GROUND WATER INFORMATION BOOKLET
OF
KARGIL DISTRICT
JAMMU & KASHMIR STATE

NORTH WESTERN HIMALAYAN REGION

CENTRAL GROUND WATER BOARD

JAMMU

GROUND WATER INFORMATION BOOKLET
OF
KARGIL DISTRICT, JAMMU & KASHMIR

CONTENTS

KARGIL DISTRICT AT A GLANCE

S. No	ITEMS	Statistics
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	14036
	ii) Administrative Divisions (2001) • Number of Tehsil & Sub-tehsils • Number of CD Blocks (2009-10) • Number of Panchayats (2009-10) • Number of Villages • Number of Inhabited Villages	 2 9 95 129 127
	iii) Population (2001 Census) • Total population • Population Density (persons/sq km) • Rural & Urban Population • Muslim & Others Population (in percent) • Sex Ratio	 1,19,307 persons 8 10,8650 & 10657 80 % & 20% 06
	iv) Average Annual Precipitation in the form of snow fall (mm)	150 mm
2.	GEOMORPHOLOGY	
	Major Physiographic units	• High table lands of U-Shape valleys developed by glacier erosion and deposition • Sharp ridges of hard rock • Intervening valleys & River Terraces • Valley fill deposits and scree and talus
	Altitude Range	5934 to 8510 m AMSL
	Major Drainages • Indus Basin	Suru and Drass rivers are the major rivers flowing in this district, Doda nala and Zanskar rivers are other major rivers draining the district
3.	LAND USE (2009-10)	
	• Forest area • Net Irrigated area • Area under food grains • Fruits and Vegetables • Total Food Crops	700Ha 9876 Ha 6727 Ha 362 Ha 7170 Ha

S. No	ITEMS	Statistics
4.	MAJOR SOIL TYPES	Sandy soil
5.	IRRIGATION BY DIFFERENT SOURCES (MI census 2009-10) (sq km) • Canals • Other sources	 9876ha 165
6.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.3.2007) • No. of Dug Wells • No. of Piezometers	 Nil Nil
7.	PREDOMINANT GEOLOGICAL FORMATIONS	Biotite gneiss, garnetiferous mica shists, phyllites of Pre-cambrian Salkala group, Shale and limestones of Permo-traissic formations, Drass volcanics, Indus formation and Granitoid formations
8.	HYDROGEOLOGY	
	Major Water Bearing Formations	
	1. Consolidated Formations/ Hard Rocks	
	• Yield prospects • GW structures	Low yield -100 to 150 lpm Handpumps and Tubewells at hydrogeologically suitable locations
	2. Unconsolidated layered formationsGravel, boulders, talus, scree material, moraine deposits in terraces and U-shaped valleys	
	• Yield prospects • GW structures	Moderate yields(300-500 lpm) Deep tube wells and Hand pumps
	3.Unconsolidated porous sediments (Alluvium) adjacent to major river (Valley fill deposits)	Moderate yields-500-600 lpm Handpumps, dugwells and tube wells
	4. Avg. Depth to water level	In Valley fill deposits adjacent to rivers water level is very shallow ranging from 5.00 to 10.00 m bgl and in Terraces and moraine deposits in higher elevations, depth to water level is deep reaching to 60 to 70 m bgl.
9	GROUND WATER EXPLORATION BY CGWB (As on 31.12.2008)	
	• No of wells drilled	1 EW
	• Depth Range (m)	86.00
	• Discharge (lps)	Meagre discharge

