Government of India
Ministry of Water Resources

GROUND WATER INFORMATION BOOKLET
KINNAUR DISTRICT, HIMACHAL PRADESH

CENTRAL GROUND WATER BOARD

NORTHERN HIMALAYAN REGION

DHARMSALA

2008

जल वर्ष 2007 Water Year 2007

स्वच्छ सुरक्षित जल – सुन्दर खुशहाल कल

CONSERVE WATER - SAVE LIFE

Contributors

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Our Vision
Water security through sound management

GROUND WATER INFORMATION BOOKLET
KINNAUR DISTRICT, HIMACHAL PRADESH

C O N T E N T S

KINNAUR DISTRICT AT A GLANCE

S. No	ITEMS	Statistics
1.	GENERAL INFORMATION	
	Geographical area (sq km)	6401
	ii) Administrative Divisions (2001) • Number of Tehsil & Sub-tehsils • Number of Blocks • Number of Panchayats • Number of Villages	 5 & 1 3 65 660
	iii) Population (2001 Census) • Total population • Population Density (per/sq km) • Rural & Urban Population (in percent) • SC & ST Population (in percent) • Sex Ratio	 78,334 12 100 & 0 9 & 71 857
	iv) Average Annual Rainfall (mm)	816
2.	GEOMORPHOLOGY	
	Major Physiographic units	• High Hill Ranges • Valleys
	General Altitude Range (m amsl)	1500 to >6000
	Major Drainages • Satluj Basin • Ganga Basin	 Baspa River, Spiti River, Bhaba River. Chor Khad.
3.	LAND USE (2003-04) sq.km • Forest area • Cultivated Area • Net area sown	 376 93 75
4.	MAJOR SOIL TYPES	• Mountainous Soil • Sub-Mountainous Soil
5.	AREA UNDER PRINCIPAL CROPS (2003-04) sq.km • Pulses • Barley • Wheat • Maize	 19.73 11.87 3.61 2.64

6.	IRRIGATION BY DIFFERENT SOURCES (MI census 2000-02) (sq km)	
		No/Scheme *Area (sq km)*
	Dug wells & shallow TW	Nil Nil
	Surface Flow Irrigation Schemes	235 77.86
	Surface Lift Irrigation Schemes	Nil Nil
	Tanks	Nil Nil
7.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (as on 31.3.2008)	
	• No. of Dug Wells	Nil
	• No. of Piezometers	Nil
8.	PREDOMINANT GEOLOGICAL FORMATIONS	1. Alluvium 2. Older Crystalline 3. Sedimentary & Metamorphic rocks
9.	HYDROGEOLOGY	
	Major Water Bearing Formations	
	1. Consolidated sediments / Hard Rocks (Older crystalline & Metamorphics)	Covering major part
	• Yield prospects • GW structures	Low (<5 lps) Hand pumps & Springs
	2. Unconsolidated / Semi-consolidated sediments	Valley areas
	• Yield prospects • GW structures	Moderate to High (5-15 lps) Hand pumps & Springs
	Avg. Depth to water level (shallow bore well)	10-30 m bgl
10.	GROUND WATER EXPLORATION BY CGWB (As on 31.3.2007)	
	• No of wells drilled	Nil
	• Depth Range (m)	-
	• Discharge (lps)	-
	• Transmissivity (m^2/day)	-
	• Storativity	-
11.	GROUND WATER QUALITY	
	Presence of Chemical constituents more than permissible limits (EC, F, As, Fe)	Nil
12.	DYNAMIC GROUND WATER RESOURCES (2004)	Not estimated due to localized aquifers.

13.	AWARENESS AND TRAINING ACTIVITY	
	Mass Awareness Programmes	Nil
	Water Management Training Programmes	Nil
14.	EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING	Nil
15.	GROUND WATER CONTROL AND REGULATION	
	Number of Over Exploited Blocks	Nil
	No of Critical Blocks	Nil
	No of blocks notified	Nil
15.	MAJOR GROUND WATER PROBLEMS AND ISSUES	1.Water scarcity in low rainfall area. 2. Effects of various hydroelectric projects on traditional sources.

