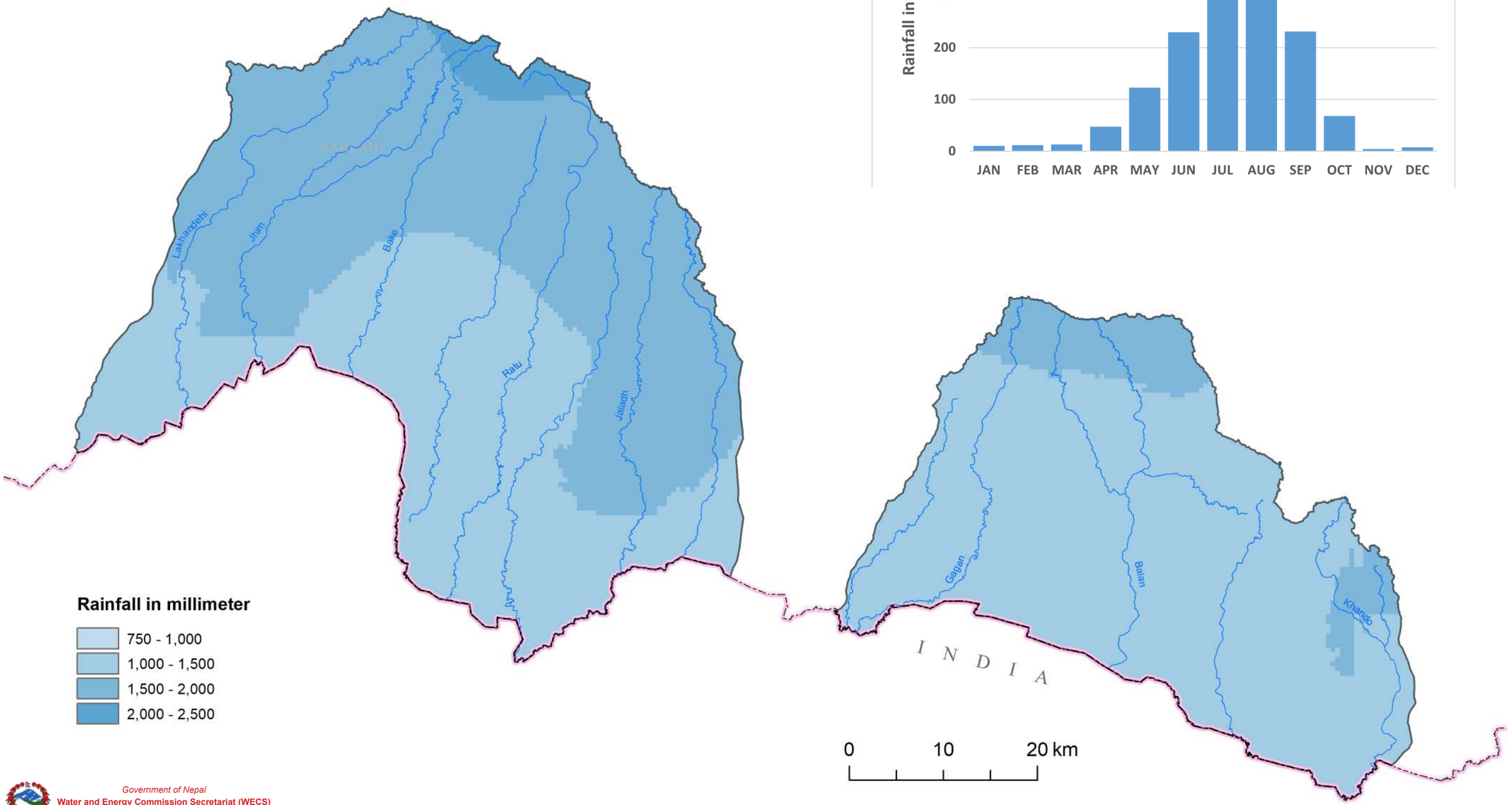
Singhadurbar, Kathmandu, Nepal

Data Source: Surface generated from DHM Temperature Data - 1985-2015.

Southern Block 3: Annual Average Rainfall Distribution





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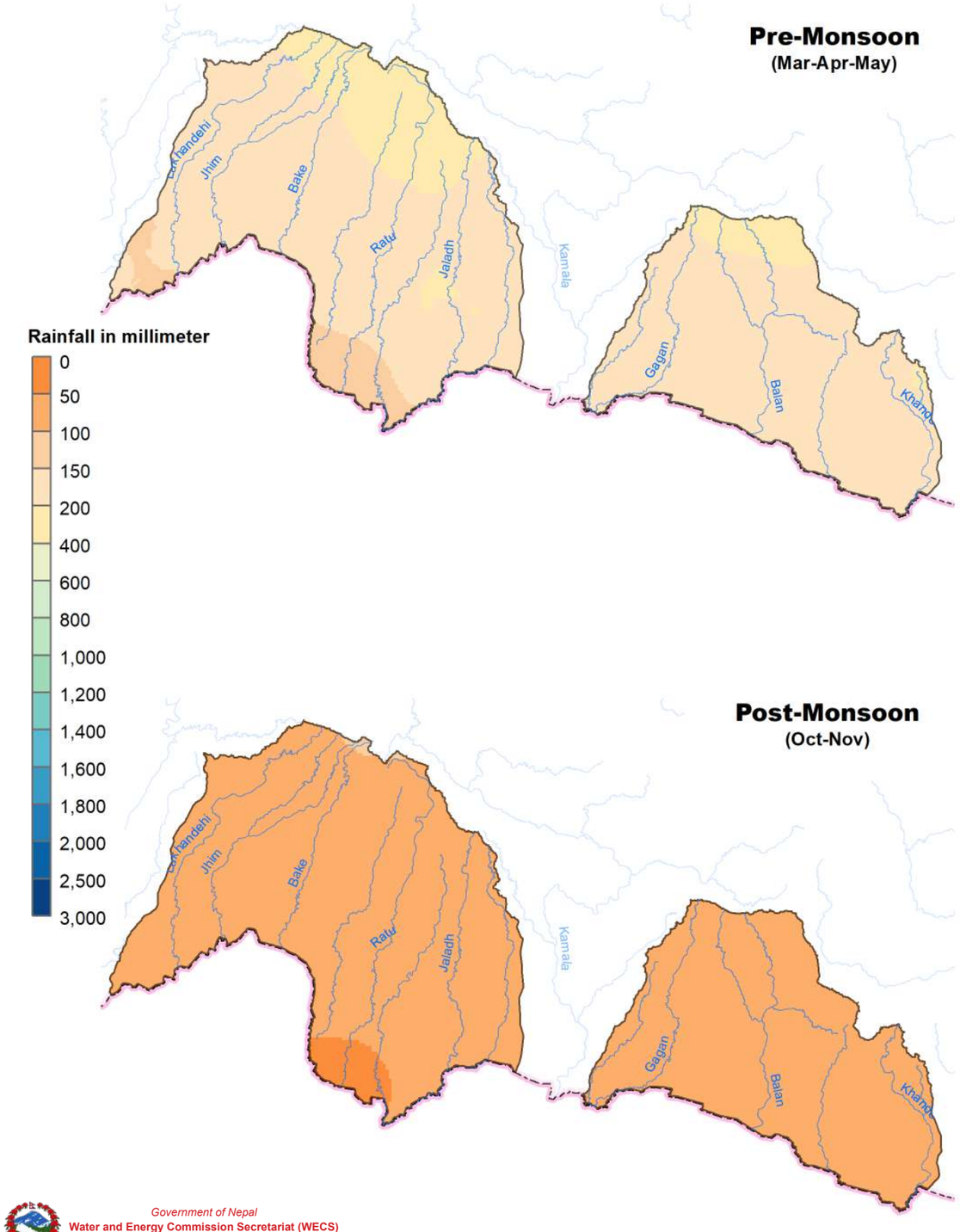
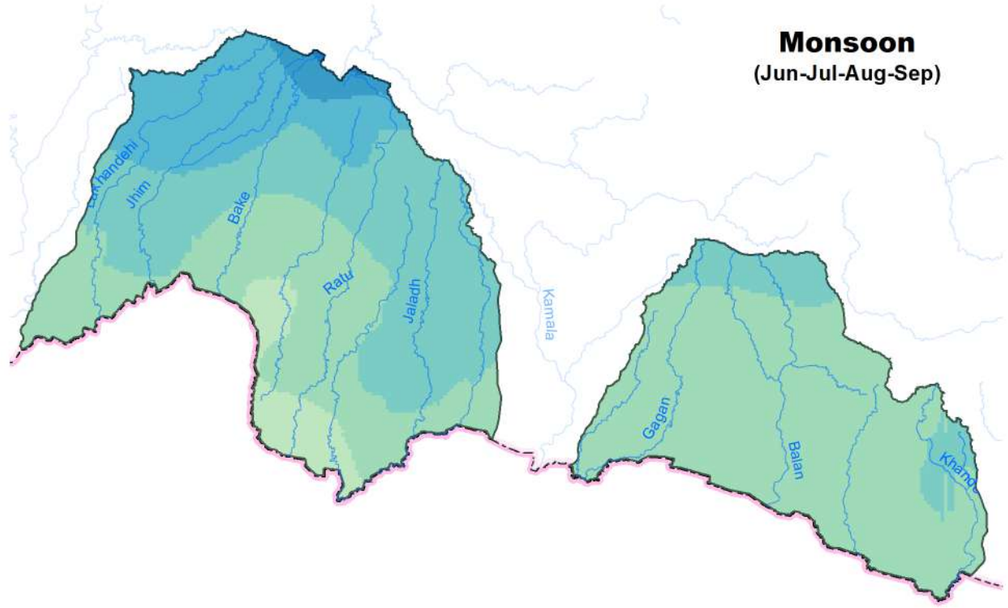
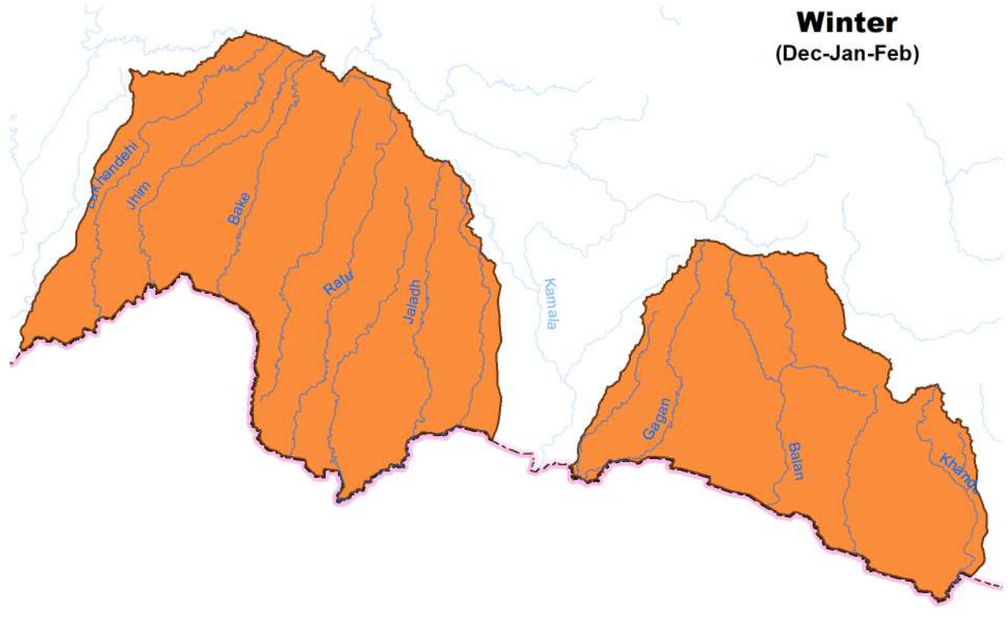
Singhadurbar, Kathmandu, Nepal

Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

Southern Block 3: Seasonal Average Rainfall Distribution







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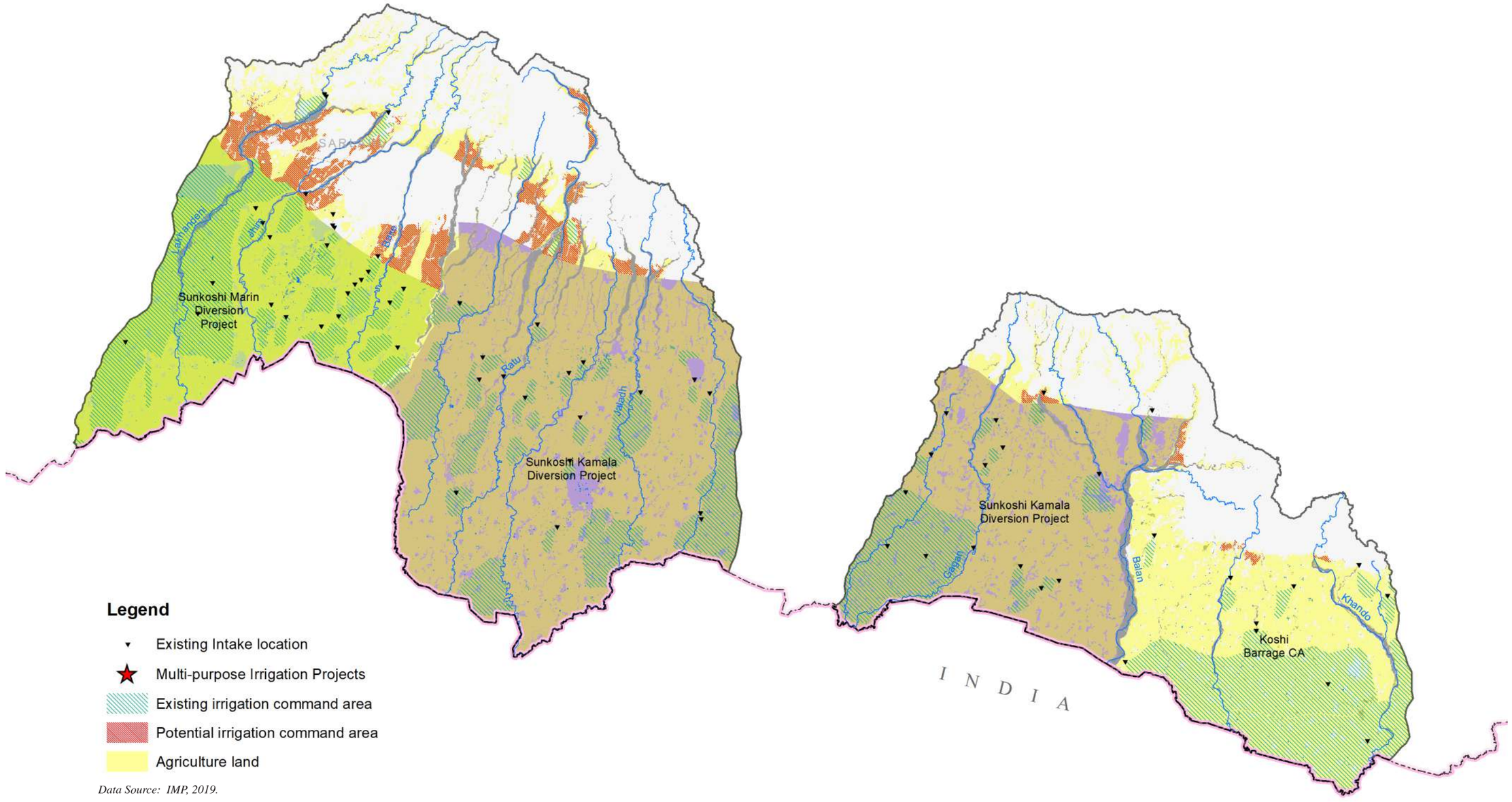
Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

Southern Block 3: Irrigation Projects



Data Source: IMP, 2019.

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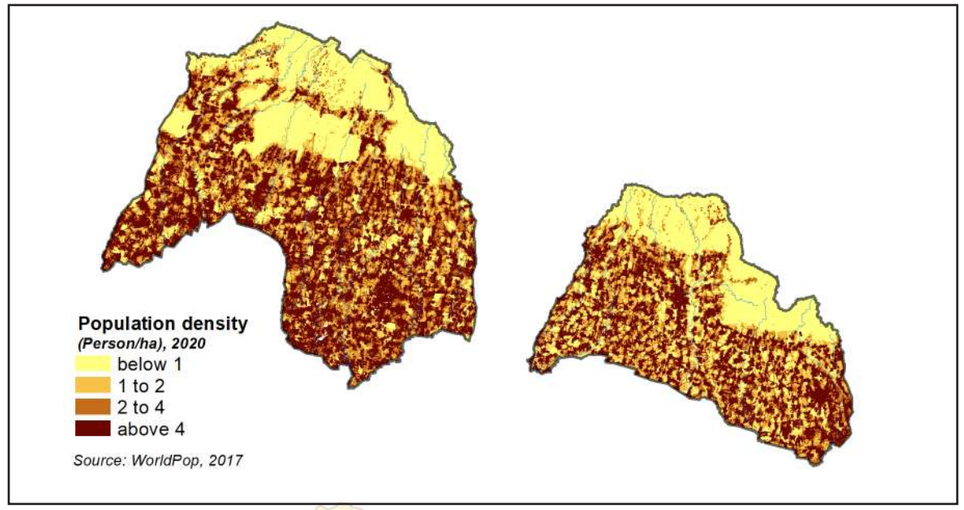
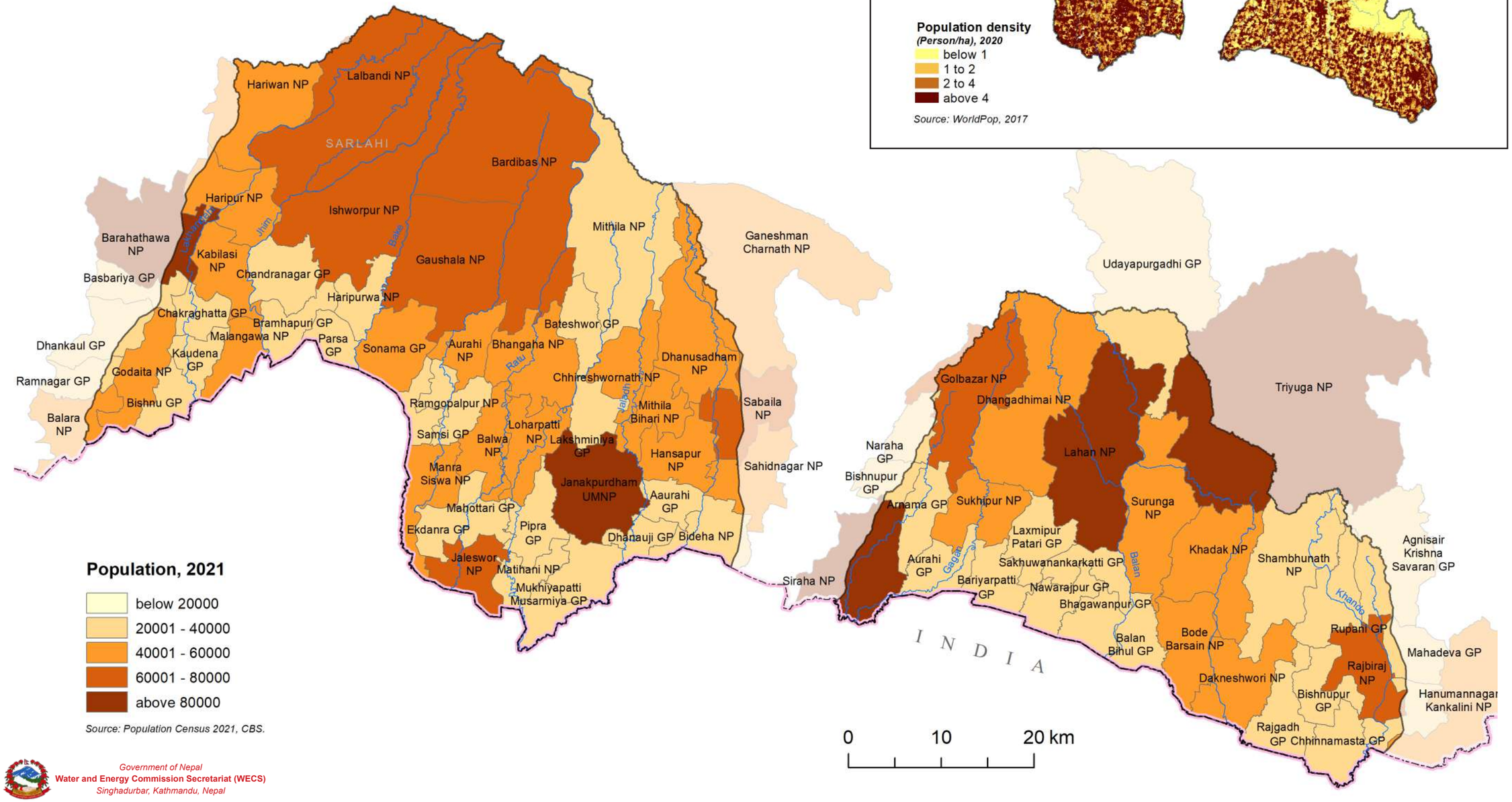
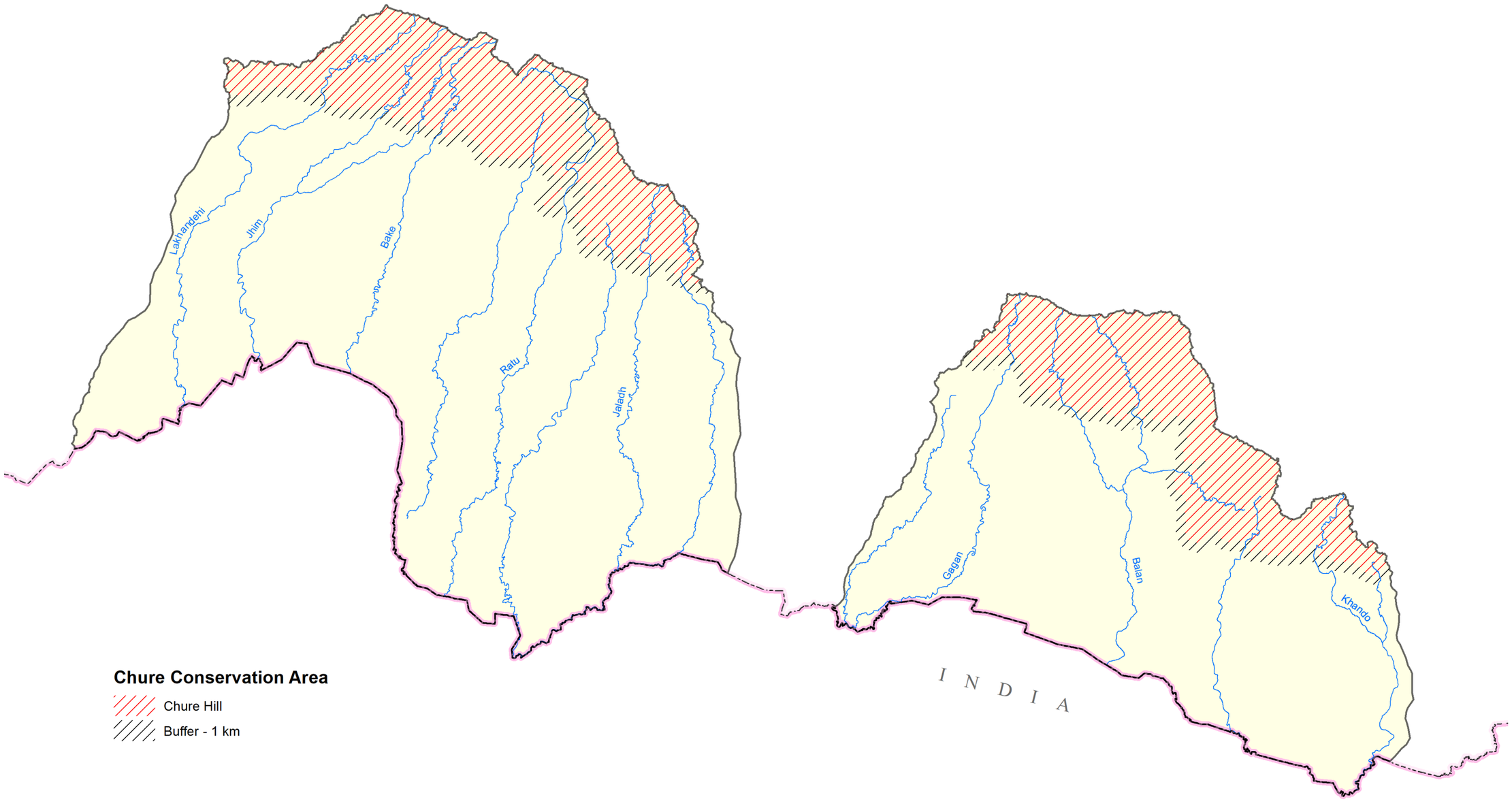
Southern Block 3: Population Distribution and Density





