DISTRICT SURVEY REPORT OF ANANTNAG DISTRICT

Prepared by

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1. Preface

In Compliance to the Notification Issued by the Ministry of Environment, Forest and Climate change vide no. S.O. 141 (E) Dated 15.01.2016, the preparation of district survey report of sand mining, or river bed mining and other minor minerals is in accordance appendix-X of the notification. It is also mentioned here that the procedure of preparation of District Survey Report is as per notification guidelines. Every effort have been made to cover sand mining locations, areas & overview of Mining activity in the District with all its relevant features pertaining to Geology & Mineral wealth in replenishable and non-replenishable areas of rivers, seasonal stream and other sand sources. This report will be a model and guiding document which is a compendium of available mineral resources, geographical set up, environmental and ecological set up of the district and is based on data of various departments, published reports, and websites. The data may vary due to flood, heavy rains and other natural calamities.

The mineral potential is calculated based on field investigation and geology of the catchment area of the river or streams. Also as per the site conditions and locations, depth of minable mineral is defined. The area for removal of the mineral in a river or stream is decided depending on geo-morphology and other factors, it can be 50% to 60% of the area of a particular river or stream. Other constituents like clay and silt are excluded as waste while calculating the mineral potential of particular river or stream. This District Survey Report shall form the basis for application for environment clearance, preparation of reports and appraisal of projects.

2. Overview of mining activity in the district

District Anantnag is situated in the foothill of Lower Himalayas. The higher reaches have rich deposits of Mineral Limestone of cement and chemical grad. These limestone deposits of high grade (CaO: 45% to 57%) forms the chief raw material for manufacture of cement, carbides and allied chemical industries here. High quality and locally available limestone has played a pivotal role in the industrialization of the state. As such sizable number of limestone based industries have been set up in the state which not only contributed to the earning of revenue in crores of rupees to state exchequer but also boosted the socio-economy profile of the areas where these industries came up, besides generating jobs to thousands. Twenty two limestone leases have been granted in district Anantnag at Zig Lower Munda, Verinag, Paunzoo, Chogund, Farishan, Ranbirpora, and Matan areas. Besides there

are ten quarry blocks of minor minerals in the district. Besides the district is blessed with abundant deposits of nalla/stream borne minor mineral resources. The district is drained by the nalla Sandran, Bringi, Lidder, Arpath and its tributaries. They finally confluence to river Jhelum at Sangam. These are perennial nallas/streams which are responsible for the deposition of all the minor minerals in the district. Many types of minor minerals namely sand, gravel, bajri and boulders are presently mined in the district particularly along the nalla beds. Clay mining also takes place on the Plio- Pleistocene fluvioglacial kerewa deposits and recent alluvium deposits for construction, filling and brick making purposes. These mineral resources are very important source of employment in the district, besides being of great proponents of infrastructure development and socio-economic up-liftment. Moreover, the mineral deposits bring huge amount of revenue to the state exchequer in shape of royalty.

3. List of mining lease with location, area and validity period (Table 1)

S. No.	Name of Mine	Location	Owner	Mineral	Area	Govt. Order No./Date	Date of execution	Period of lease
01	M/S Ilahi Cements	Devipora Mattan	Sh. Malik Mohd. Qasim Shah R/o Anchidora, Anantnag.	Limestone	115 ha	145-Ind of 1983 dated 22.04.1983 and Corrigendum No. 227-Ind of 1985 dated 5.07.1985 and 310-Ind of 2003 dated 02.12.2003	17.8.1985	20 years Applied for renewal
02	M/S K.C Minerals	Punzoo Verinag,	Sh. Raju Chodhry Prop. M/S K.C.Minerals & Allied Industries Lane No. 4 SIDCO Industrial Complex, BB, Jmu.	Limestone	2.44 ha	116-Ind of 2000 dated 27.04.2000	28.04.2000	30 years
03	M/S Chattan Cement Industries, Kathua	Mattan	Sh. Ab. Majid Bhat of Laran Wanpoh Anantnag	Limestone	4.1150 ha	117-Ind of 2000 dated 27.04.2000 transferred vide Govt. Order No. 56-Ind of 2008 dated 20.02.2008	18.07.2001	30 years
04	M/S Pee Ell Alloys	Punzoo Verinag,	Sh. Rajesh Trehan S/o Pyara Lal Saraf R/o 31-D/C, Gandhi Nagar, Jammu	Limestone	4.67 ha	133-Ind of 2001 dated 12.06.2001	29.08.2001	20 years
05	M/S Shanker Industries Jakh Taror, Samba	Chowgund Verinag,	Sh. P.K. Agarwal, Patti NH Jakh Taror Bridge, Samba	Limestone	2.37 ha	16-Ind of 2002 dated 24.10.2002	20.11.2002	20 years
06	M/s Chenab Cements Kartholi, BB, Jmu.	Chowgund Verinag,	M/s Chenab Cements Shree Complex NH1A Kunjwani, Jammu	Limestone	3.10 ha	296-Ind of 2002 dated 22.11.2002	22.11.2002	30 years

07	M/S Shining Star Stone Quarries	Wantrag Renbirpora, Mattan,	Sh. Mohd. Maqbool Nath (Managing Partmer) R/o Peer Bagh Sempora, Srinagar.	Limestone Ferruginous Quartzite	21.250 ha	45-Ind of 1997 dated 24.01.1997	25.03.1997	30 years
08	M.M.Khan(1)	Punzoo Verinag	Sh. Mond. Mansoor Khan R/o Salyaloo Qazigund Doru, Anantnag	Limestone	2.065 ha	115-Ind of 2000 dated 27.04.2000	28.04.2000	30 years
09	M.M.Khan(11)	Punzoo Verinag	Sh. Mond. Mansoor Khan R/o Salyaloo Qazigund Doru, Anantnag	Limestone	0.8505 ha	169-Ind of 2003 dated 27.07.2003	28.07.2003	30 years
10	M/S Shahbad Stones	Punzoo Verinag	Sh. Jhangir Ah. Khan Qazigund, Anantnag	Limestone	3.65 ha	272-Ind of 2002 dated 9.10.2002	2.11.2002	20 years
11	Mohd. Hamid Khan	Chowgund Verinag	Mohd. Hamid Khan R/o Kanchloo Kund, Kulgam	Limestone	3.035 ha	273-Ind of 2002 dated 09.10.2002	02.11.2002	30 years
12	Sh. Ab. Rashid Banday	Devipora karigam Mattan	Sh. Ab. Rashid Banday S/o Ab. Razaq Banday R/o Kulgam, Kmr.	Limestone	9.907 ha.	46-Ind of 2004 dated 04.03.2004	16.03.2004	20 Years.
13	M/S Bagdad Minerals	Punzoo Verinag	Sh. Gh. Ah. Shah S/o Gh. Mohiudin Shah R/o Kurigam Qazigund, Anantnag	Limestone	3.13 ha	291-Ind of 2002 dated 20.11.2002	03.03.2004	30 Years
14	M/S Hamdania Minerals	Verinag	Sh. Manzoor Ah. Sheikh S/o Md. Abdullah Sheikh R/o Gutligund, Verinag, Anantnag(Partner)	Limestone	4.095 ha.	133-Ind of 2005 dated 11.05.2005	26.07.2005	30 Years
15	M/S Iqra Stone Mills	Sadiwara Dooru	Sh. Abid Ayoub Khan S/o Mohd. Ayoub Khan R/o Kurigam Qazigund, Anantnag	Limestone	4.954 ha.	158-Ind of 2005 dated 21.06.2005	27.07.2005	30 years
16	Mohd. Yousuf Itoo	Farishan Kot Doru	Mohd. Yousuf Itoo S/o Ab. Ahad Yatoo R/o Vessu Qazigund	Limestone	4.14 ha	146-Ind of 2005 dated 30.05.2005	20.10.2005	30 Years

17	M/S Bawan Minerals	Mattan	Jahangir Ah. Khan S/o Mohd. Rafiq Khan R/o Salyaloo Qazigund,Ang	Limestone	4.844 ha	159-Ind of 2005 dated 21.06.2005	15.12.2005	30 Years
18	M/S Verinag Stones	Wantin Verinag	Sh. Showket Ahmad Wani R/o Omoh, Verinag, Anantnag(Managing Partner)	Limestone	4.0875 ha	160-Ind of 2005 dated 21.06.2005	18.11.2005	30 Years
19	M/S S.A. Minerals	Chowgund	Sajad Ahmad Khan S/o Mohd. Yaqoob Khan R/o Salyaloo, Kurigam Qazigund,	Limestone	4.459 ha	299-Ind of 2005 dated19.12.2005	26.12.2005	30 Years
20	Ab. Majid Sheikh	Rain Chowgund	Ab. Majid Sheikh S/o Gh. Rasool Sheikh R/o Rain Chowgund Verinag, Anantnag	Limestone	4.781 ha.	111-Ind of 2007 dated 23.05.2007	12.06.2007	30 Years
21	Fayaz Ahmed Raina	Chowgund	Fayaz Ahmed Raina S/o Gh. Hassan Raina R/o Ganaigund Verinag, Anantnag	Limestone	4.378 ha.	180-Ind of 2008 dated 07.07.2008	16.07.2008	30 Years
22	M/S Shalimar Stones	Sadiwara Doru	Sh. Mohd. Shafi Wani S/o Habib –Ullah Wani R/o Sadiwara Doru Anantnag.	Limestone	4.519 ha.	190-Ind of 2008 dated 17.07.2008	30.07.2008	20 Years

4. Details of revenue/royalty collected in last three years

Table 2 summarizes the revenue/royalty received/collected in INR (Rupees) from the minor minerals mined in the district Anantnag from the last three years and the same is represented in the Figure 1.