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KINNAUR DISTRICT, HIMACHAL PRADESH

1.0 Introduction

Kinnaur district is located in eastern part of Himachal Pradesh. The district is entirely hilly except few small, deep valleys in between. The district lies between 31° 06' & 32° 06' North latitudes and 77° 45'& 79° 00' East longitudes and falls in the Survey of India degree-sheet nos. 53I, 53E and 52L. The district has a total geographical area of 6401 sq km which covers about 11.5 % area of the State. The district is bounded by Lahaul & Spiti district in the north, Kullu district in the northwest, Shimla district in the southwest, Uttranchal State in the south and international border with China (Tibet) in the east.

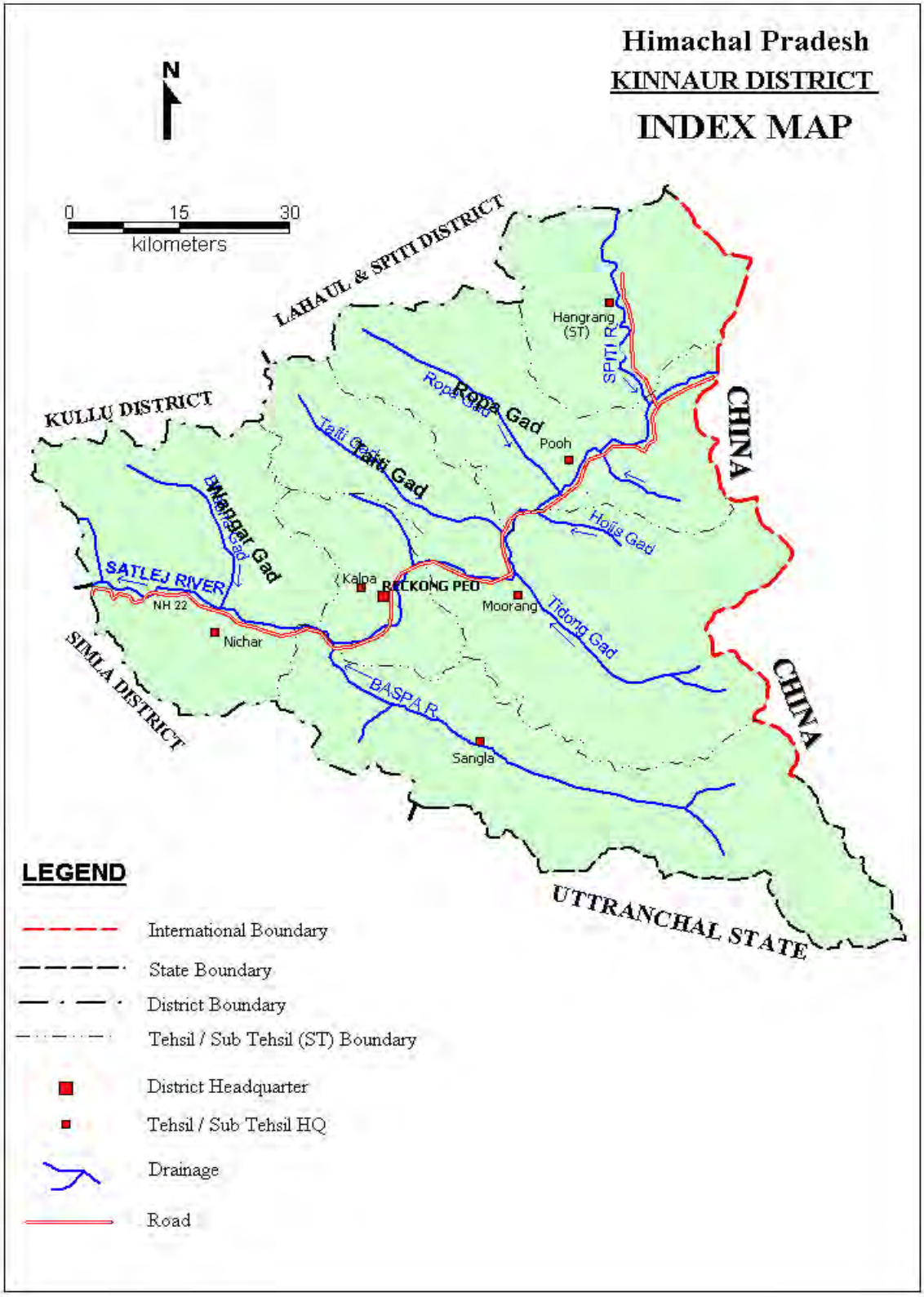
The district is divided into five tehsils namely Nichar, Kapla, Sangla, Pooh and Moorang and one sub-tehsil namely Hangrang. The district headquarters, Recong Peo town falls in Kalpa tehsil. For development purpose, the district has been subdivided in to 3 Community Development Blocks viz., Nichar, Kalpa and Pooh. There are 660 villages in the district out of which 234 villages are inhabited and 426 are uninhabited. As per 2001 census, the district has a population of 78,334 persons with density of population 12 persons per sq. km.