Southern Block 3: Protected Areas



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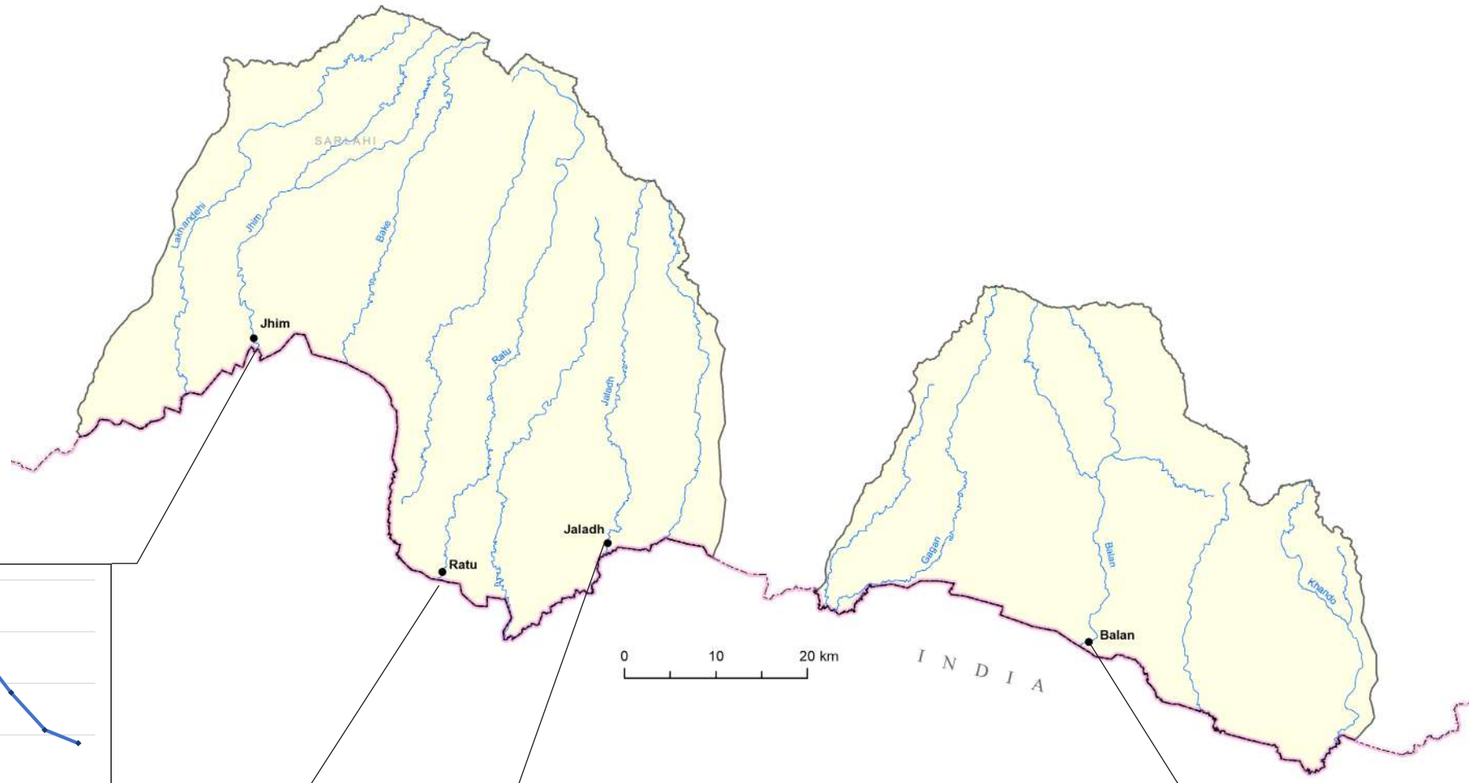
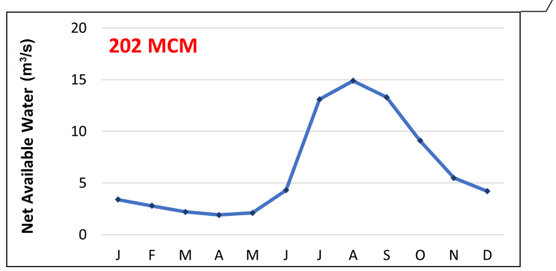
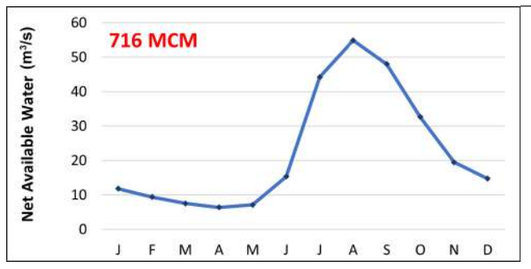
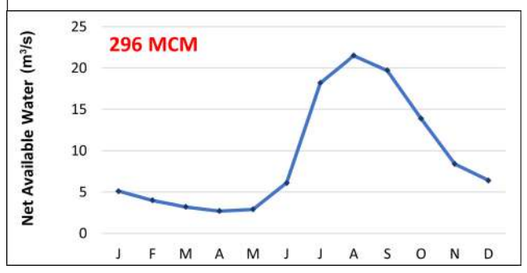
Data Source: PCTMCDB, GoN, 2022.

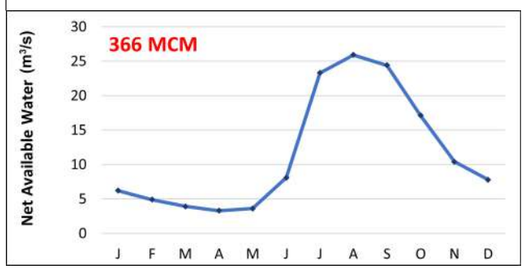
Hydrographs at Major River Nodes











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Administrative Division of Southern Block - 4