10.	GROUND WATER QUALITY	EC=60 to 700 ms/cm F=0.07 to 1.63 mg/lt NO3=3.2 to 40 mg/lt Iodine=0.275 to 1.22 micrograms/lt
	Presence of Chemical constituents more than permissible limits EC, F, As, Fe)	Sankoo village, Fluoride content is more than the permissible limits of 1.5 mg/l
11.	DYNAMIC GROUND WATER RESOURCES	Being hilly district, ground water resources are not estimated
12.	AWARENESS AND TRAINING ACTIVITY	
	Mass Awareness Programmes	Nil
	Water Management Training Programmes	Nil.
13.	EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING	
	Snow Water Harvesting	CGWB has prepared technical report for snow water harvesting in four watersheds- 1. Watershed located south of Air Force Station 2. Munjigund watershed 3. Cheskar watershed 4. Lalu-Lungpa watershed
14.	GROUND WATER CONTROL AND REGULATION	
	Number of OE Blocks	Nil
	No of Critical Blocks	Nil
	No of blocks notified	Nil
15.	MAJOR GROUND WATER PROBLEMS AND ISSUES	
	1. Presence of loose and collapsing bouldery formation causing difficulties in drilling tube wells	
	2. Deep water levels in talus scree and moraine deposits	
	3. High hydraulic gradient resulting rapid outflow of ground water from the area and causing hardship during dry season of August to November	

GROUND WATER INFORMATION BOOKLET
OF
KARGIL DISTRICT, JAMMU & KASHMIR

1.0 INTRODUCTION

Kargil district with headquarters at Kargil town lies between the northern latitude $75^0$45' to $76^0$30'and East longitude $34^0$15' to $34^0$47'30". Kargil district is bounded by Leh on north eastern side, Line Of Control in the north and Anantnag, Baramulla, Srinagar and Doda districts on South Western side. Suru, Zanskar, Drass Shamker Chikar, Wakna, Laws and Indus are some of the valleys of this district. District Headquarter, Kargil is approachable by National Highway NH-1A, from Srinagar at a distance of 204 kms. The area is accessible by road during May to October and under the snow cover during the rest of the period.

Kargil district has a total geographical area of 14,036 sq km, comprising of 129 villages (127 inhabitant villages and 2 un-inhabitant villages). Administratively, the district is divided into 2 *tehsils* (Kargil and Zanskar), 09 CD blocks (Kargil, Shaker, Drass, Sankoo, Zanskar, Shargole, Taisuru, G.M. Pur, and Cha development blocks) and 65 Village Panchayats. As the area of the district is mountainous with difficult terrain, the normal concept of a village as a contiguous and compact habitation does not apply in Kargil district. Here a number of families have settled down here and there depending upon land availability and irrigation facility.

As per 2001 census, the district has a population of 1,19,307 persons, with density of population 9 persons per Sq. Km. Kargil is one of the sparsely populated district in India and settlement pattern is just along the river valleys and few broad valleys formed as terraces in Great Himalayan ranges due to erosional activities of glaciers. The male and female population in the district is 64955 and 54352 persons respectively with a male/female sex ratio of 836. The schedule caste population in the district is 139 persons i.e 1.16% of the total population and Scheduled Tribe population is nil in this district. During 1991-2001 population growth was recorded as 36.89%. The decadal population growth rate during 1961-71 was 18.88%, during 1971-81 was 23.58 and during 1981-91 was 32.89%. It is observed that there is a steady increase in population growth in this district since independence.

The main source of Irrigation is canals and an area of 9709 hectares is brought under irrigation by canals, tanks, wells and 53 hectares are irrigated by other sources. 1472 ha of wheat crop area, 5255 ha of other cereals, pulses and millets, 329 ha of other food crops and 3517 ha of non-food crops are irrigated by different sources.

Central Ground Water Board has carried out extensive hydro-geological studies under Ground Water Management Studies. A special study was also carried out to harness snow water at suitable locations of Kargil mountain ranges. CGWB has constructed one exploratory deep tubewell in Khumbathang cantt under the ground water exploration programme after selecting a suitable site based on detailed surface geophysical electrical surveys. Time to time CGWB has carried out hydrogeological investigations in number of defence establishments in this district and recommended suitable areas for ground water development.