The major sources of irrigation are small water channels locally known as "Kuhls" in the district and an area of 77.86 sq km is brought under irrigation by these surface water sources. A sizeable part of the cultivated area of the district is not having assured irrigation facilities and the agriculturists have to depend on the vagaries of weather. Under various plans, the construction of kuhls and lift irrigation schemes are being taken up in the district.

CGWB has carried out hydrogeological studies both by conventional and non-conventional methods in the district. The area has not been covered so far under ground water exploration as well as ground water regime monitoring programme.

2.0 Rainfall & Climate

The variance of climate is as varied as the area. One experiences change, from the heat of the tropical zone almost to the freezing temperature of a lowland winter. In the outer Himalayas, which are partly under the influence of the periodical rain, the temperature is much more uniform than in the interior, where the summer is sultry, and the winter extremely cold.



From 2400 to 3100 m in favorable situations, such as Chango, Leo, and Moorang the temperature of July and August is from 20° to 22° C and in October temperature is about 10° C. At 12,000 feet the summer temperature appears to be from 13° C to 18° C and in October it is 3° to 4°C. In summer it acts fairly warm in lower hills. The winter is often rigorous, and in some parts there is no moving out of the homes because of heavy snow. The mean monthly temperature varies from 5° C to 23° C.

The district receives rainfall from the month of June till September. The marginal shift in the monsoon pattern is noticed over the period of years. The average annual rainfall in the district is 816 mm. However, much of the rainfall is received in parts of lower Kinnaur. There is a progressive decrease in rainfall as one goes from west to east. The parts of upper Kinnaur receive more snowfall than the rainfall.

The district receives heavy snowfall from November end or early December till March or sometimes April. During this period the area remains totally cutoff from rest of the area. The higher peaks of Kinnaur are completely covered for entire year.

3.0 Geomorphology & Soil Types

Kinnaur district presents an intricate mosaic of mountain ranges, hills and deep valleys. It is primarily a hilly district with altitudes ranging from 1500 to more than 6500 m amsl. There is a general increase in elevation from west to east and from south to north. The major part of the district is drained by Satluj River except small part in the southeastern area, which is drained by Ganga River. Geomorphologically the district has been sub divided into the fluvial terrain, fluvio-glacial terrain, Alpines / meadows and Rocky terrain

Taking into consideration the morphological and physio-chemical characteristics of the soils and general similarity in them the various types of soils observed in the district can be grouped into three major types. **Type-I** soil is coarse loamy, mixed in nature. This type of soil is developed from granites, highly metamorphosed gneisses, schist and occurs on moderately sloping to steep lands. These soils are well drained with moderately rapid permeability. Natural vegetation exists in these soils and various crops are cultivated according to the suitability. **Type-II** soil is fine loamy, mixed, frigid in nature. They have developed on parent material consisting of granite-gneiss and mica schist on steep to very steep slops at an altitude of about 3000 m amsl. These are grazing lands supporting alpine grasses. **Type- III soil** includes various series like Sangla, Spilo, Kalpa, Leo, Rocky I, Rocky II and Scree series.