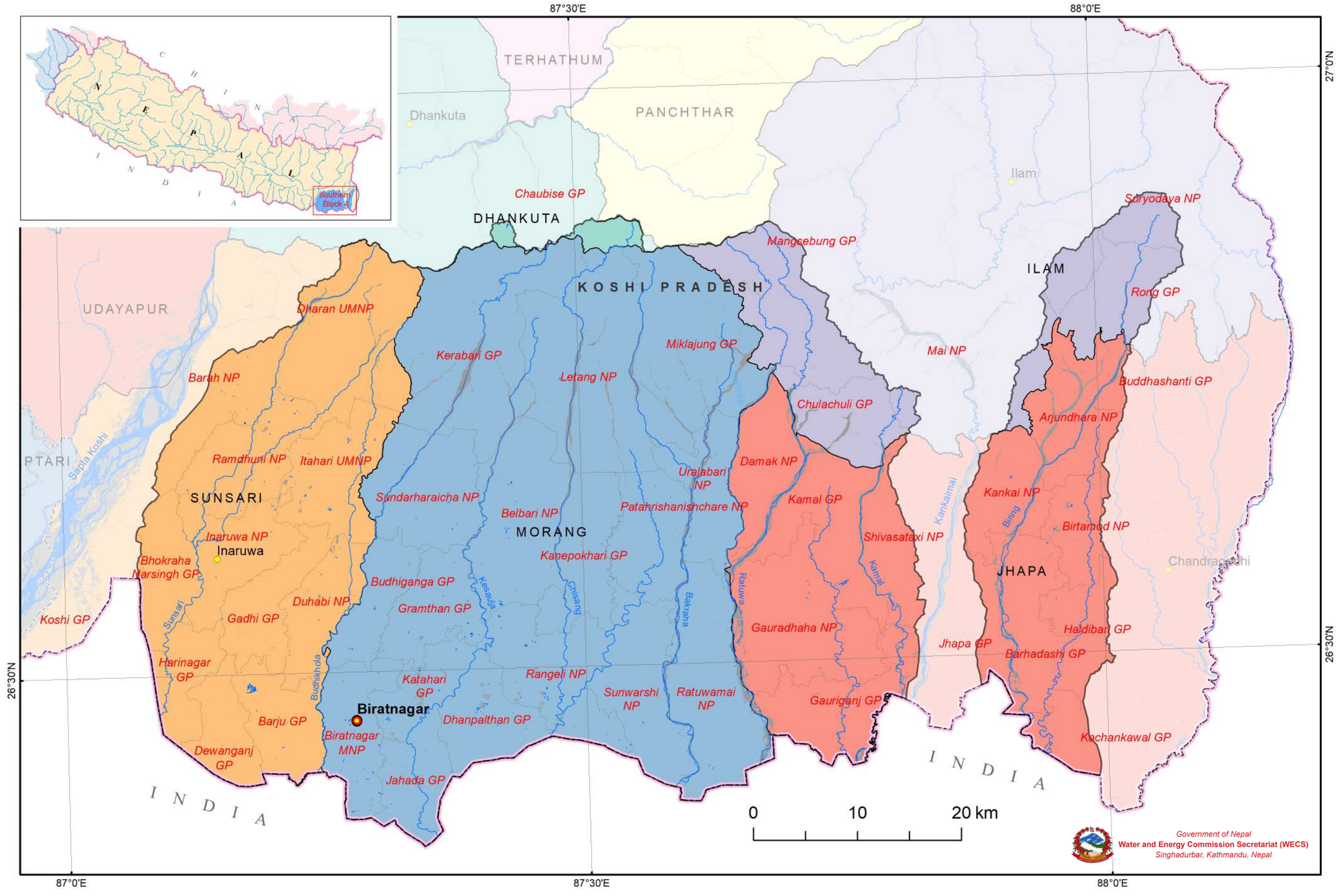
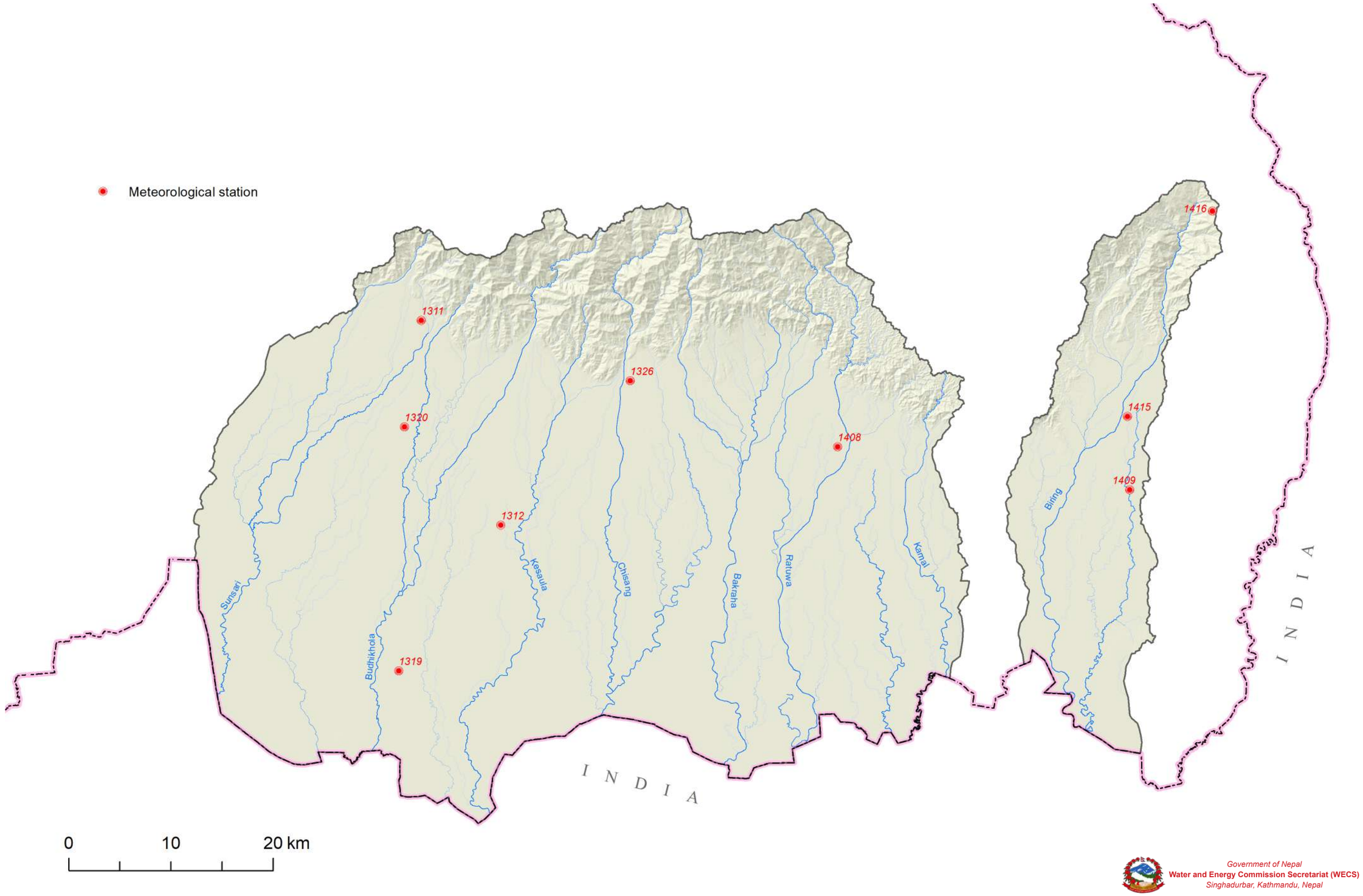


Table 3.5 List of Local Bodies in Southern Block 4

SN	Province	District	Name of Local Body	% of Area
1	Koshi	Ilam	Chulachuli GP	100
2			Mai NP	12
3			Mangsebung GP	52
4			Rong GP	46
5			Suryodaya NP	24
6		Jhapa	Arjundhara NP	85
7			Barhadashi GP	100
8			Birtamod NP	63
9			Buddhashanti GP	11
10			Damak NP	100
11			Gauradhaha NP	100
12			Gauriganj GP	94
13			Haldibari GP	46
14			Jhapa GP	31
15			Kachankawal GP	36
16			Kamal GP	100
17			Kankai NP	90
18			Shivasataxi NP	42
19		Morang	Belbari NP	100
20			Biratnagar MNP	100
21			Budhiganga GP	100
22			Dhanpalthan GP	100
23	Koshi	Morang	Gramthan GP	100
24			Jahada GP	100
25			Kanepokhari GP	100
26			Katahari GP	100
27			Kerabari GP	100
28			Letang NP	100
29			Miklajung GP	100
30			Patahrishanishchare NP	100
31			Rangeli NP	100
32			Ratuwamai NP	100
33			Sundarharaicha NP	100
34			Sunwarshi NP	100
35			Uralabari NP	100
36		Sunsari	Barah NP	32
37			Barju GP	100
38			Bhokraha Narsingh GP	100
39			Dewanganj GP	100
40			Dharan UMNP	83
41			Duhabi NP	100
42			Gadhi GP	100
43			Harinagar GP	100
44			Inaruwa NP	100
45	Koshi	Sunsari	Itahari UMNP	100
46			Koshi GP	2
47			Ramdhuni NP	100
48		Dhankuta	Chaubise GP	15

Southern Block 4: River System



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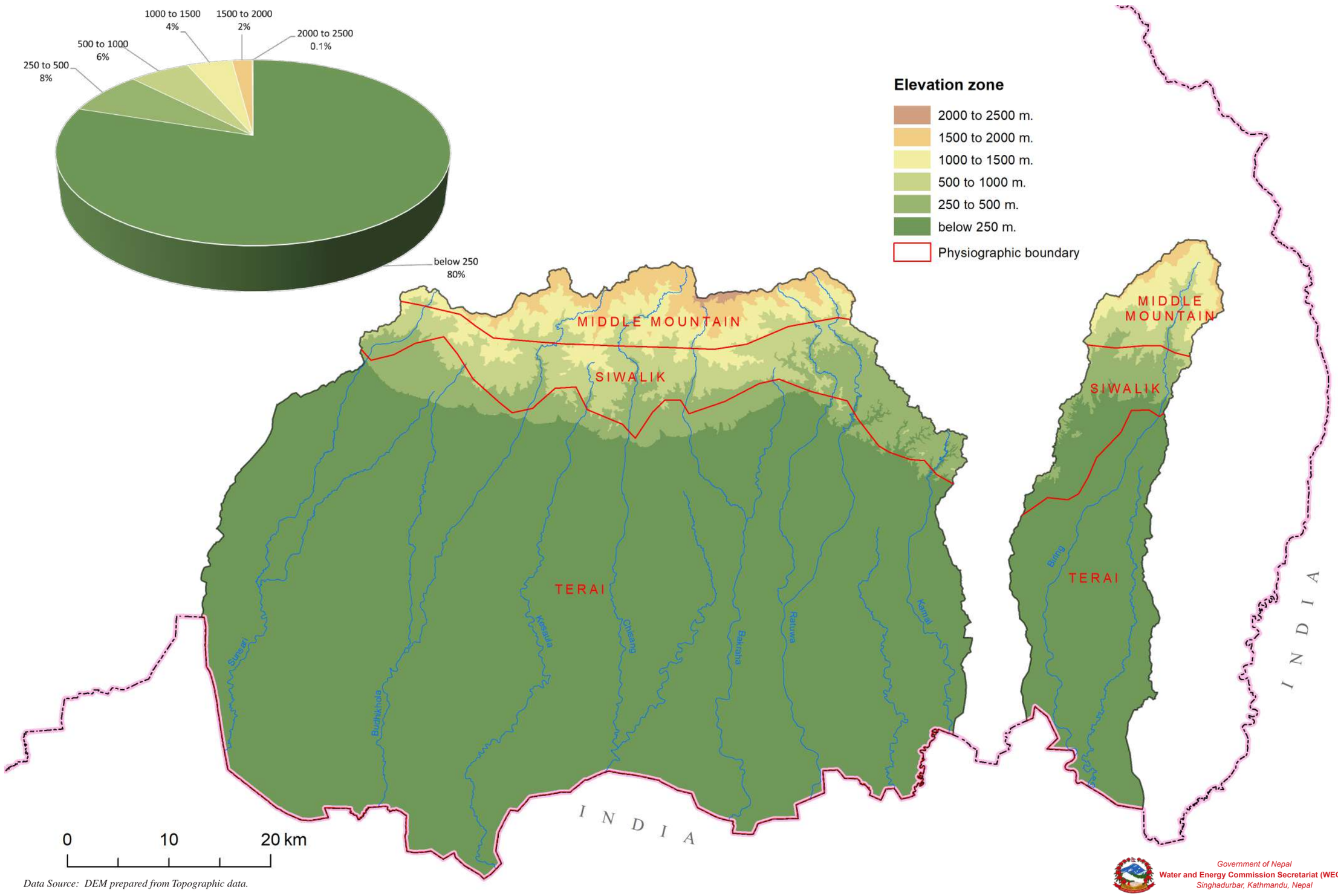
Southern Block 4: Elevation Zone



Data Source: DEM prepared from Topographic data.