2.0 CLIMATE AND RAINFALL

Kargil lies on the rain shadow side of the Himalayan where dry monsoon winds reaches Kargil after being robbed of its moisture in plains and the Himalayan mountain. The district combines the condition of both arctic and desert climate. Rainfall in the area is negligible. Heavy snowfall is experienced in winter. In winter mercury drops to minus 48 degree Celsius at Drass (Kargil), which is the second coldest inhabited place in the world after Siberia. The main features of the climate are:

- Wide diurnal and seasonal fluctuations in temperature with -48° C in Winter and +35° C in Summer.
- Precipitation is very low with annual precipitation of 15 cm mainly in the form of snow
- Another important climatic factor is wind factor in this district where winds are very strong with velocity of wind ranging between 3 km / hour to 20 km / hour during November to April and 18 to 35 km /hour during May to October respectively. Wind velocity is preferably low during winter. In Kargil area surface wind flowing in the direction between WNW to NNW made the condition on the northern slopes of mountain conducive for accumulation of large quantity of snow.
- Average relative humidity in Kargil district is between 29% to 73%. Maximum percentage of relative humidity available in the air between December to May and minimum value correspond to June to October. Low temperature as well as high relative humidity prevails during November to March favour heavy snowfall over the entire area as a form of precipitation.
- The villages situated on the banks of Indus and on the Sangham of Suru and Drass rivers are very warm and fine.

3.0 GEOMORPHOLOGY AND SOILS

Kargil district is a mountainous desert. The topography of the district is mountainous with little or no vegetation. The mountains are of sedimentary rocks and are in process of disintegration due to weathering. This district is separated from the rest of the State by high mountains which are crossed through passes at various points. The District is divided into four high level natural Valleys namely the Suru Valley, the Drass Valley, the Indus Valley and the Upper Sindh Valley of Kanji Nallah Valley. Zojila and Fotulla passes situated at the height of 3567 and 4192 meters above the sea level are called gateways for Kashmir Valley and Leh District for entry in Kargil District. High peaks of Namikala and Penzila are called the sky pillars of the District. The terrain being hilly, available land for agriculture is meagre. General elevation ranges between 5934 meters to 8510 m AMSL. In Zanskar ranges, permanent glacial body is existing because of higher elevation of these ranges. Deep gorges and valleys are being formed due to rapid flows of rivers in the district. Almost all the rivers are flowing through deep valleys. The important major rivers draining the Kargil district are Drass, Suru, Zanskar and Indus. Width of these valleys range between less than a kilometer to around one kilometer around Salskot. Suru valley constitutes a major part of the Kargil district, which is surrounded by hills of soft mixture of clay and sand stone. Suru valley has comparatively at lower altitude and most of the villages are located in this valley only. This valley is comparatively warmer and favorable for cultivation.

The summer being short, only one crop of local gram or wheat is grown. The soil of the district is sandy to loamy in nature and deficient in organic matter and availability of phosphorus and potashes low and mixed with stones and gravels. It is shallow in formation, weak friable and being sandy it is vulnerable to all types of erosion. Soils developed on river terraces highly porous and coarse grained in nature. Fertility of the soil varies from place to place and growing season is very short. The district has some deposits of chromed at Drass and around it. Copper is also found in Lungnak valley, Zanskar and Tai-Suru. Besides, deposits like lime stone, marble and building material also exist. However, these mineral resources are yet to be exploited.