4.0 Ground Water Scenario

4.1 Hydrogeology

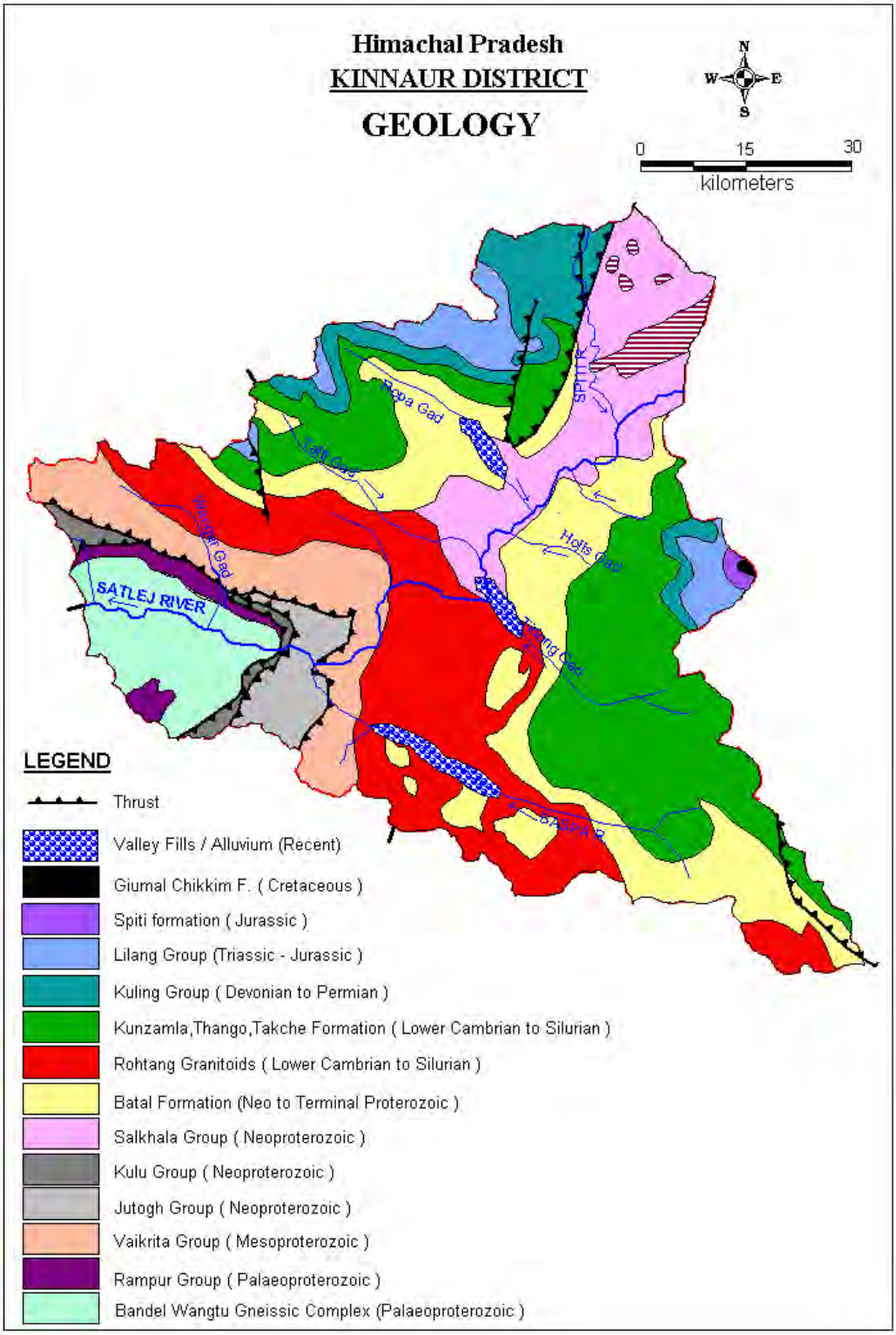
The rock formations occupying the district range from Pre-Cambrian to Quaternary period. The generalized geological succession in the district is given below.

Generalized geological succession, Kinnaur district.

Age / Period	Group / formation	Lithology
Quaternary	Alluvium, Terrace & Fluvial deposits	Alluvium, clay, sand, gravel, pebble, boulder and cobble
Tertiary	Nako Granitoid	Granitoid
Mesozoic	Giumal – Chikkim Spiti formation, Lilang Group	Shale, Sandstone, Siltstone Carbonate rich sedimentary rocks
Palaeozoic	Kuling Group Kunzamla, Thango, Takche formation	Sandstone, shale, conglomerate
Proterozoic	Batal formation Salkhala, Kulu, Jutogh Vaikrita, Rampur Group, Bandal Wangtu Gneissic Complex	Slate, phyllite, quartzite and schist, Amphibolite, Gneisses, granite, Pegmatite

The hydrogeological framework of the district is essentially controlled by geological setting, distribution of rainfall/snowfall and movement of water through inter-connected primary and secondary porosities of the geological formations constituting in aquifers. Based on the geological diversities and relative ground water potentialities of different geological formations, the district can be divided broadly into two hydrogeological units viz., Porous and the Fissured Formations.