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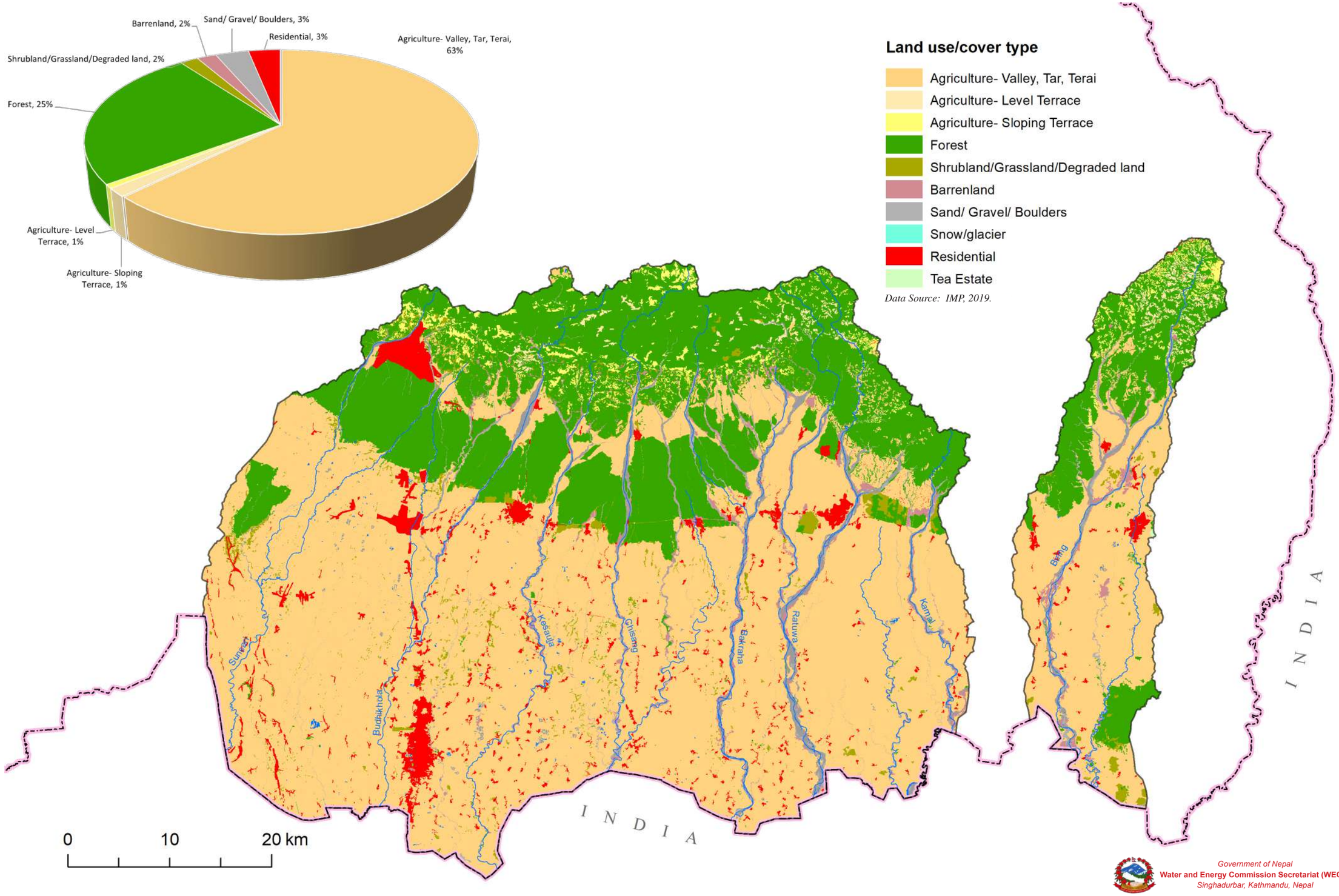
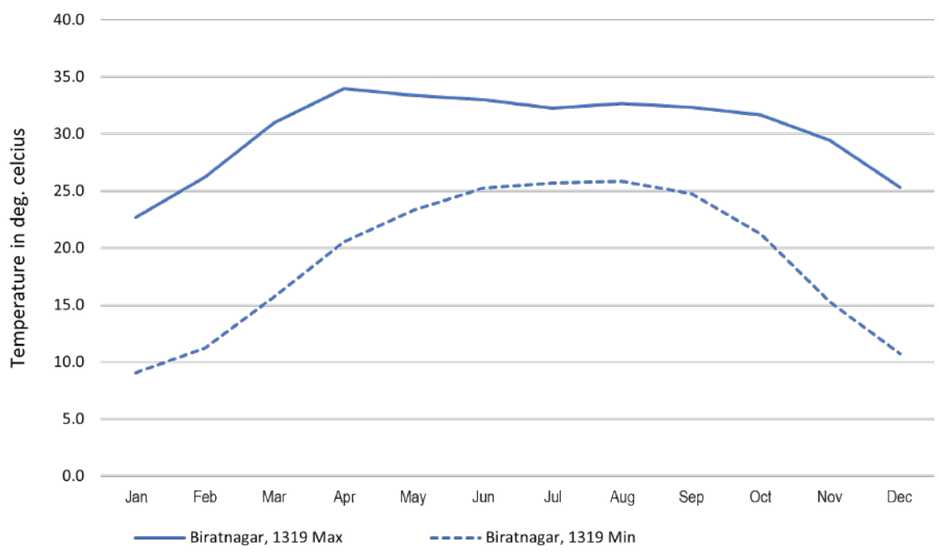
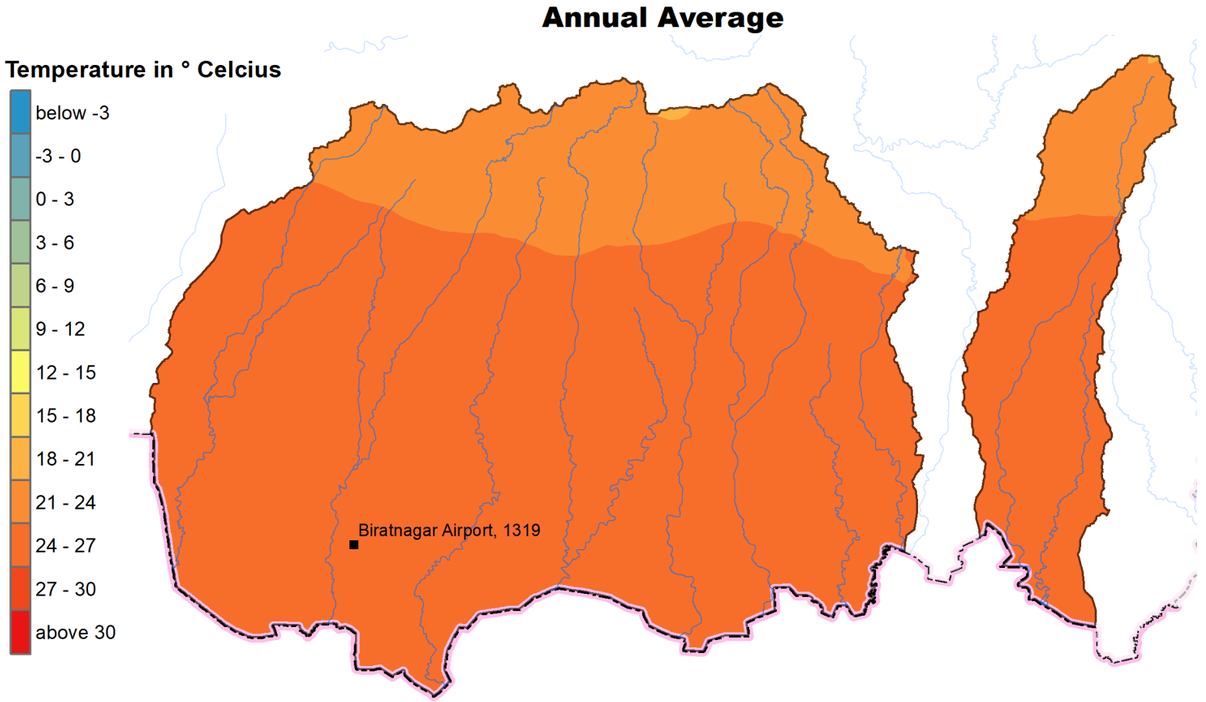
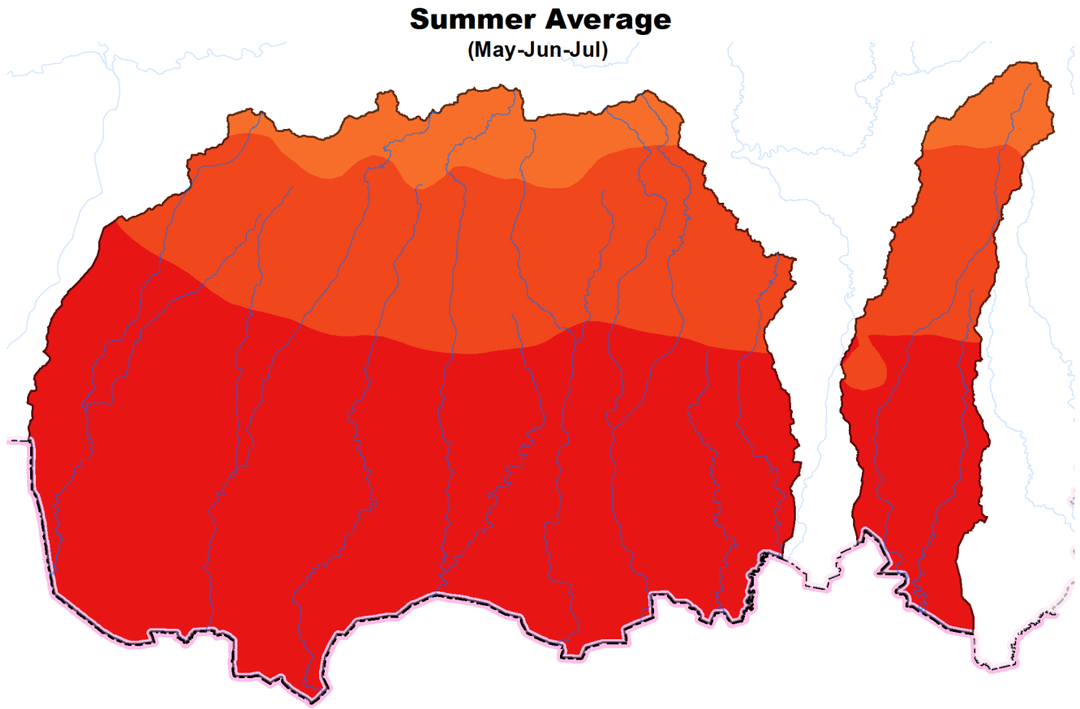
Southern Block 4: Land Use/Cover