Table 2: Statistical summary of revenue received/collected from last three years

Year	2014-2015	2015-2016	2016-2017
Total Amount	15,36,088	28,19,917	21,50,400

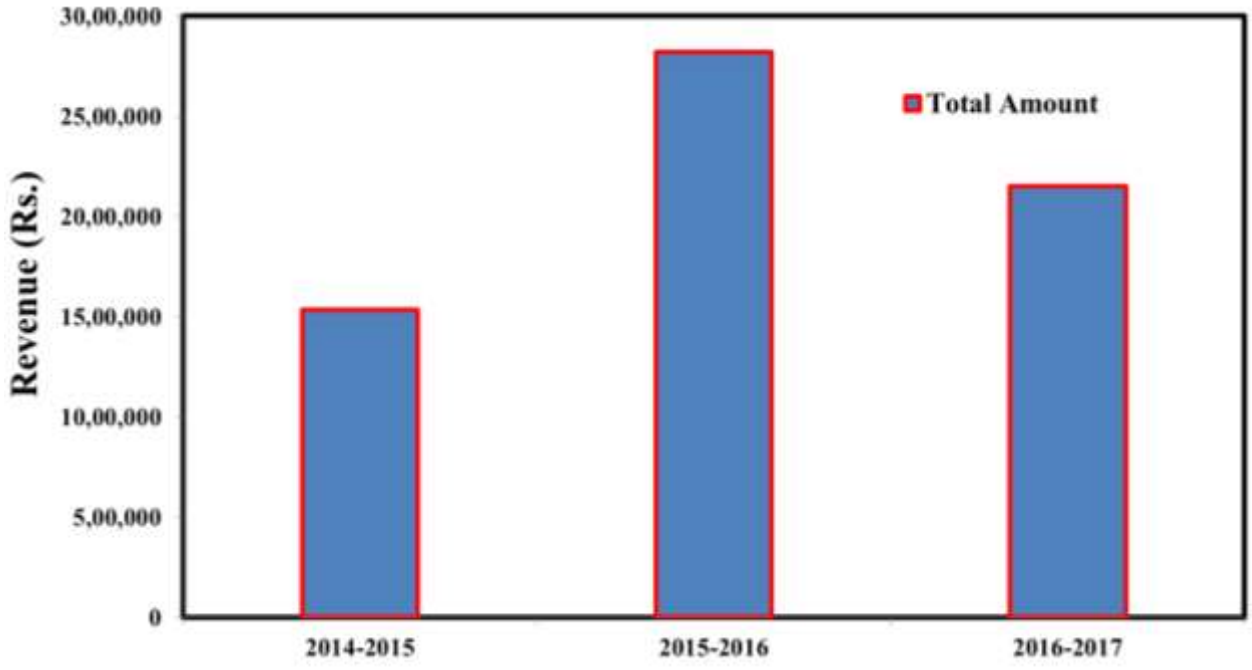

Figure 1: Graphical representation of the royalty received or collected from last three years

5. Detail of minor mineral production in last three years

Table 3: Minor minerals produced in the last three years (MT*=metric ton)

S. No.	Minor mineral	2014-15 (M.T)	2015-16 (M.T)	2016-17 (M.T)
1	***Nalla boulder***	12335	16376.7	7585
2	***Crushed boulder***	22419	92965	46573
3	***Nalla-mukh***	32496.7	43911	10450
4	***Sand***	25951	22936	18814
5	***Nalla bajri***	9246	166	0
Total		**102447.7**	**176354.7**	**83422**

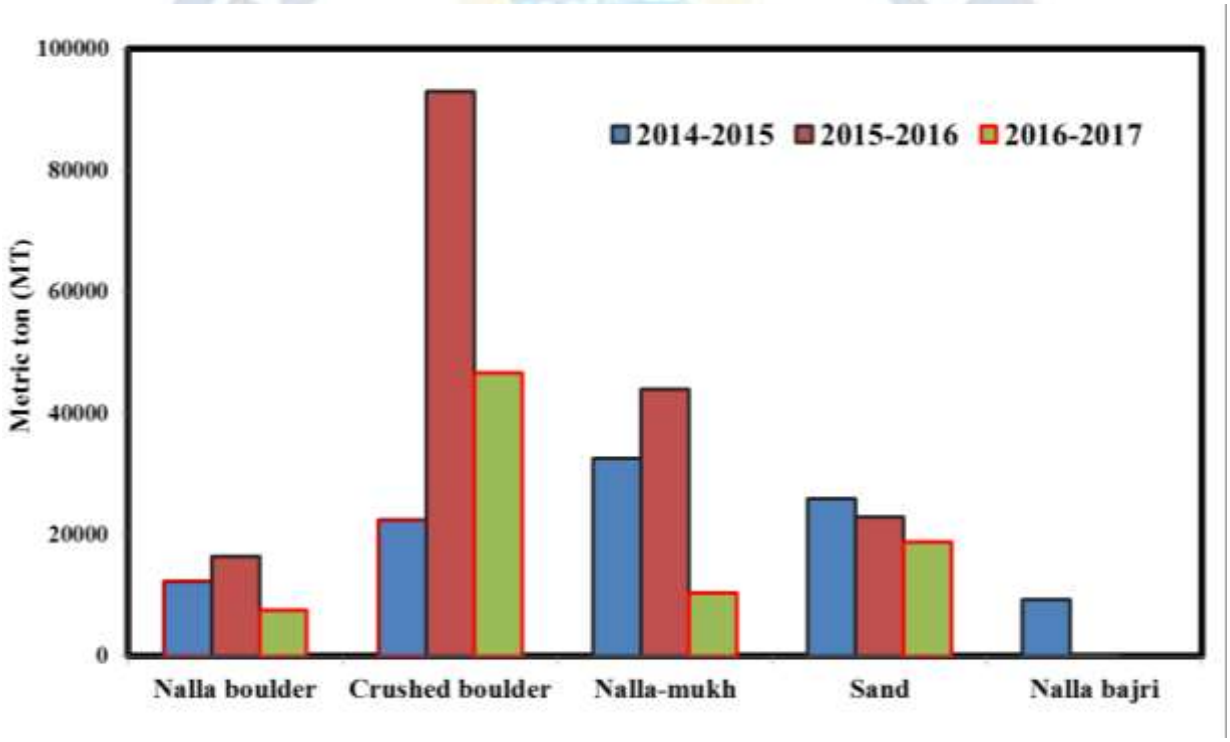

Figure 2: Graphical representation of the minor mineral production in last three years

6. Proposed minor mineral blocks

The district is characterized with number of main streams and tributaries carrying large quantities of gravel, sand and bajri in their flow path after erosion and weathering of geological formations viz. Panjal Volcanics, Limestones, Shalkhala and Quaternary sediments present in the district. Presence and availability of these minor minerals on the rivers bed minor mineral blocks were demarcated and mapped as per guidelines of Jammu and Kashmir Minor Mineral Concession Rules 2016 issued vide SRO 105 dated 31st March 2016. Table 3 gives the summary and description of the Proposed Minor Mineral Blocks of District Kulgam are presented for Mineral concession and accordingly for the environmental clearance from the authorized departments. The mineral potential of these blocks are discussed in detail in drainage system with mineral potential section.

Table 4: Minor Mineral Blocks of District Anantnag

S. No.	Name of the Block	District	Nalla/Stream	Area (Ha)
01.	Block ANG/SA/01, Dooru Bridge Downstream Sandran Nallah	Anantnag	Sandran	4.51
02.	Block ANG/SA/02, Mehmoodabad Bridge upstream Sandran Nallah	Anantnag	Sandran	3.27
03.	Block ANG/SA/03, Mehmoodabad Bridge Downstream Sandran Nallah	Anantnag	Sandran	8.69
04.	Block ANG/SA/04, Shankerpora Bridge Upstream Sandran Nallah	Anantnag	Sandran	6.67
05.	Block ANG/SA/05, Shankerpora Bridge Downstream Sandran Nallah	Anantnag	Sandran	5.82
06.	Block ANG/SA/06, Neesu Bridge Downstream Sandran Nallah	Anantnag	Sandran	9.82
07.	Block ANG/SA/07, Veesu Bridge Upstream Sandran Nallah	Anantnag	Sandran	7.06
08.	Block ANG/BR/08, Soaf Shali Bridge Downstream Bringi Nallah	Anantnag	Bringi	7.87
09.	Block ANG/BR/09, Hillar Bridge Upstream Bringi Nallah	Anantnag	Bringi	9.77
10.	Block ANG/BR/10, Hillar Bridge Downstream Bringi Nallah	Anantnag	Bringi	7.77
11.	Block ANG/BR/11, Larkipora Bridge Upstream Bringi Nallah	Anantnag	Bringi	10.00
12.	Block ANG/BR/12, Larkipora Bridge	Anantnag	Bringi	9.34

	Downstream Bringi Nallah			
13.	Block ANG/LI/13, Akura Bridge Downstream Lidder Nallah	Anantnag	Lidder	8.34
14.	Block ANG/LI/14, Aang Bridge Upstream Lidder Nallah	Anantnag	Lidder	9.23
15.	Block ANG/LI/15, Aang Bridge Downstream Lidder Nallah	Anantnag	Lidder	6.57
16.	Block ANG/JH/16, Urnhall Bridge Downstream Jhelum River	Anantnag	Jhelum	4.23
17.	Block ANG/JH/17, Zirpora Bridge Downstream Jhelum River	Anantnag	Jhelum	6.89
18.	Block ANG/JH/18, Sangam Bridge Upstream Jhelum River	Anantnag	Jhelum	8.38
19.	Block ANG/JH/19, Sangam Bridge Downstream Jhelum River	Anantnag	Jhelum	9.74
20.	Block ANG/VE/20, Y.K.PORA to Kuchapora Downstream Vethvethri Nalla	Anantnag	Veyhvethri	7.38

7. Process of deposition of sediments in the rivers

The water flowing through a river could erode the land over which it flows, transport sediments that are formed by weathering and erosion, and finally deposit the transported materials, under favourable conditions into discrete landforms. An idealized river system can be divided broadly into three zones (i) production zone or a zone of sediment erosion, (ii) zone of sediment transfer, and (iii) a zone of deposition. The production zone will be steep, rapidly eroding head waters, whereas in transport zone the sediment is moved without net gain or loss. The transported materials will be deposited in the storage zone of the river under favorable conditions. In the upper course of a river, processes are dominated by sediment production and incision of the channel into the landscape. The process of erosion becomes very conspicuous in excavating or down cutting the valley floor. The size of the sediment transported in any segment of the river is dependent on the geology of the basin as well as the distance of the segment from the source. The amount of sediment load carried depends on the size of the material, discharge, slope, and channel and catchment characteristics.