The **Porous Formations** constituted of unconsolidated sediments comprises of the quaternary sediments. These sediments are the fluviatile deposits occurring along the Baspa River, Ropa Gad, Taiti Gad, Wenger Gad, Tidong Gad in the lower reaches and in the upper reaches generally underlain by glacio-fluviatile deposits. These are deposited in narrow elongated stripe; valley fills within the hard rock terrain.



These form a potential aquifer. The thickness of these deposits may be more along the soft rock formations or in structurally weak zones. Along the Baspa River in Sangla valley, about 40 sq km area and along Ropa River valley, about 7 sq. km area is ground water worthy with expected thickness between 20 to 30 m below riverbed. However there are other numerous isolated small valley fills, which is also ground water worthy.

Fissured formations are constituted by hard rock formations belonging to crystalline rocks. Jutogh/Vaikritas Rampur group, Giumal and Chikkim formations. These rock formations are consisting of granite gneisses, slate, pegmatite, phyllite, schist, quartzite, limestone, sandstone, shale, conglomerates and boulder beds. These rocks are generally massive and devoid of primary porosity. However due to the tectonic activities, secondary porosity has been developed along the fracture / joints and fault zones. Weathered zone rarely form an aquifer because of the poor thickness of the weathered mantle due to the topographical set up of the areas.

In district Kinnaur, the ground water is distributed along structurally weak/fractured zones, faults and landslides zones or along the contacts of the different rock formation in the topographically favorable areas. In the Satluj River valley, the areas around Taranda, Tapri, between Oling and Lipa, Moorang and Tabling are most promising for Exploration. The other ground water potential areas are along Baspa River, Tidong Gad, Taiti Gad and Spiti River.

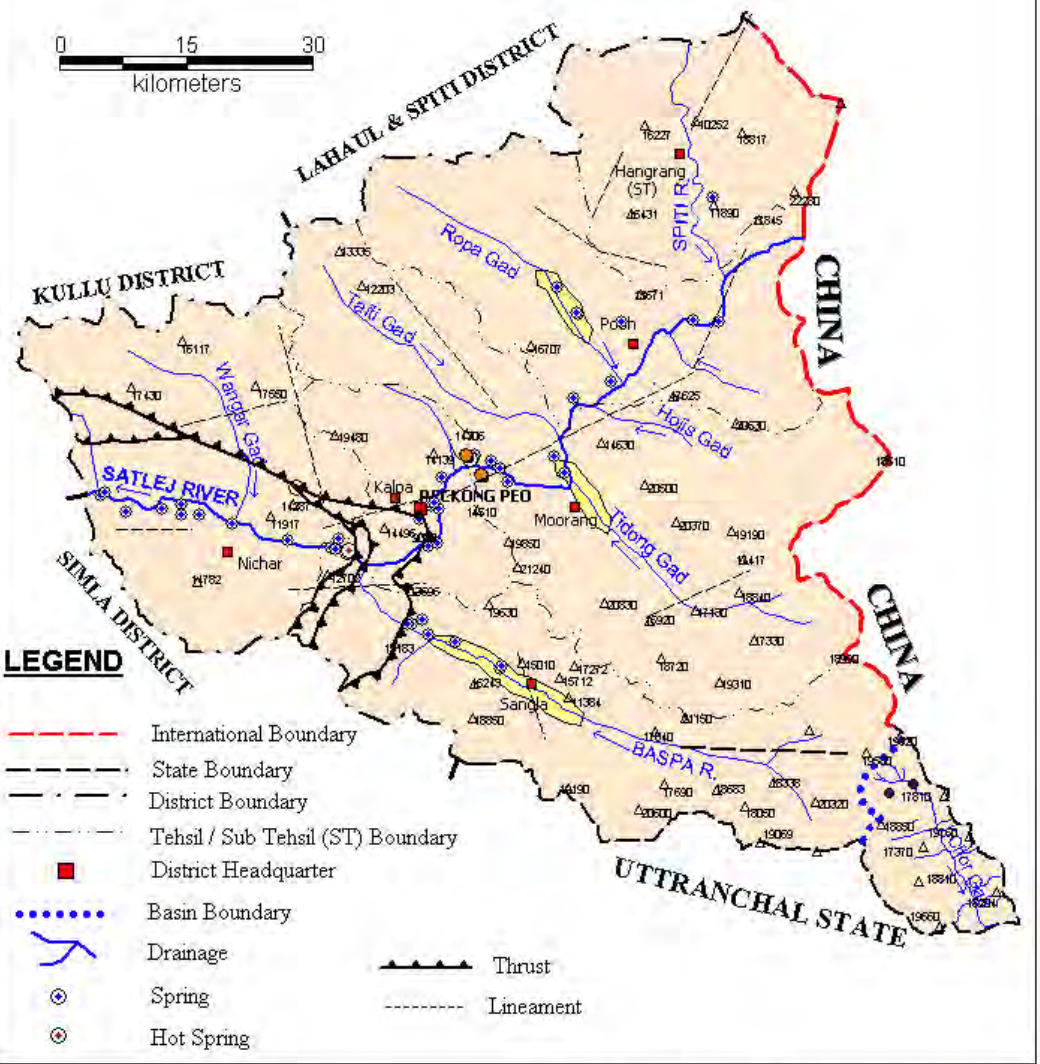
The traditional dug wells tapping the shallow aquifer are not available however; this aquifer is being tapped by the hand pumps and shallow tube wells, which are widely used for domestic purposes. The deep tube wells have not been constructed by CGWB. Ground water in the district occurs in valley area under water table and semi confined to confined conditions. The average depth to water level in shallow bore well ranges from 10 to 30 m bgl.