4.0 GROUND WATER SCENARIO

4.1 GEOLOGY

Geology of Kargil district is complicated due to its severe collision of Indian plate with Eurasia plate resulting into elimination of most of the geological records. Undifferentiated Central Crystalline rocks (Lioned / Kilar formations) are the oldest rocks exposed in the district. These are mainly Garnetiferous mica-schists, Kyanite schists with thin bands of quartzite and marble. These crystalline rocks are overlain by a thick belt of sedimentary rocks designated as Phe formation of upper proterozoic age. They comprised of silt stone/arenite, black pyritous and carbonaceous shale with limestone bands. The Phe formation is directly overlapped by a thin strip of basic volcanic rocks of lower permean age designated as Ralakung volcanics which are homotaxially correlatable with Panjal volcanics of Kashmir. Lilang group of rocks of Perma-triassic age comprising grey splintery shales and thick sequence of inter-bedded ferruginous limestones with Cephalopods overlie the Ralakung volcanic formations. Cretaceous volcanics known as Drass volcanics are intrusive ultrabasic rocks consisting of succession of volcanic, pyroclastic, volcano-clastic sediments with Gabbro and Doleite dykes. Isolated serpentinite lenses are also present. It is thrust over the molasses or the Indus formations in the northern part. Along its southern contact Drass formation thrusts over, by the different units, which include Mesozoics of the Zanskar, super group. Drass formation is well developed around Drass, Fashkyum and surrounding areas without crops reaching upto 15.5 km.

The Indus Suture Zone which forms northern part of the district is characterized by the presence of ophiolite mélange tectonically mixed with other rocks which are highly deformed marine sediments of Cretaceous-Eocene age. North of Indus suture zone is exposed by the rocks of Indus formation which is a sedimentary belt of a thickness of over 5000 mtrs extending NW-SE for more than 5000 km located between the Ladakh Plutonic complex in the North and the ophiolite melange in the South. Indus formation consists of a thickly inter-bedded succession of predominantly conglomerate sandstone, siltstone and shale together with sub-ordinate calcareous shale and limestone.

4.2 Hydrogeology

The district is underlain by consolidated formation in maximum part. Ground water in these formations occur in fissures and fractures developed due to repeated tectonic activities. Large scale ground water development is not possible in consolidated formations but limited development of ground water resources can be taken up. As the settlement pattern of people in this district mainly concentrated in the river valleys and few broad valleys formed due to erosional activity of glaciers, ground water development in these areas is of utmost importance. The unconsolidated formations like alluvium, scree and talus formations present along the river valleys play vital role in terms of occurrence and movement of ground water. Ground water resources of these formations can also be developed on sustainable basis These moraine formations (Talus and scree formations) consists of boulders and clasts in a matrix of sand, silt, clay and gravel. The aquifer is made up of boulders and clastic material in clay, silt and sand matrix. Depth to water levels in moraine formations is very deep and varies between 60 to 75 m bgl. The valley fill deposits are mainly boulders and gravel mixed with silt and sand material. This is mainly transported material lying un-sorted in the recent river valleys. Ground water occurs as un-confined condition in this formation. Depth to ground water is in continuous with river water table and is very shallow to as deep as about 25 m bgl. Kargil town is located in terraces formed due to previous glaciation and is underlain by morain succession consisting of gravel, sand and clay alternate layers. Thickness of this succession is not known. Depth to water level is also very deep in this area. Only few springs are present which are basically formed due to cutting of water table with land surface. These are the only source of drinking water supply in Kargil town. Recently Army authorities have constructed shallow tubewells adjacent to Suru river to mitigate the water supply problems. State PHE department also constructed a number of hand pumps in Kargil district, which are yielding fresh water throughout the year. Thus, recently ground water development through construction of tubewells and handpumps is taking place for meeting the water requirements of general public as wells as troops present in this district.

4.3 Springs:

These are the major source of water supply for drinking and irrigational requirements. The detailed study of origin and discharges of 33 springs were studied. Out of 33 springs 17 nos. were structural controlled originating from the fractures and joints existing in the lithology of various geological formation and remaining were either from contact of two rock units or gravity. Discharge of water yielded by these springs ranges between 0.06 lps in Chhutumel village and highest of 7.5 lps in Kargil (1 km of Kargil). By and large spring situated on hard rock granatoid shows an average discharge of 4.4 lps and which situated on volcanic rocks (Drass Volcanics) shows average discharge 1.939 lps whereas sedimentary rocks (Kargil formation) exhibit an average of 0.8490 lps. The springs which are perennial in nature are generally snow fed, and their recharge area lies in higher reaches of mountain.