River sediments comprise a spectrum of particle sizes such as boulder, cobble, pebble, granule, sand, silt, and clay (Lane 1947). Among these, the largest particles commonly occur in upland channels where the terrain gradient is the highest, while finer entities are enriched

progressively downstream due to sediment sorting based on size and specific gravity (Blatt et al. 1972).

Natural sands are weathered or worn out particles of rocks. Many minerals will be lost or modified during the weathering processes in the source area. A significant portion of the weathered products will be later removed during erosion, and transported to the site of deposition. A part of the minerals will be changed during diagenesis as well. Due to weathering of feldspars in the host rocks will be altered to kaolinite or an intermediate product; pyroxenes and amphiboles are more likely to dissolve and be transported as dissolved ions. Minerals like quartz are practically insoluble or sparingly soluble. Therefore, they will be left out in rivers and other depositional environments along with durable minerals like zircon, sillimanite, etc. Hence, such minerals remain almost unchanged in their chemical composition during weathering, erosion, transportation or deposition. River sands seem to be more feldspathic than either dune or beach sands. The ever changing climatic conditions, sea level positions and tectonic processes in the Pleistocene and Holocene epochs have had a major role in the formation of the present day sand deposits in different areas of the world.

Huge volumes of sand and gravel are extracted from the river systems of Anantnag district every year for meeting the ever increasing demand of aggregate materials for building constructions.

The major rivers of the district Anantnag originate and cut across hilly terrain disintegrating and weathering hard rocks such as Quartzite, Panjal Traps and Agglomeratic Slates into rock fragments by the process of saltation. These rock fragments are further transported along river course during rainy season, there by producing boulders, cobbles, gravels, pebbles and sand and depositing them in the river section at suitable place to place of the district.

8. General profile of the district Anantnag

i) Profile: Anantnag district is in southern sector of Jhelum Valley. It is because of its rejuvenating climate, the inspiring majesty, its lofty mountains, the melodious flow of sweet waters of its springs and streams, fertile soil, fragrant flowers and delicious fruits that the district has come to be synonymous with greatness. District Anantnag is one of the oldest districts of the valley and covered the entire south Kashmir before its bifurcation into Anantnag and Pulwama in 1979. The districts of Anantnag and Pulwama later got sub-divided into Kulgam and Shopian, in 2007. Consequently the districts of Pulwama and Kulgam lie on the north and north-west of district Anantnag, respectively. The district of Ganderbal and Kargil touch its eastern boundary and the district of Kishtwar meets on its southern boundary while as District Doda touches its west land strip. The name of Anantnag district is according to archaeologist, Sir Aurel Stein comes from the great spring Ananta Naga. This is also corroborated by almost all local historians including Kalhana according to whom the town has taken the name of this great spring of Cesha or Ananta Naga "land of countless springs". The spring is mentioned in the Neelmat Purana as a sacred place for the Hindus and Koshur Encyclopedia testifies it.

ii) Location, boundary and area: Geographically the district lies between 33°-20' to 34°-15' north latitude and 74°-30' to 75°-35' east longitude. The entire southern sector of the district, which is contiguous with Tehsils of Reasi, Banihal and Kishtwar of Jammu province, and eastern sector which is contiguous with Tehsil Kargil of Ladakh division comprises of thick forests and mountains. The northern and western sides of this district are bounded by Pulwama district while Kulgam district falls in its west. Of all the districts of the state, Anantnag claims the largest number of streams (Nallas) like Sandran, Bringi, Arpath and Lidder. The most important among these is Lidder which originates from Shesram and Kolahoi glaciers and irrigates maximum area of the district. The area of the district after carving out district Kulgam in year 2007 stood at 2917 km^2, which constitutes about 1.31% of the total area of Jammu & Kashmir state.

iii) Demography: As per Census 2011, the population of the district is 1070144 persons with 552404 males and 517740 females. Anantnag urban town is home to more than 458,700 people. Sex ratio of the district is 937 and the literacy rate is more than 64% (Table 1.1). Highest growth rate has been recorded in the district during the decade of 2001-2011 while as lowest growth rate was recorded during 1911-1921.

Table 5: Profile of the District

District	Area (Km^2)	Total population	Male	Female	Sex ratio	Literacy (%age)
Anantnag	2559	1070144	552404	517740	937	64.32

Source: *Census of India, 2011*

As per the report of revenue authorities, the district consists of 605 Villages having 01 municipal council and 10 municipal committees. There are six tehsils in the district i) Anantnag ii) Bijbehara iii) Dooru iv) Shangus v) Kokernag and vi) Pahalgam which have further ben sub divided into 16 Nayabats (Land Revenue Circles) and 96 Patwar-halqas. These villages have also been divided into 07 community development blocks viz. i) Achabal ii) Breng iii) Dachnipora iv) Khoveripora v) Qazigund vi) Shahabad vii) and Shangus.

Figure 3: Location map of district Anantnag

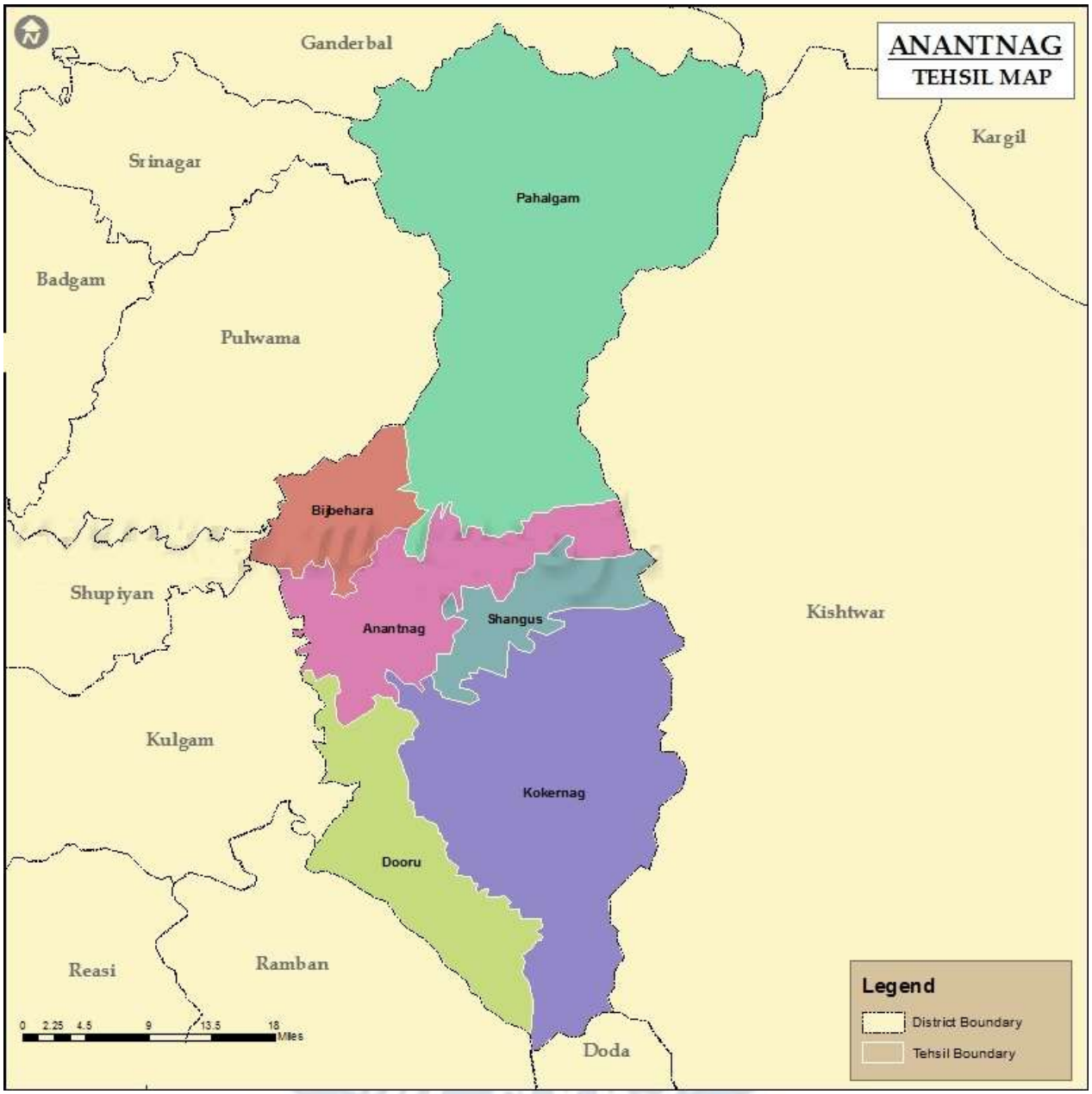

Figure 4: Tehsil Map of Anantnag district

9. Land utilization pattern

The total area of Anantnag 2765 Km^2. The dense forest is the most dominant land use class/category with an area of 652.98 Km^2 in 2016. It occupies the 25% of the district. Scrub was the other major land use class total area is about 506.57 Km^2 with 19.45%. Wasteland occupied 441.97 Km^2 constituted with 16.97%. Another category is Agriculture covers 315.6 Km^2 with 12.10% of the district. Other category is Horticulture which is spread in 248.02