4.2 Ground Water Resources

Rainfall is the major source of groundwater recharge apart from the influent seepage from the rivers, irrigated fields and inflow from upland areas whereas discharge from ground water mainly takes place from effluent seepages of ground water in the form of springs and base flow in streams etc.

The district has a hilly terrain having very high slopes. The valley areas are deep, narrow and isolated. The areas therefore not considered for estimation of the ground water resources being discontinuous aquifers.

Himachal Pradesh
KINNAUR DISTRICT
HYDROGEOLOGY



AGE	FORMATION	GROUND WATER CONDITIONS
Quaternary	Alluvium / Valley Fills (Unconsolidated)	GW under water table condition Moderate to High yield, Wells / Tubwells feasible Ground Water Quality Good
Proterozoic to Tertiary	Older Metamorphic Crystallines / Sedimentary	GW under water table condition Low yield, shallow borewells feasible Ground Water Quality Good

4.3 Ground Water Quality

CGWB has not been established Ground Water Monitoring Stations in the district because nonexistence of dugwells and piezometers. However, the water samples were collected from various sources like spring and hand pumps during the various hydrogeological studies.

The ground water of the district is alkaline in nature. Ph of shallow ground water ranges from 6.95 to 7.75. The EC in the area ranges from 127 to 672 micro mhos/cm. Nitrate values range between 1 to 10 mg/l. The chemical quality revels that the overall ground water quality is good and is suitable for domestic and irrigational use. However, quality of water from hot springs in Karcham has brackish water with EC 1780 µS/cm and fluoride concentration 3.5 mg/l. There is an urgent need to have proper water quality monitoring & checks on regular basis. The range of mineral concentration is tabulated below.

S. No	Parameter		Range	
			Min	Max
1.	pH		6.95	7.75
2.	EC	µS/cm	127	672
3.	Cl	(mg/l)	7.1	18
4.	NO_3	(mg/l)	1	10
5.	Ca	(mg/l)	18	93
6.	Mg	(mg/l)	3.6	25
7.	Na	(mg/l)	3.5	11
8.	K	(mg/l)	0.31	10
9.	TH as $CaCO_3$	(mg/l)	69	338

4.4 Status of Ground Water Development

The entire demand for domestic and irrigational use is fulfilled by means of either spring or nalas sources. Most of these sources are perennial with low to moderate seasonal fluctuation. Such sources are tapped by the irrigation department for its further use.