4.4 Ground Water Resources

The district is predominantly hilly terrain, ground water resources cannot be estimated and quantified. Ground water development through construction of tube wells and hand pumps is very much possible in this district. Till date ground water development in this district is in nascent stage. People mainly dependant on surface water sources and springs for meeting water supply requirements. Thus the stage of ground water development is very minimum. PHE department has constructed about 700 hand pumps in different habitats and villages from 2001 to 2008. There are about 52 dug wells constructed by PHE department. There are a number of tube wells constructed mainly by army authorities are working which are mainly tapping valley fill deposits and morain deposits. The discharge of these tube wells ranges from about 900 to 1200 lpm. The depth of these tube wells is in general less than 90 m bgl.

4.5 Ground Water Quality

CGWB has carried out scientific ground water management studies in Kargil district and collected ground water samples from hand pumps, dug wells and springs. The range of chemical parameters in the district is summarized below.

Table-2: Chemical quality of ground water

Sl.No	*Parameter*		*Range*	
			Min	Max
1	pH		7.15	7.47
2	EC	µS/cm	175	700
3	HCO_3	mg/l	79	201
4	Cl	mg/l	3.5	11
5	NO_3	mg/l	Tr	9.61
6	F	mg/l	Tr	0.23
7	Ca	mg/l	26	80
8	Mg	mg/l	2.4	34
9	Na	mg/l	0.7	14
10	K	mg/l	0.1	3.8
11	TH as $CaCO_3$	mg/l	90	340
12	Iodine	Micro-grams/lt	0.275	1.22

From chemical quality point of view, ground water in the area is fresh and potable with electrical conductivity (EC) generally less than 700 µS/cm at 25°C. One of the trace element Iodine studies have been carried out which shows that the concentration of iodine is much less than the permissible limits.

4.6 Status Of Ground Water Development

Ground water development in the district is on moderate scale restricted to the valley portions. All the major irrigation and drinking water supplies depend on natural springs, rivers and nalas. Recently PHE department constructed handpumps in villages to mitigate the drinking water problems. Public Health Engineering and Irrigation and Flood control departments are the nodal agencies in the district concerned with the water supplies for drinking and irrigation respectively. The depth of the hand pumps is about 60 to 70 m bgl. Few tube wells tapping valley fill deposits are also present in this district which is being used mainly for domestic water requirements. Central Ground Water Board has explored valley fill deposits of Khumbathang cantt area by constructing one exploratory tubewell. The total depth of this tubewell is 86.00 m bgl. The zones encountered are 63.00 to 71.00 m and 78.00 to 84.00 m bgl.

5. GROUND WATER MANAEMENT STRATAGY

5.1 Ground Water Development

Most of the district is concentrated in valley portion drained by major river Indus and its tributaries. In the past development of ground water was mainly through dug wells and percolation wells along the riverbeds, nallas and also some springs has played a major role for sustainable domestic and irrigational purposes. In some of the areas, at present too these are the only sources of water. However, in recent years modern means of ground water development have been employed. Public Health Engineering has been constructing number of hand pumps and shallow-moderate depth tube wells for large-scale water supplies.

5.2 Snow Harvesting and Artificial Recharge

Snow water harvesting is a technique of preservation of snow and delaying the melting so that snow melt water is available for longer duration in a year. Selection of sites for snow harvesting shall depend on Insolation of an area, wind direction, wind velocity and Relative Humidity. CGWB inventoried few of the sites where snow harvesting can be taken up. These are:

1. Catchment located South of Air-Force Station- Total area is 57750 Sq. m and can harvest 8662 Cu.m of snow.
2. Munjigund catchment: Total catchment area is 27550 Sq.m and can harvest 5167 Cu.mt of snow.
3. Cheskar catchment: Total area is 42600 Sq.m and can harvest 6390 cu.m of snow.
4. Lalu-Lungpa catchment: Total Catchment area is 43600 m^2 and can harvest about 6540 Cu.m of snow.