Km^2 with 9.52%. Then there is sparse forest it is an area of 228.43 Km^2 which constitutes 8.77 %. Glacier occupied 146.28 km^2 area which constitutes 5.62 %. Built up were extended in the area of 45.25 Km^2 it constitutes 1.74 %. Water body occupies 20 Km^2 with 0.78 % of the Anantnag district. Dense Forests in the district Anantnag have decreased by 220 Km^2 from 1990 to 2010. Total area under this category was 901.4 Km^2 in 1990 which has come down to 652 Km^2 in 2010.

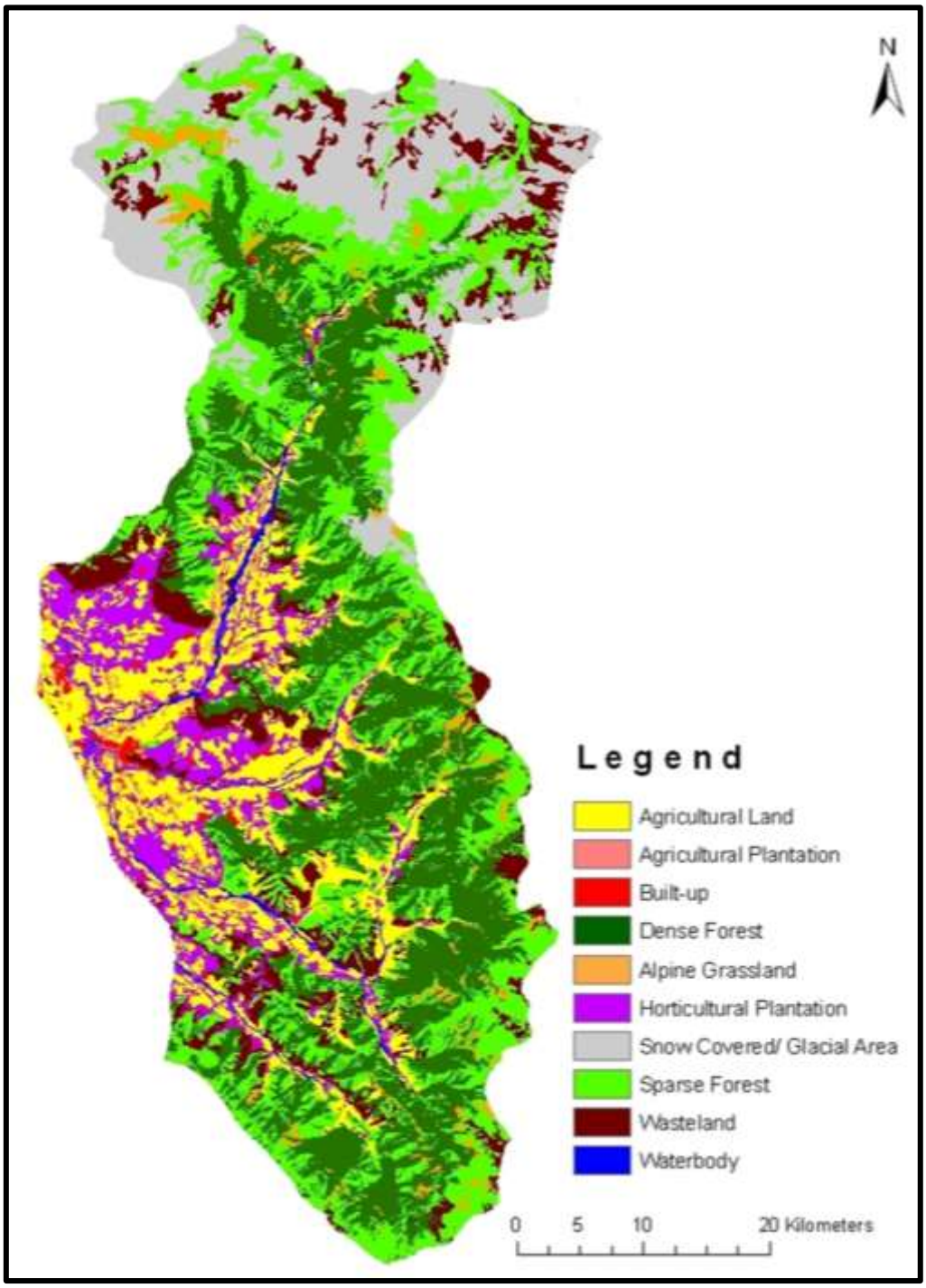

Figure 5: Land use/land cover of district Anantnag

Table 6: Land use/land cover statistics of district Anantnag

S. No.	Land use/Land cover Category	Area (Km^2)	% to total area
1	Dense Forest	673.0	26.2
2	Sparse Forest	645.8	25.2
3	Agricultural Land	318.5	12.4
4	Snow Covered/ Glacial Area	358.4	14.0
5	Wasteland	225.8	8.8
6	Horticultural Plantation	191.7	7.5
7	Alpine Grassland	53.5	2.1
8	Agricultural Plantation	41.6	1.6
9	Water body	29.4	1.1
10	Built-up	28.8	1.1
11	Wetland	0.0	0.0

10. Physiography

The northern part of the district is an upland part of Jhelum Basin, which occupies the western part of the Himalayan Synclinorium and south eastern part of the Kashmir region. This region includes three mountainous catchments of Himalayan Tethyan Belt and cover an area of ~2200 km^2, which include, Liddar (1243 km^2), Kuthar (362 km^2) and Bringi (595 km^2). It is predominantly surrounded by mountains on all sides except southwest. It is surrounded by Pir Panjal range in the south and southeast, the greater Himalayan range in the north and northeast and Zanskar range in the west and northwest. Region is girdled on three sides by lofty ridges; like the Saribal-Katsal ridge (4800 m, asl) on the east, and Wokhbal ridge (4200 m, asl) on the west. The interior of the northern part of the region has a concentration of high mountain ridges like Dadwar, Goucher and Tramakzan which run parallel to the course of rivers. The general elevation ranges from 1596 m, asl (Anantnag) to 5425 m, asl (Kolahoi peak) with the average altitude of 3510 m, asl. The other important mountain peaks are Sheshnag. It was observed that higher elevations (more than 3600 m, asl) are noted towards the outer limits of the Lidder catchment which are characterized by rock

outcrops and permanent snow fields with very steep slope. The slope values have a complex distribution in map view . The steepest slopes (40°-71°) are generally observed in the upper parts particularly in north-eastern side and occupy 35.1 km^2 area of the district. The lowest slopes (0°-10°) are present in the central part of the district and occupies the 591.54 km^2 area. The total area occupied by slope angle of 30°-40°, 20°-30° and 10°-20° are 11.4 km^2, 12.8 km^2 and 10 km^2 respectively.