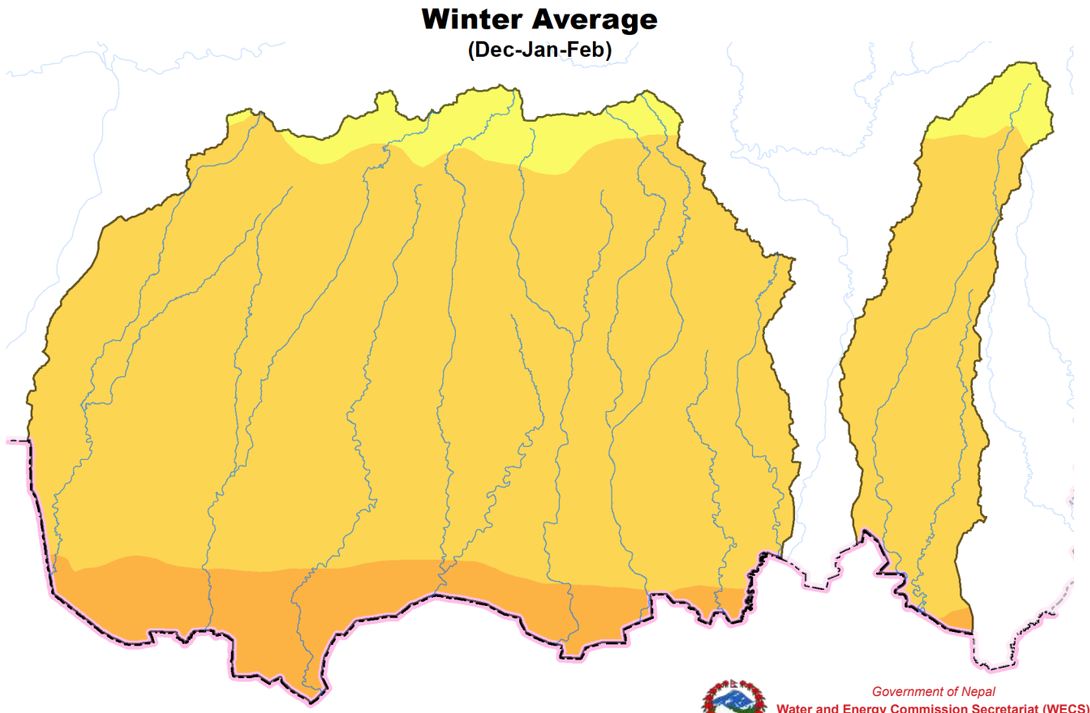


Southern Block 4: Average Temperature Distribution









Data Source: Surface generated from DHM Temperature Data - 1985-2015.

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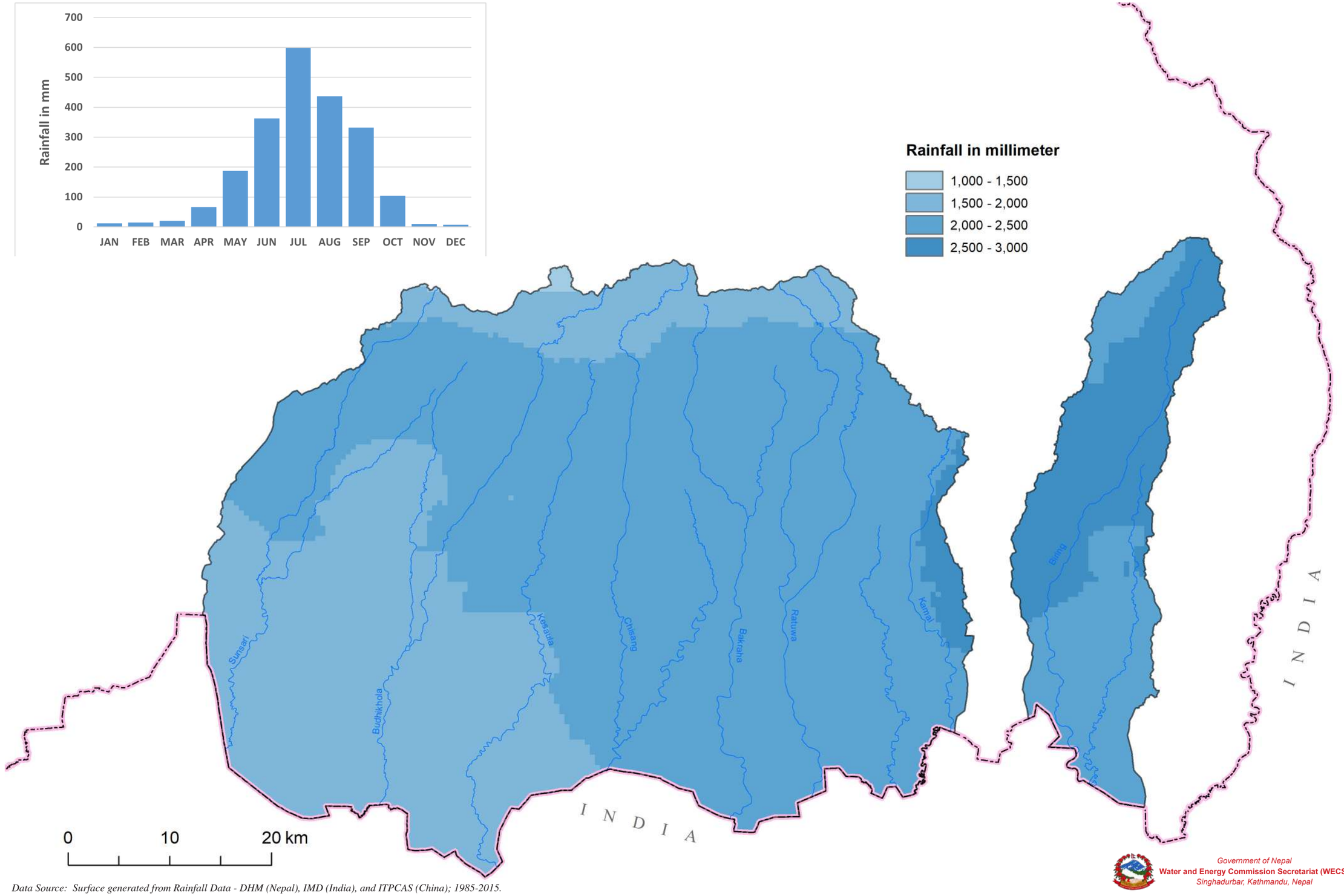
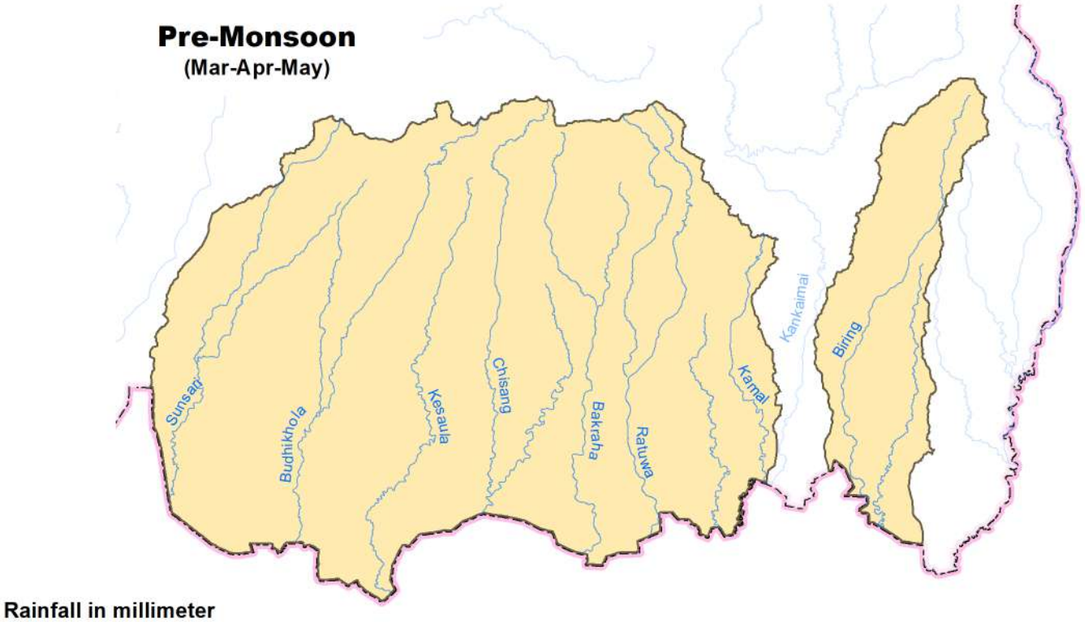
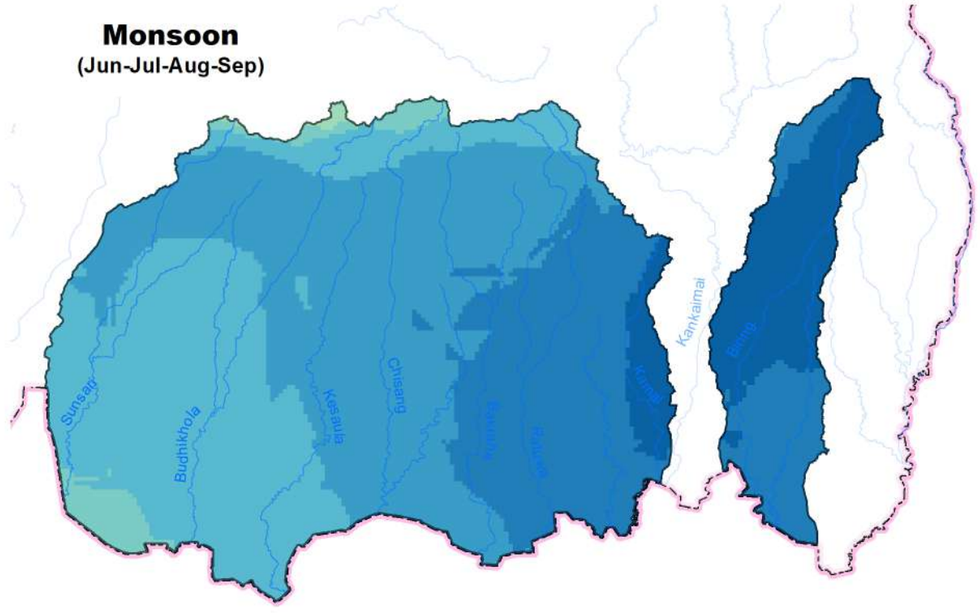
Southern Block 4: Annual Average Rainfall Distribution



Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

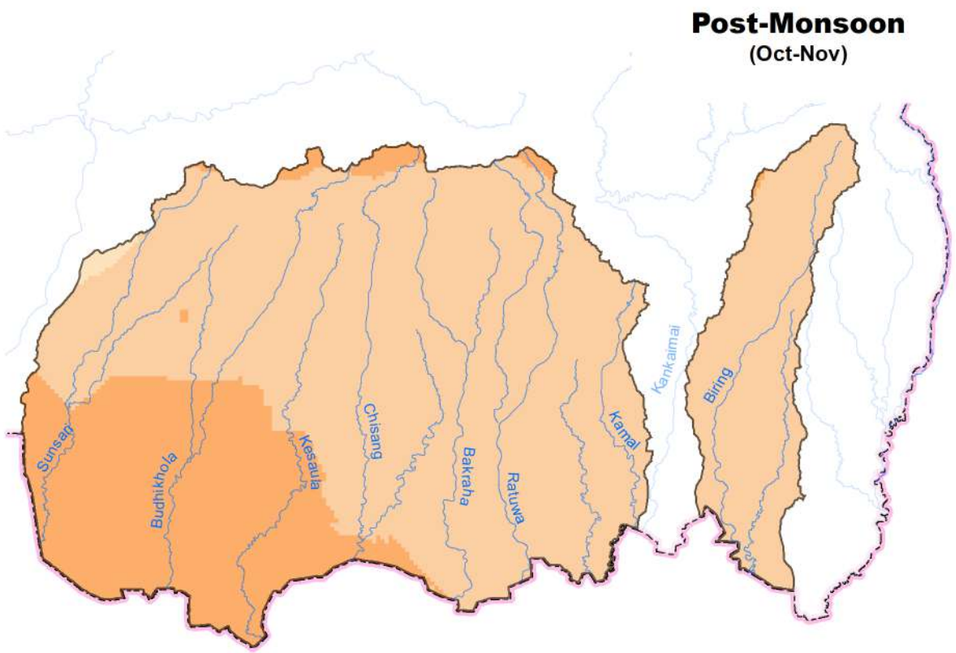
Southern Block 4: Seasonal Average Rainfall Distribution

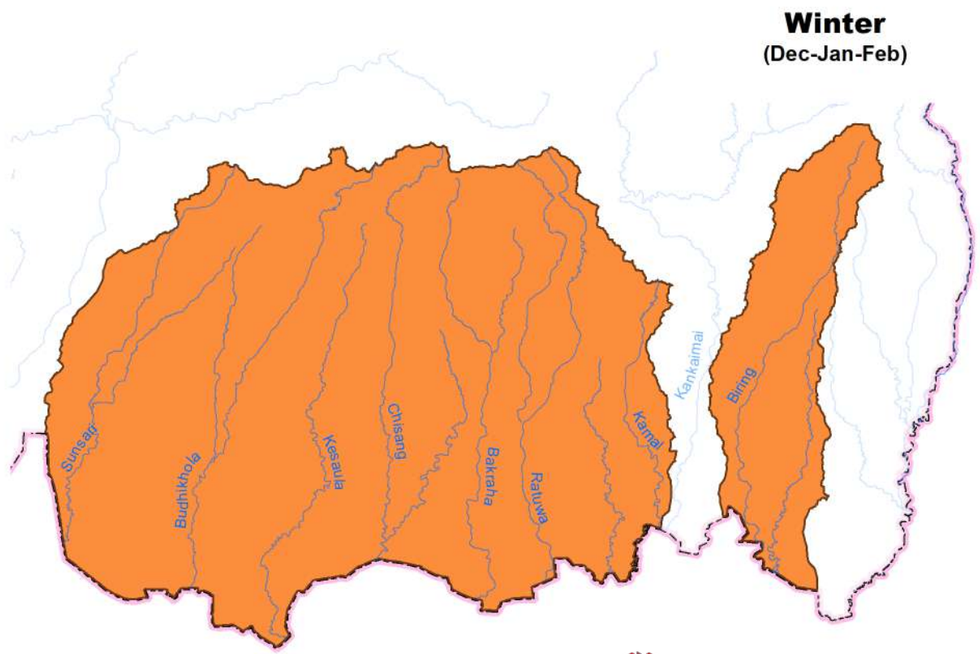




Rainfall in millimeter

0
50
100
150
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000
2,500
3,000





Data Source: Surface generated from Rainfall Data - DHM (Nepal), IMD (India), and ITPCAS (China); 1985-2015.

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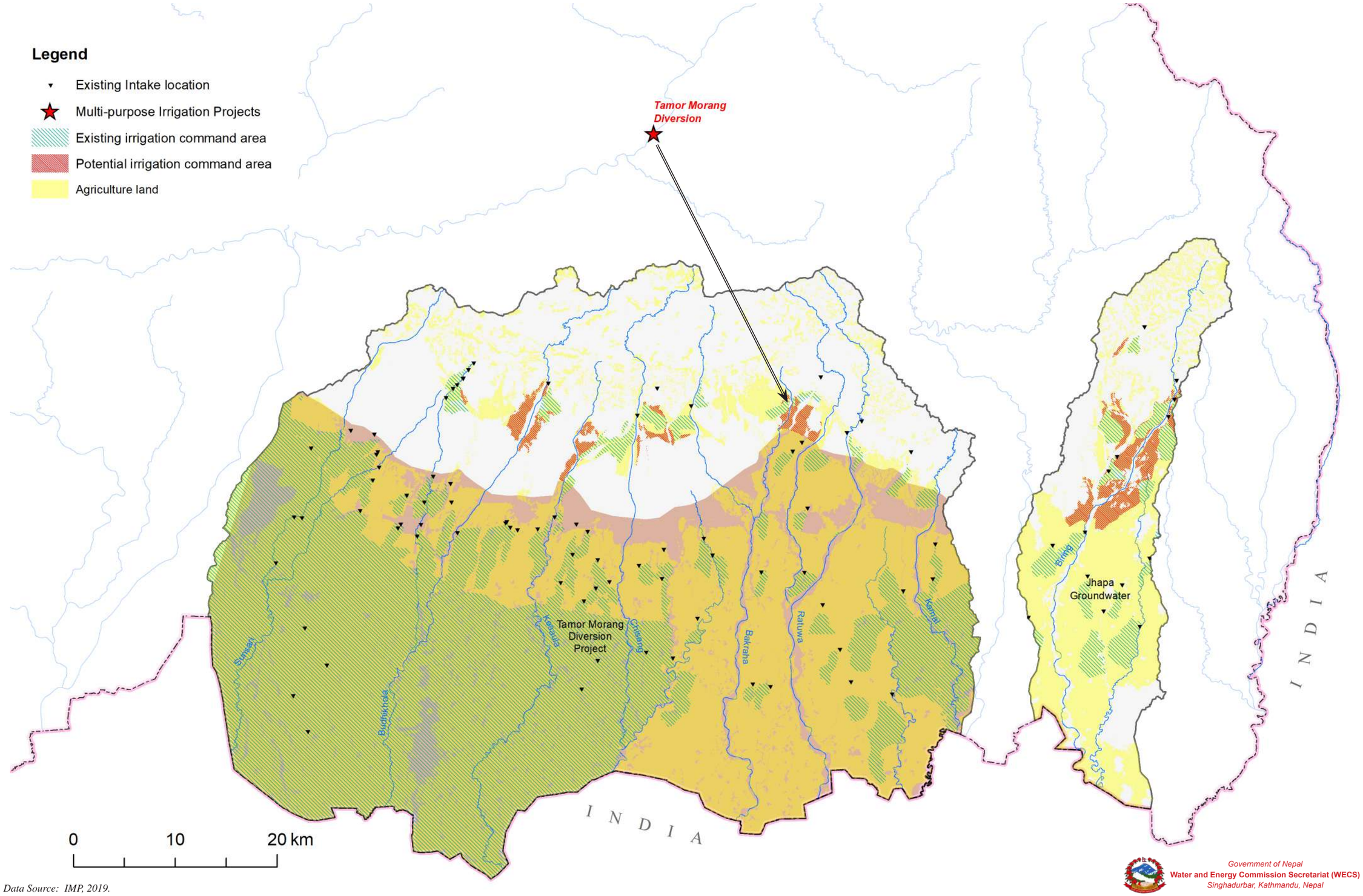
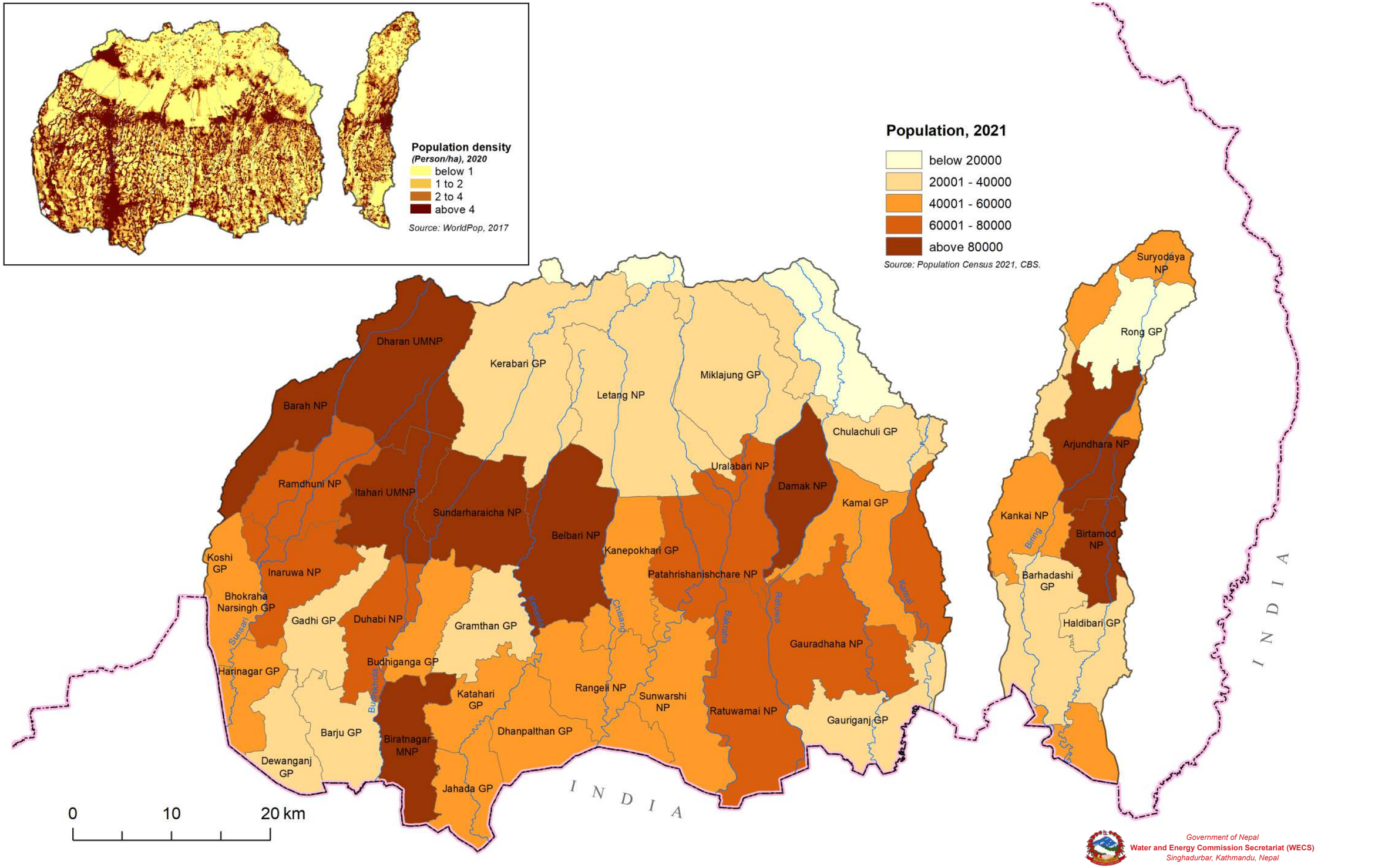
Southern Block 4: Irrigation Projects