In the hilly areas roof top rainwater harvesting structures like storage tanks are recommended while in low hill ranges, check dams and snow water harvesting structure can be adapted. These structures were already constructed by local people on their own initiation and at some places government of Jammu and Kashmir has constructed few snow water harvesting structures.

6.0 GROUND WATER RELATED ISSUES AND PROBLEMS

Because of global climatic changes, springs which are traditional sources of water supply for villages and habitats are getting dried up and causing hard ship to the people. Moreover, it is also being reported that the snow fall during winter period is also reduced. To mitigate the water supply crisis, hand pumps and tubewells can be constructed at suitable locations by deploying the suitable rig units like DTH rig unit or percussion rig units. To avoid failure of tubewells, before selecting the sites, surface geophysical surveys should be carried out while constructing deep tubewells. Valley fill deposits and moraine deposits are highly productive zones for construction of tubewells, shallow as well as deep tubewells can be constructed for water supply.

7.0 AWARENESS AND TRAINING ACTIVITY

So far neither Mass Awareness Programme (MAP) nor Water Management Training Programme (WMTP) is conducted by CGWB.

8.0 AREAS NOTIFIED BY CGWA/SGWA

As the district is hilly in nature, quantification of ground water resources is not possible. But at present the development of ground water resources is very meagre and ground water resources of valley fill deposits and moraine deposits of terraces can be developed. On terraces, proper recharge structures like check dams and nala bunds can also be constructed to avoid over-exploitation of ground water resources at local level. Till date no area or block has been notified for ground water development.

9.0 RECOMMENDATIONS

- In Valley areas, like Suru valley, Drass valley and Indus valley, ground water resources can be developed by constructing infiltration galleries (Percolation wells) and dugwells. Shallow tubewells can also be constructed by deploying the percussion rig units or DTH rig units.

- In hilly terrain, springs and perennial nallahs are the major sources of water. These springs shall be developed based on modern scientific knowledge base and their sources need to be protected.

- On terraces which are underlain by moraine formations, deep tubewells of depth about 150 m is recommended to be constructed for water supply. Hand pumps of depth about 70 to 80 m are also recommended in small hamlets to meet the water supply requirements.

- It is observed that irrigation channels which are carrying irrigation water from higher reaches need to be maintained properly and if require cemented properly so that the water can be transported to longer distances. Along the channels, small ponds can be constructed at suitable locations so that water can be stored in these ponds which can also act as recharge structures for the terraces present at lower depths.

- Monitoring of springs both the discharges and quality shall be taken up regularly. Scientific studies shall be taken up to study the source and recahrge characters of springs in this district.

- Traditional resources like springs needs to be revived, developed & protected on scientific lines for various use. All the springs shall be enumerated and listed properly and data shall be properly maintained. The discharge of such springs can be sustained by construction of small check dams or subsurface dykes across the nallahs/tributaries in the downstream at favourable locations.

- Small ponds/tanks can be utilized for recharging ground water. These structures can be constructed for harvesting water and utilized for both recharging and meeting the domestic needs.

- Roof top rainwater harvesting practices must be adopted in hilly areas since the district receives precipitation in the form of snow and rain.