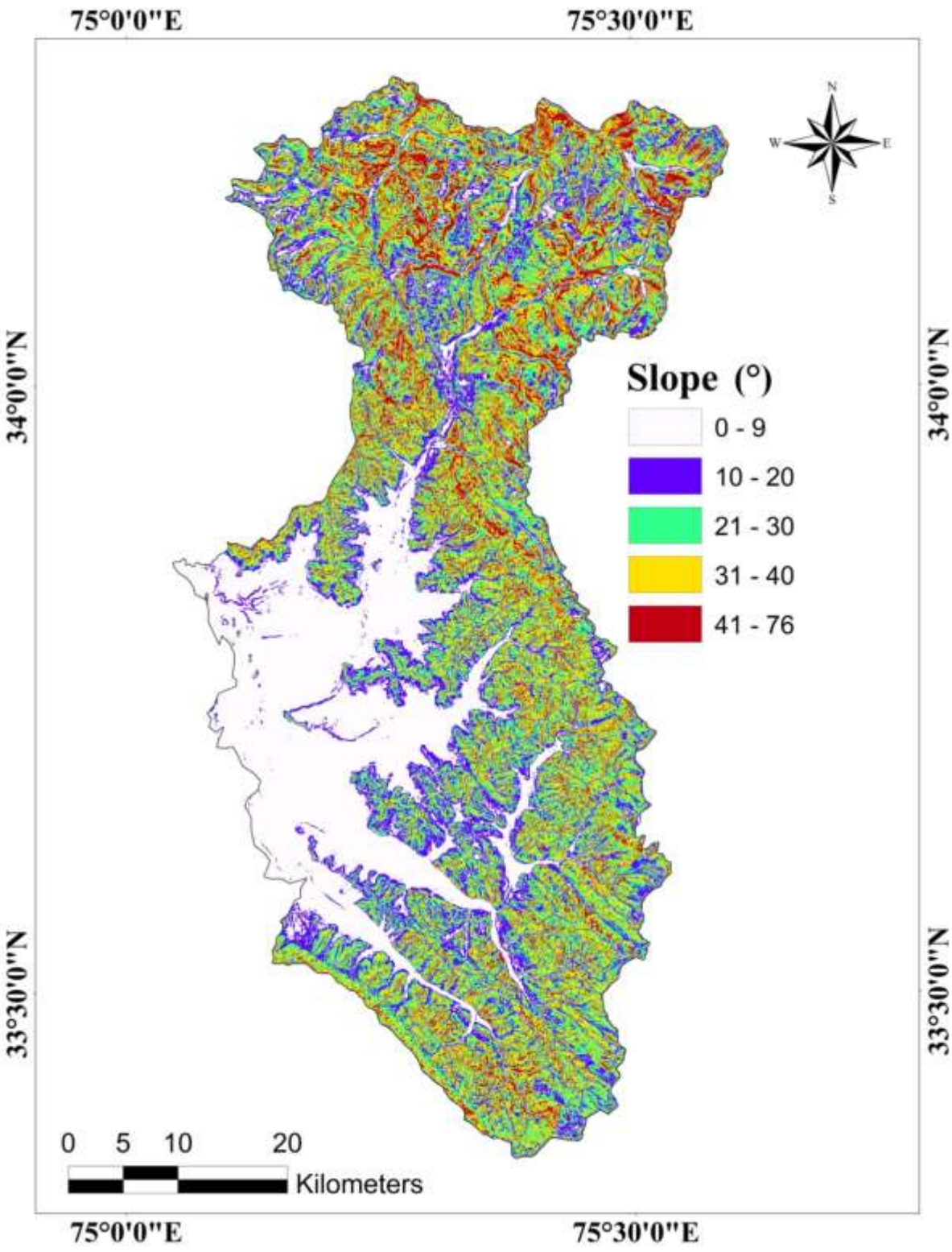

Figure 6: Slope map of district Anantnag

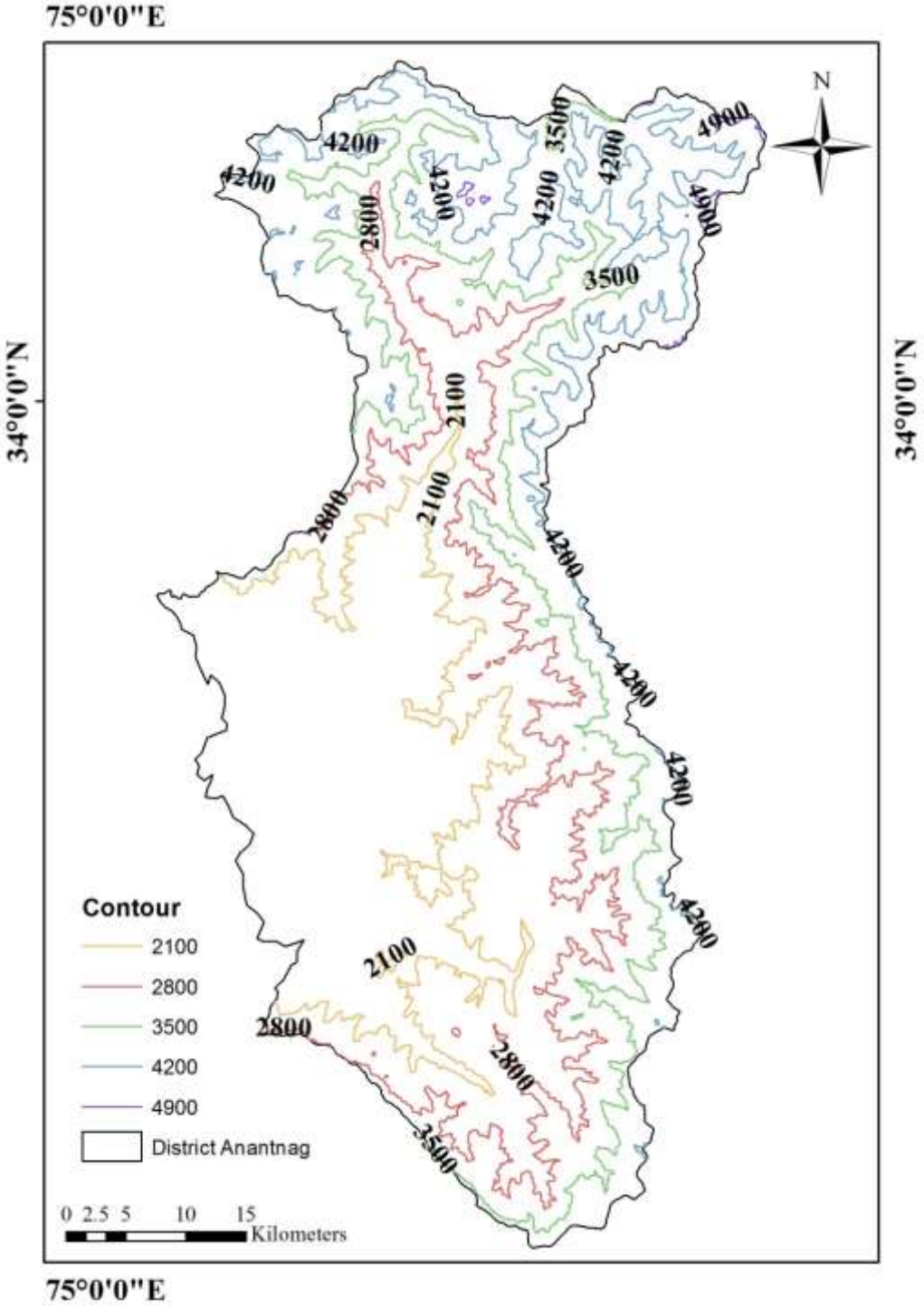

Figure 7: Contour map of Anantnag district (Contour interval= 700 m**)**

12. Climate and rainfall: Owing to proximity of Pir Panjal Range, which stretches in its south and South-East, the district has a more temperate climate in summer than other districts of the Valley. In winter, however, snowfall is heavier and temperature is relatively low. Being engulfed on two sides by mountains, the moonsoon does not generally reach the

district. The rainfall is often excessive in Spring, moderate in Summer, deficient in Autumn and moderate in Winter. Similarly, the climate of the district is effect by Meditarrian and Indian summer monsoon climatological system, where western disturbances cause heavy precipitation from December to April while as Indian summer monsoons cause precipitation from July to September. The weather of the Kashmir Valley has been divided into four distinct seasons: winter, spring, summer and autumn. The winter season starts from December to February. This season receives heavy snowfall caused by the western disturbance. The pattern of snowfall varies with the altitude. The daily minimum temperature fluctuates between -13.2 ºC and +1ºC. The temperature distribution in the higher altitudes shows characteristic altitudinal gradient. During this season winter the sunshine is low and relative humidity remains about 90%. Spring Season starts in March when temperature starts rising gradually and snow starts melting. The spring weather is characterized by sunnier and brighter days and cool nights. The day temperature swings between 12^{o}C-15^{o}C. The summer season commences from June to August. The summer season is characterised by shower type of the rain accompanied by thunder storm. The rainfall is local in nature and gets marginal benefit from the monsoonal winds because of the rain-shadow effect of the Pir Panjal range. September to November are the months of autumn season, a most awaited season in Kashmir Valley. These months mark a transition from the warm sub-tropical summers to temperate winters. This season is characterized by least disturbed weather, the highest amount of sunshine, high diurnal range of temperature and little rain or snow. Average ambient temperature in Autumn season is 10 ^{o}C whereas average precipitation has been recorded as 55mm.

The monthly mean minimum rainfall measured at Pahalgam from 1971 to 2010 is 71 mm and the monthly mean maximum is 136.2 mm. Kokarnag is a high altitude meteorological station like Pahalgam, situated in the south bordering mountain chain of Pir Panjal. The monthly mean minimum rainfall recorded at this station from 1971 to 2010 is 25.8 mm while as the monthly mean maximum is 208.2 mm. Quazigund meteorological station is no exception to this variability. Monthly mean minimum and the monthly mean maximum rainfall figure recorded at this station during the above mentioned period is 73.3 mm and 234 mm respectively