Data Source: IMP, 2019.

Southern Block 4: Population Distribution and Density



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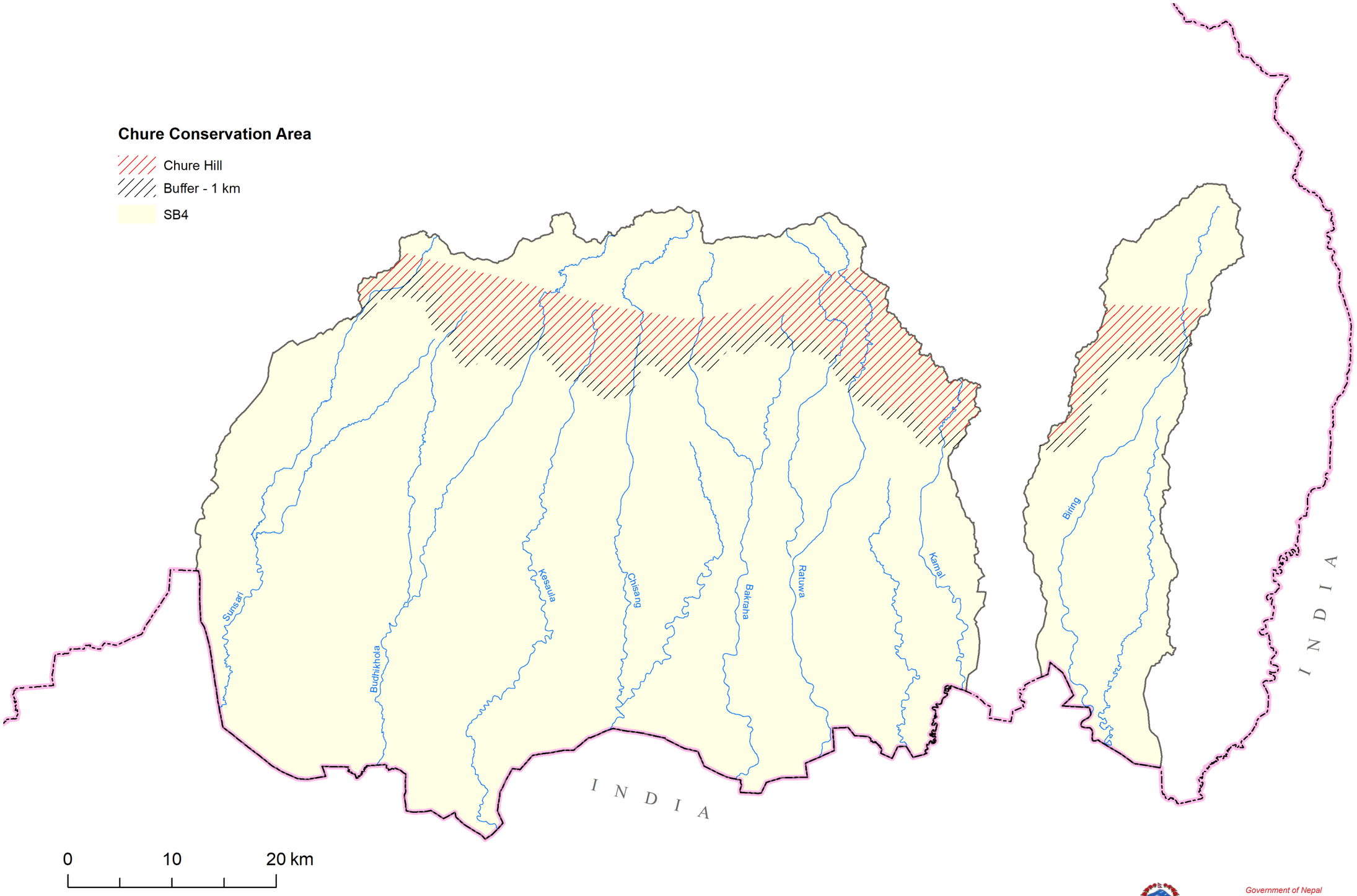
Southern Block 4: Protected Areas



Data Source: PCTMCDB, GoN, 2022

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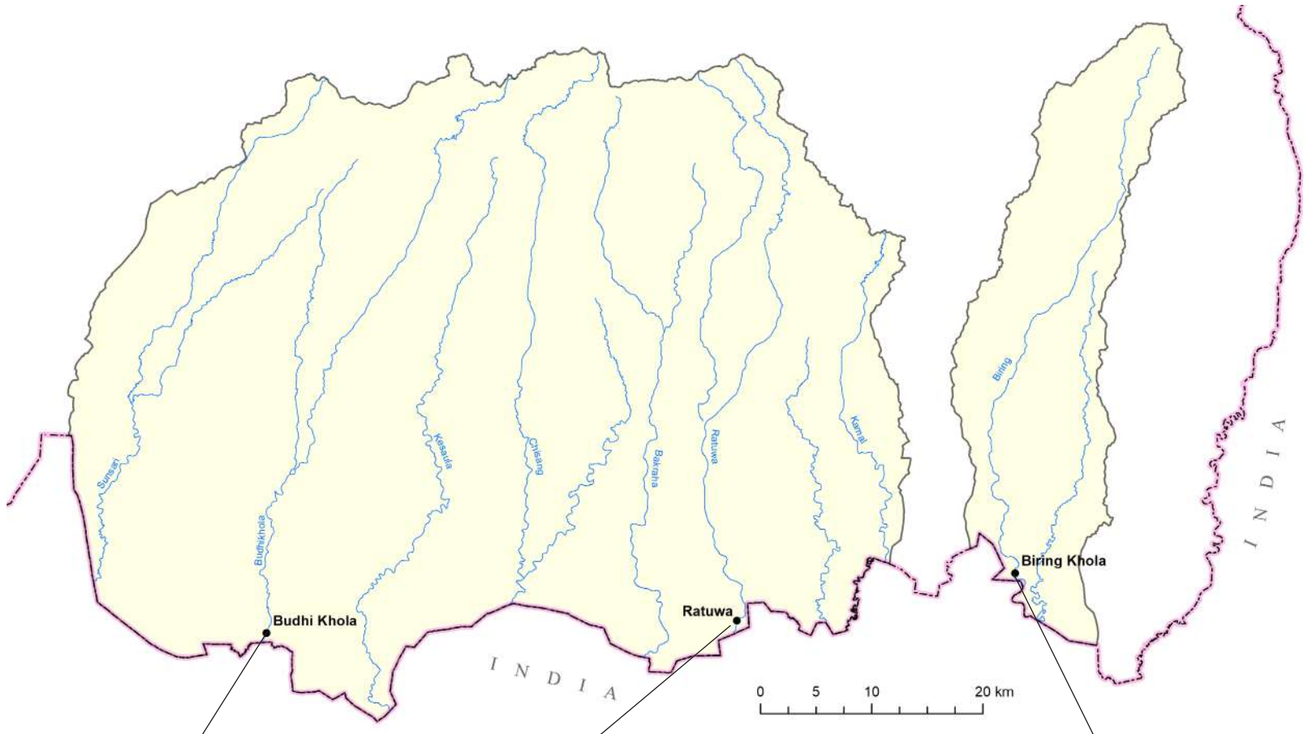

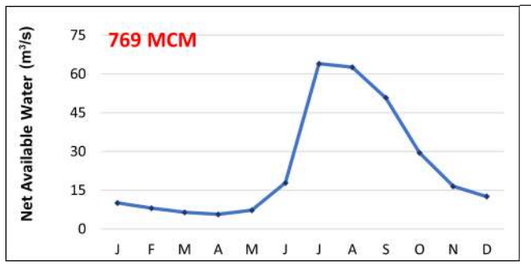

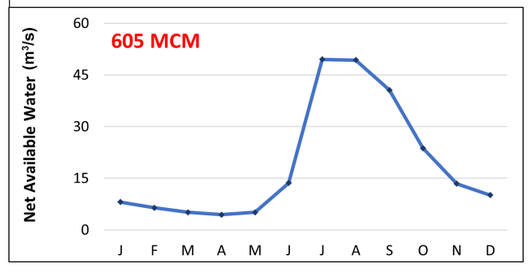

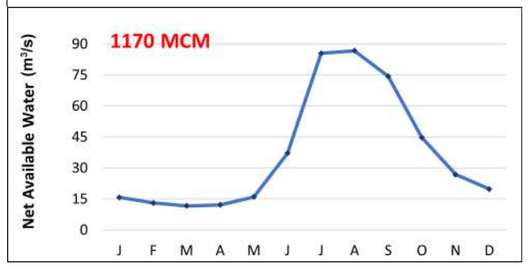

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