PLATE - I

INDEX MAP OF KARGIL DISTRICT

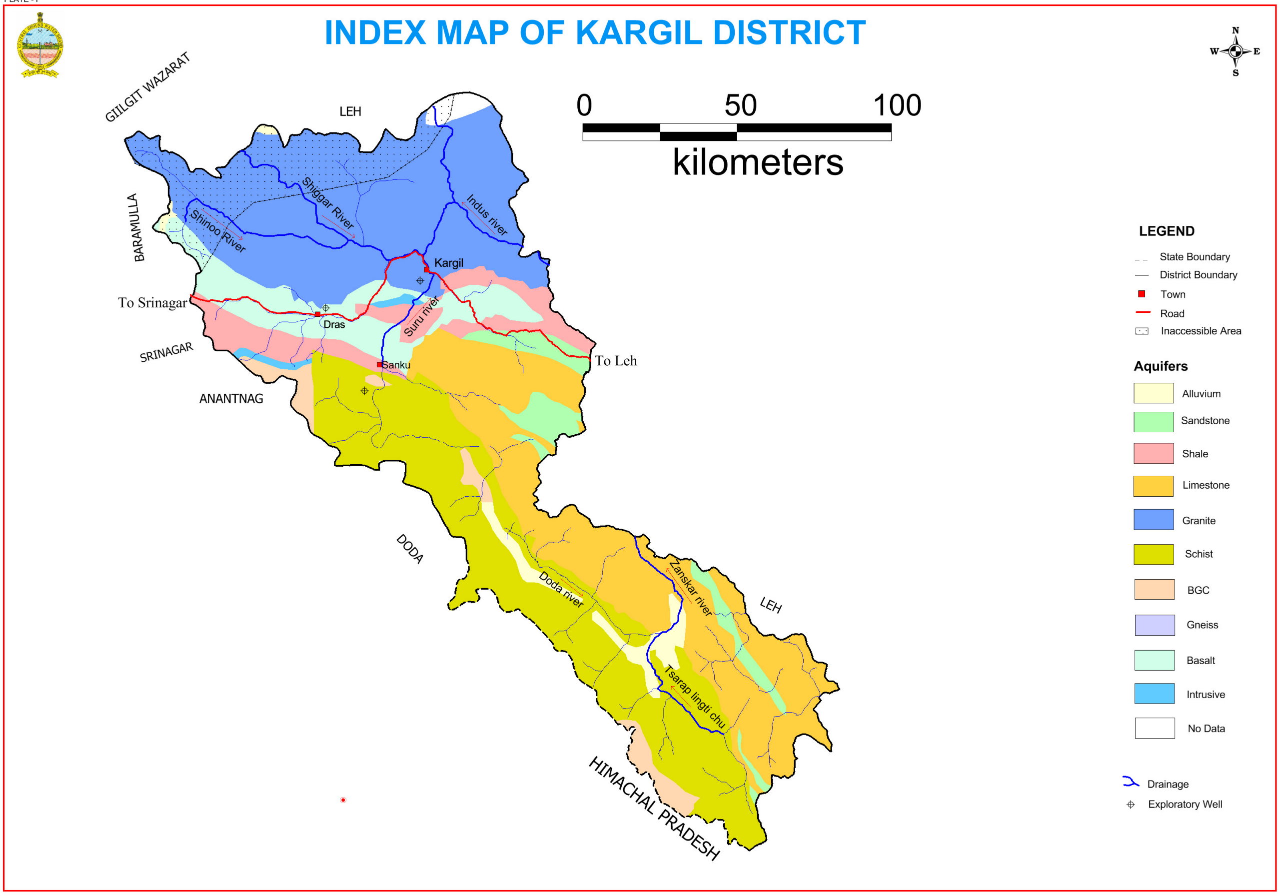
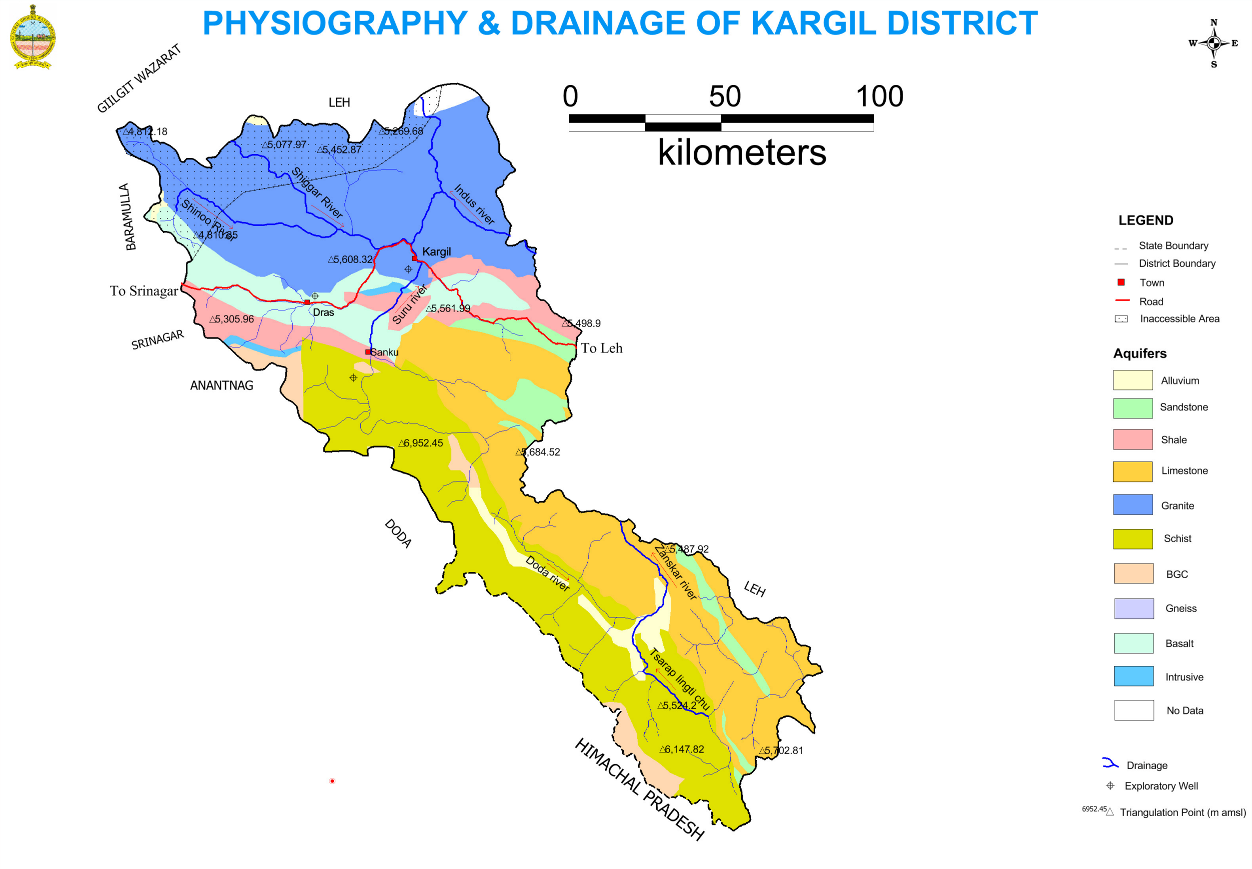


PLATE - II

PHYSIOGRAPHY & DRAINAGE OF KARGIL DISTRICT



GROUND WATER INFORMATION BOOKLET
OF KARGIL DISTRICT
JAMMU & KASHMIR STATE

CONTRIBUTORS

The Ground Water Information Booklet in respects of Kargil District of J & K State has been compiled by Dr.R.K.Prasad, Scientist – 'B'(HM) under the supervision & guidance of Sh.Manoj Shrivastava, Regional Director, NWHR, Jammu and under the overall direction of the Chairman and Member (SAM), Central Ground Water Board, CHQ, Faridabad.

Various scientific officers and staff of the NWHR, Jammu have generated information and provided assistance in compiling the data and preparation of maps.