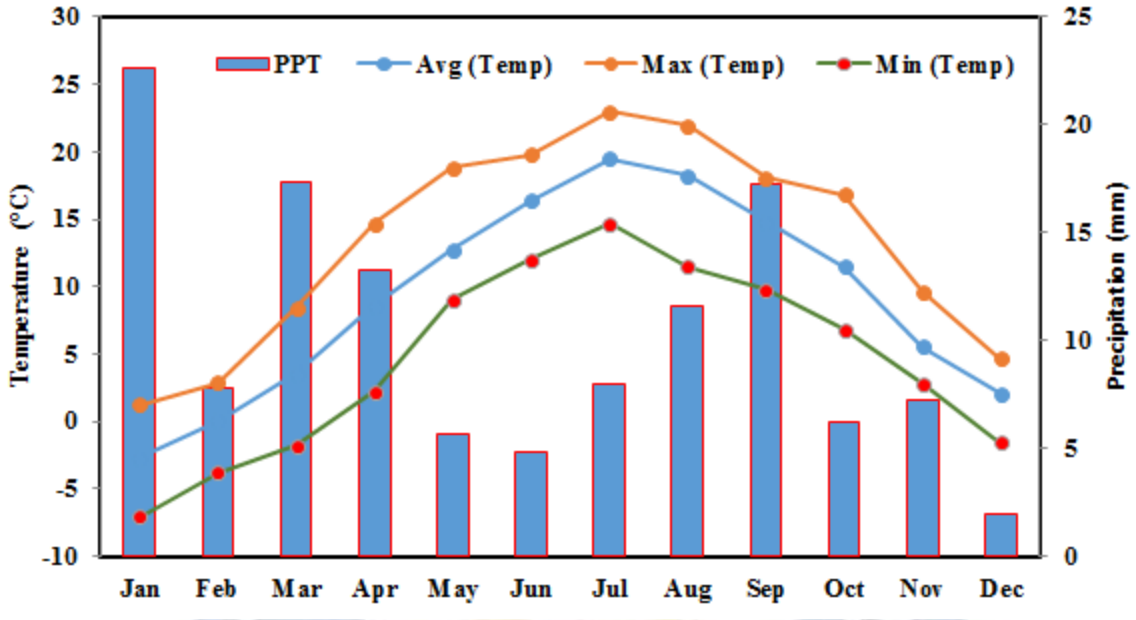

Figure 8: Monthly temperature and precipitation in district Anantnag

12. Geology

Kashmir Valley preserves a geological record of the Himalayan Orgenesis, displaying the rock specimen belonging to all ages from Achaean to Recent . Palaeozoic, Triassic carbonate rocks, Quarternary Karewa deposits and Recent Alluvium are dominant geological units in the Anantnag district. Triassic carbonate rocks are surrounded by Palaeozoics and are overlain by Pleistocene (Karewa) and Recent sediments. Palaeozoic rocks include sandstone, silt stone, mudstone and shale (Lower Paleozoic), quartzites (Muth quartzite), Grey limestone, quartzite and shale (Syringothyris Limestone), quartzite and shale (Fenestella Shale), pyroclastic slates, conglomerate, quartzite and porphyry granites (Agglomeratic Slate), andesitic and basaltic lavas with amygdaloidal and glomeroporphyritic texture (Panjal Traps), cherts, calcareous and siliceous shales, limestones and quartzite's (Gangamopteris Beds) which occur mostly towards the marginal areas. Triassic Limestone, which consists of compact blue limestone, argillaceous limestone and dolomitic limestone intercalated with sand stone and shale, overlies the Palaeozoic rocks and occur in the form of dissected ridges. The Karewa deposits of Pleistocene consist mostly of unconsolidated sandstones, beds of loess, conglomerates, etc. Small valleys between Triassic Limestone ridges and Karewa are filled with Alluvium. Each litho-unit has a distinctive depositional environment in the vertical sequence and ultimately suggests the evolution of the valley catchment in which these rocks

were deposited and their relative competence for erosion. The detailed characteristics of each stratigraphic unit are as:

a) Salkhala Formation: The Achaean or Precambrian rocks in the Kashmir Valley are locally known as "Salkhala Formation" named after a Village on the left bank of Kishan Ganga River in the northwestern Kashmir. The Salkhala Formation comprises green schist, greenish-grey splintery slates, phyllites and flaggy quartzite and is generally unfossiliferous. These rocks are exposed all around the about 2-6 km in thickness.

b) Muth Quartzites: The snow white coloured succession of Muth Quartzites constitutes the lower part of the Upper Paleozoic sequence. These rocks are well exposed in the near Aishmukam,. The lower part of the Muth Quartzite consists of thinly bedded siliceous shale which is followed by a massive white amorphous quartzite with pink and ferruginous specks.

c) Syringothris limestone: The Syringothris limestone of Early Carboniferous age comprises limestone, quartzite and shale. These rocks outcrop at Aishmuqam. The most characteristic index fossil found in these stratigraphic units is "*Syringothris Cuspidate*". The other fossils reported from these rocks are *Chonetes, Productus,* and *Rhynchonella* . The thickness of this formation is about 300 m. The Syringothris Limestone is overlain by the "Fenestella Shale" of Middle Carboniferous age. These rocks comprise almost 600 m thick beds of quartzite and carbonaceous shale. These rocks are well exposed in the district Anantnag.

d) Agglomeratic slates: The Upper Carboniferous Period represents the close of marine environment of deposition and start of continental environments. This period witnessed an intensive phase of igneous activity. This igneous phase is represented in the stratigraphic strata by two volcanic divisions. The lower series consists of pyroclastic slates, conglomerate, sandstones, quartzites, with few bands of limestone known as "Agglomeratic slates". The rocks of Agglomeratic Slate have their basal contact with progressively older formations up to the 'Salkhala Slates' of the Precambrian, whereas on the eastern side, there is a gradual change from 'Fenestella Shale' to 'Agglomeratic Slate'.

e) Panjal Traps: The rocks of 'Agglomeratic Slate' appear to have been followed by intense magmatic activity as is indicated by numerous dikes and sills. These rocks are overlain by a thick series of bedded andesitic and basaltic traps called "Panjal Traps". The Panjal Traps are

formed by a succession of bedded basaltic flows. The geochemical study of the Panjal Traps reveals that these correspond to tholeiitic Continental Flood Basalts (CFB) originated from little evolved slightly enriched P-MORB-type magmas. The Panjal Traps show distinctive amygdaloidal structures and glomero-porphyritic texture. The vesicles are filled with calcite, chlorite and epidote minerals. Quartz veins are common and are confined to joints and fractures. The traps are intercalated with pyroclastic material and intertrappean beds. These rocks occupy steep slopes and the high peaks in the northwestern and southwestern side of the Kashmir Valley. The estimated thickness of the Panjal traps is about 1800-2400 m. These rocks are Upper Carboniferous to Lower Permian in age.

f) Zewan Formation: The Zewan Formation of Permian age overlies the Gangamopteris Beds with a sharp contact and comprises sandstones, sandy limestone, sandy shale, calcareous shales. The middle part of this sequence is characterized by rhythmic alteration of calcareous sandstone and arenaceous shale and has yielded specimens of *cyclolobus* walker and *xenaspi*. The upper part of Zewan Formation is mostly thick bedded sandy limestone with minor sandy shale, argillaceous sandstone and calcareous sandstone. This part of Zewan Formation includes fossils of *conodonts Neogondolella carinata, Hindeodus typicalis* and *Ellisonia triassica*. The estimated thickness of Zewan Formation is about 240m and is well exposed in Lidder Valley.

g) Limestone: The rocks of Zewan Formation are followed by widespread deposition of limestone. These rocks chiefly consist of about 2000 m thick succession of compact blue limestone, argillaceous and dolomitic limestone and shales. The fossil assemblage of these rocks is dominated by cephalopods, lamellibranches, brachiopods and gastropods of Triassic age. These rocks are followed by the series of limestone, sandstone and shale of Jurassic Period overlying the Upper Triassic rocks on the northeastern side of the Banihal pass in Pir-Panjal.

The geological materials from soils to sands and gravels, to rocks and minerals, to petroleum resources form the basis of modern society. Adequate supplies of minerals are essentially required for manufacturing, construction, energy requirements and agriculture and thus for the sustainable development of modern economy. All the minor and major minerals come from the lithology and rocks of the district and thus it becomes imperative to study and classify the rock units of a region more particularly with reference their mineral content. The location of mines and quarries fundamentally reflects the geology of the district Anantnag.

Nalla bajri, nalla-muck, boulders and sand are the main minor minerals found in the district These minerals are present as river bed material in Lidder, Kuthar, Bringi and Sandran streams and are utilized as construction material and road metal. About 96,150 metric tonnes of minor minerals were produced in the financial year 2015-16 and an amount of Rs 15.16 lac was realized as royalty on account of minor mineral extraction in the district. The locally available mineral resources of the district have played a significant role in the developmental activities of the region, source of employment for the local populace, raising the socio-economic profile of the region and revenue generation for the state exchequer.

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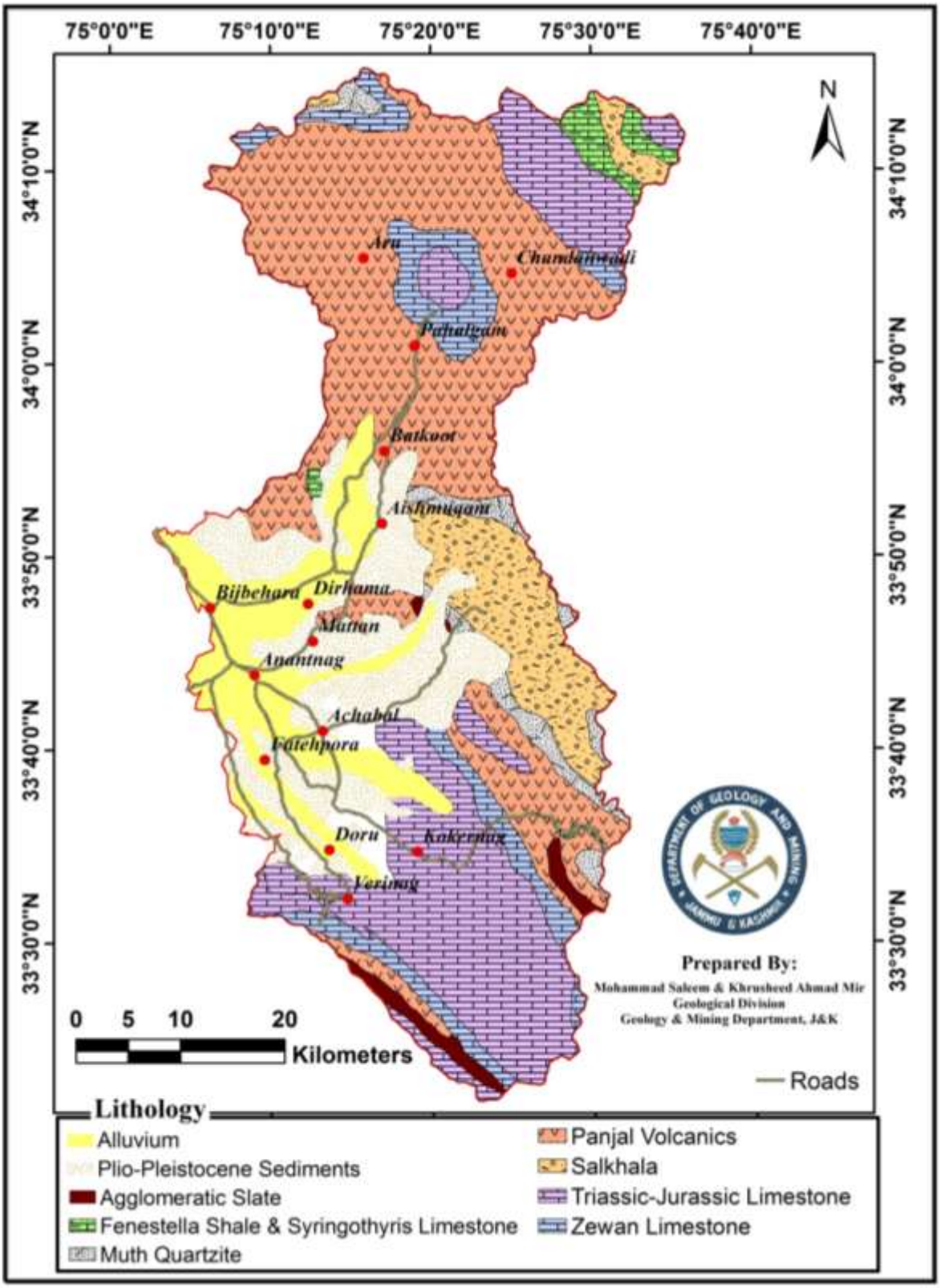

Figure 9: Geological map of Anantnag district

h) Drainage system with mineral potential of the district

Anantnag district is mainly drained by the four major streams such as, Liddar, Arapat/or Kuthar, Sandran and Bring. The drainage pattern of the district corresponds more or less to the topographical trend of the area. The Liddar is the main upland watershed of the district Anantnag covering an area of 1283 km^2. It is bestowed with abundant water resources in the form of glaciers, snow, lakes and springs. The watershed is one of a few catchments within the Jhelum basin with snow and permanent glaciers, which occupy about 3 % of the entire Liddar watershed. The Liddar watershed has 17 glaciers, which cover an area of about 40 km^2. Kolahoi and Sheshram are the two major glaciers with an area of about 10.2 and 8.5 km^2, respectively. The Liddar stream consists of two main arms, Eastern Liddar and Western Liddar originating from the Great Himalayan Range. East Liddar collects the snowmelt from the accumulated snow packs and permanent snow packs at higher altitudes as well as from Sheshram glaciers. The altitude of the Sheshram glacier is 4675m amsl. Whereas West Liddar takes melt water from Kolahoi glacier and winter accumulated snow and permanent snow packs at higher elevation. The altitude of the Kolahoi glacier is 5187 m amsl. West Lidder has a catchment area of 350.6 km2, which constitute about 28% of the total catchment area of river Lidder . At Pahalgam both the tributaries join each other and form a mighty Liddar stream. The Bringi stream drains over a wide area in the Pir Panjal range. It is formed by the confluence of two streams which include East Bringi and West Bringi. Both these stream meet each other above village Wangom. Then the Liddar main stream joins Jhelum at Gur Village after travelling a course of 70 km. Similarly, Arapat (Kuthar) stream drains through Kuthar valley within the Great Himalayan slopes of eastern Valley. It flows rapidly upto Chatrugul and then becomes slow. It merges with the Bringi stream below Chakilyur. The drainage pattern of all these streams is dendritic and from their head waters all the streams are fed by large number of small tributaries. During summer months, the flow of water is the maximum in the streams. These streams in their upper reaches or when flowing through harder formations form narrow V-shaped valleys. In the lower reaches or when flowing through softer formations, these form rather U shaped valley. All these stream, particularly Liddar stream transports a huge debris and contributes significant quantity of water to the mighty River Jhelum draining whole Kashmir Valley.

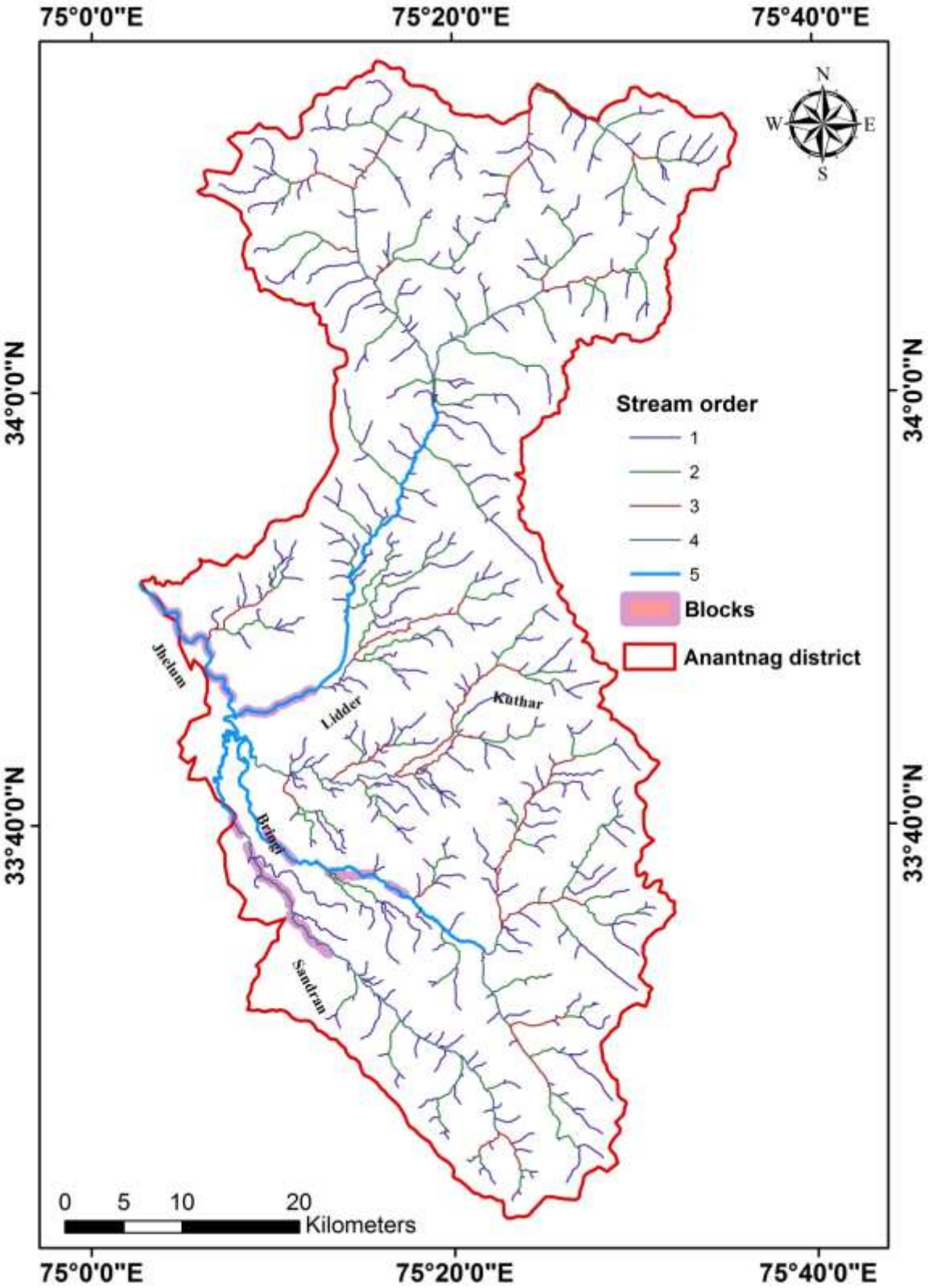

Figure 10: Drainage map of district Anantnag with proposed mineral blocks

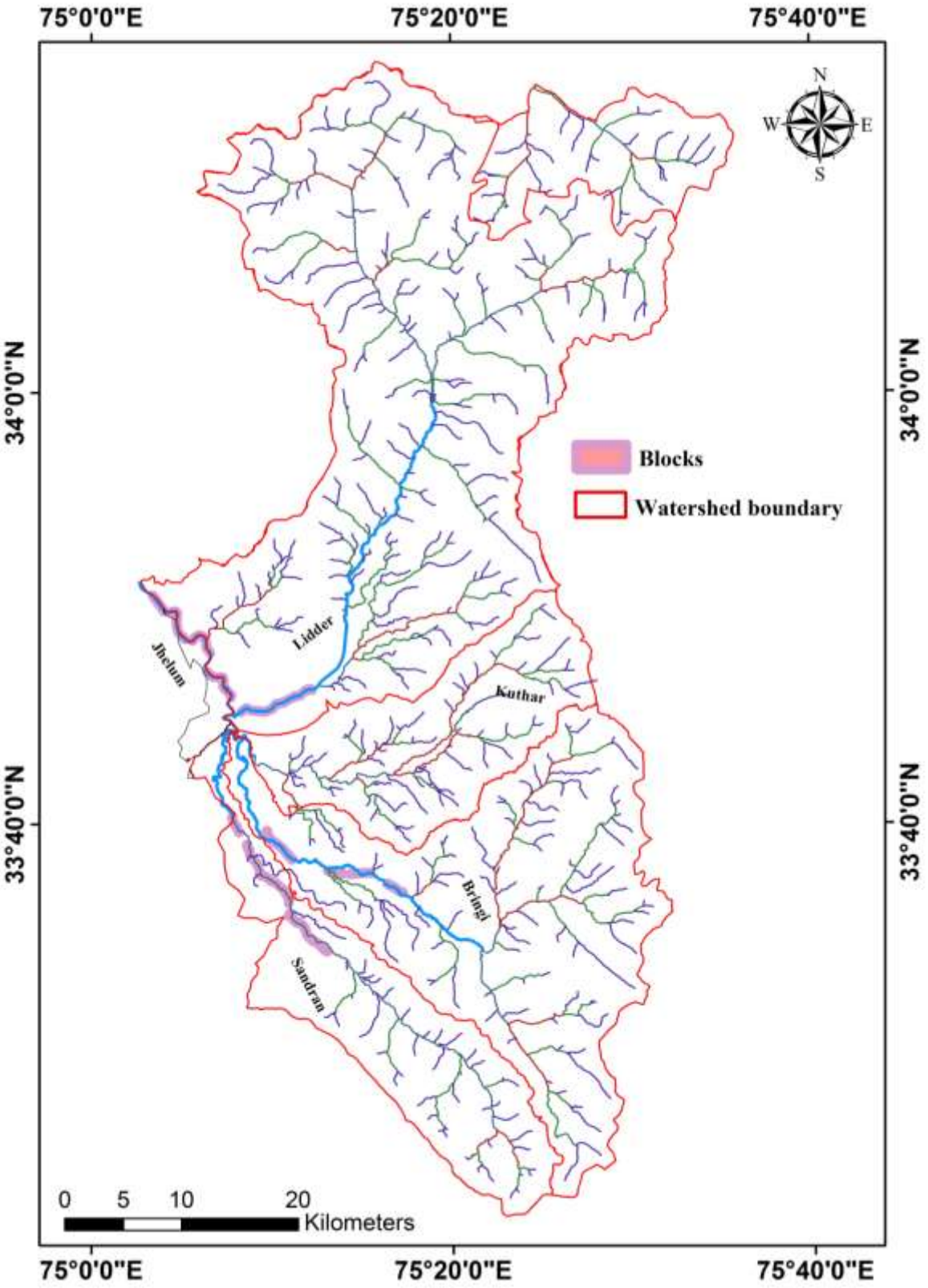

Figure 11: Drainage map with sub-watershed boundary of district Anantnag

Table 7: Drainage system with description of main rivers

S. No.	Name of Stream/River	Area drained (Km^2)	% area drained in the district
1	Lidder	1283	46
2	Bringi	669.6	24.2
3	Kuthar	307.8	11
4	Sandran	483.7	17.5

S. No.	Name of Stream/River	Total length in the district (Km)	Place of origin	Altitude of origin
1	West Lidder	1^{st} order =110.7	Kolahoi Glacier	5187 m amsl
		2^{nd} order =51.6		
		3^{rd}order =18.5		
		4^{th} order =17		
2	East Lidder	1 order =38.7	Shesram Glacier and Sheshnag Lake	4675 m amsl
		2 order =42.6		
		3 order =10.2		
		4 order =14.3		
3	Bringi	1 order = 197.4	Snow melt and small lakes	430 m amsl
		2 order = 89.0		
		3 order = 39.7		
		4 order = 9.6		
		5 order = 29.2		
4	Kuthar	1 order = 104.4	Snow melt	4000 m amsl
		2 order = 41.8		
		3 order = 39.1		
		4 order = 15.7		
5	Sandran	1^{st} order =83.9	Snow melt	4020 m amsl
		2^{nd} order =34.3		
		3^{rd} order =6.5		
		4^{th} order =38.2		

Lidder: It is formed by the confluence of two mountain torrents at Phalgam. The two streams, which come from north east and north, are known as the west and east Lidder. East Lidder has its source from the Sheshnag glacier on the southern slopes in the Mahagunus mountains. From Sheshnag to Pahalgam it is joined by numerous rills and looses almost 1400 m of altitude. The the west Lidder originates from Kolhai glacier in Goshbrari mountains of Pahalgam tehsil. The united waters of these two streams below Pahalgam flows through a narrow valley known by Lidder. It joins the Jhelum river at Gur village of Anantnag tehsil.

Table 8: Showing mineral potential of Lidder stream

Boulder (MT)	Bajri (MT)	Sand (MT)	Nallah Mukh (MT)	Total Minable Mineral Potential (MT)
425829.6	405552	Nil	387302.16	1218683.7

Bringi*: It* is the other Himalayan tributary received by Jhelum. The stream flow in north-westerly direction and is joined by the waters of Kokenag at village Hillar in Anantnag tehsil from the village Vailu in Doru two more streams join with it. It has a length of 35 miles.

Table 9: Showing mineral potential of Bringi stream

Boulder (MT)	Bajri (MT)	Sand (MT)	Nallah Mukh (MT)	Total Minable Mineral Potential (MT)
789390	751800	Nil	717969	2259159

Arapat or Kuthar: The stream takes its rise in the Hairbal Ki Galli in Anantnag tehsil and flows in the south-westerly direction through Pargana village. It has a length of 23 km and joins Bringi stream at village near Danter.

Sandran: It is the southern most Himalayan tributary that meets in close neighbourhood of Nand Marg pass below Kaukot peak in Anantnag tonsil. It flows in north westerly direction and receives the affluent of Chiwar Nar, Shal-Kul at Rishipora, Haroar at Chogund village and the water of Verinag spring at Duru. Saddran has a total catchment area of 484 km^2 and measures a length of 53 km from its source to its mouth.

Table 10: Showing mineral potential of Sandran stream

Boulder (MT)	Bajri (MT)	Sand (MT)	Nallah Mukh (MT)	Total Minable Mineral Potential (MT)
808617.6	770112	Nil	735456.96	2314186.56

4. Jhelum: The Jhelum is the main waterway of the Kashmir valley. It originates from the spring Verinag situated in Doru tehsil of Anantnag district at an altitude of 1900 m amsl. It flows towards west through the Kashmir Valley. In Anantnag tehsil where the water of

Sandran and Bring streams from southeast and Arapat stream from northeast join with the nallah and thereafter the Jhelum take the shape of a river. Below Bijbehara near Sangam the river is joined by Vishu and Rambiara streams.

Table 11: Salient features of the Jhelum River

Name of Stream/River	Total length in the district (Km)	Place of origin	Altitude of origin
Jhelum	38	Verinag Spring	1900 m amsl

Table 12: Showing mineral potential of Jhelum river

Boulder (MT)	Bajri (MT)	Sand (MT)	Nallah Mukh (MT)	Total Minable Mineral Potential (MT)
Nil	Nil	921060	Nil	921060

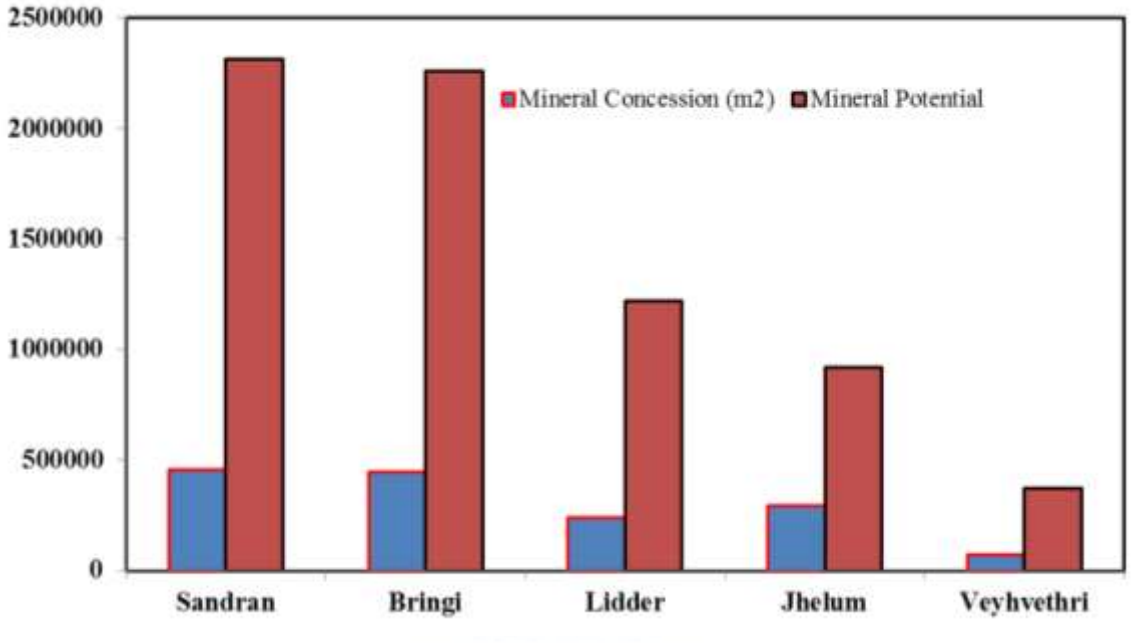

Figure 12: Mineral concession area (m^2) and total mineral potential (MT) of different rivers/streams of the district