So far ground water exploration has not been carried out by CGWB in the entire area of Kinnaur district because of hard approachability for the heavy machinery. However, state Irrigation department has drilled number of shallow bore wells fitted with hand pump in various parts of the district for domestic use. The depth of these bore wells ranges between 100 to 120 feet.

At places where the discharge is sufficient, depending upon the need, they are energized. These hand pumps are installed in hard rock hilly terrain and

LEGEND

	Wells feasible	Rigs suitable	Depth of Well (m)	Discharge (lpm)	Suitable artificial Recharge structures
Soft rock aquifers	Tube well Dug well	DTH with Odex Manual	100-150 10-20	1200-2500 300-500	Check dam, Check dam cum ground water dam, Recharge shaft
Hard rock aquifers	Dug well Spring development	Manual	10-20	300-500 30-2000	
# Hot water spring (40^0C) ● Spring			Fault/Lineament		
Major drainage			Tehsil boundary District boundary State boundary International boundary		

also along the River valleys. Tube wells are absent in all these valleys. In future, the areas of Sangla and Ropa valley can be taken up for ground water exploration.

5.0 Ground Water Management Strategy

5.1 Ground Water Development

The district being hilly & mountainous, traditional sources of ground water mainly springs has played a major role since past in providing assured irrigation and water supply. These include the nalas, springs. In some of the areas, at present too these are the only sources for the water of the settlements. However modern means for tapping the ground water have been employed in recent years.

During the last 15-20 years, Irrigation and Public Health Department has constructed number of shallow depth bore wells fitted with hand pumps in these areas. High hill ranges occupy the more than 95 % of the area of the district. During the very past years, the traditional ground water source has served the settlements. Ground water development on small scale is seen in the valley areas particularly in the Baspa valley. Hand pumps have been installed in these areas and are energized for the water supply. There exists a scope to explore the potentialities of rest of the areas for ground water in low-lying valley areas. The entire hilly area of the district is feasible for only drilling shallow to medium depth bore wells.

5.2 Water Conservation & Artificial Recharge

Ground water extraction through springs and hand pumps are the major sources of water supply, but the availability of water during summer is limited particularly in lean periods and requires immediate attention to augment the ground water resource. Based upon the climatic conditions, topography, hydro-geology of the area, suitable structure for rain water harvesting and artificial recharge to ground water are required. Proper scientific intervention for spring development and revival is required in water scarce areas. In the hilly areas, roof top rainwater harvesting structures like storage tanks are recommended while in low hill ranges, check dam and roof top rainwater harvesting structures can be adopted.

6.0 Ground Water Related Issues & Problems

The district being hilly and mountainous, most of the rainfall goes waste as runoff. This has resulted in varying degree of recharge to the ground water. In such hard rock terrain, since the aquifers are discontinuous and of different geological/hydrogeological setup, the ground water scenarios are different in various parts of the districts.

Most of the ground water issues and problems so far noted in the district are localized and need to be treated independently by taking micro level studies in a particular area. Some of the common issues are deeper water level because of the terrain and hydrogeological setup, effects of various hydroelectric projects on the traditional water sources like springs as noticed in the Nichar area of the district.

7.0 Awareness & Training Activity

7.1 Mass Awareness Programme (MAP) & Water Management Training Programme (WMTP) by CGWB

No Mass Awareness Programme / Water Management Training Programme have been conducted in the district So far.

7.2 Participation in Exhibition, Mela, Fair etc

CGWB has not participated in exhibition, Melas so far.

7.3 Presentation & Lectures delivered in public forum/ Radio/ TV/Institution of repute/Grassroots association /NGO/Academic institutions etc

No presentation/lectures has been delivered in public forum so far.

8.0 AREAS NOTIFIED BY CGWA/SGWA

None of the areas of the district are notified by CGWA / SGWA.

9.0 RECOMMENDATIONS

- In valley areas, in addition to traditional ground water structures like springs, shallow to medium depth tube wells can be constructed for developing the ground water resource.

- In hilly terrain, springs and perennial nalas are the major sources of water. Shallow to medium depth bore wells fitted with hand pump are useful ground water structures for meeting the domestic needs and are feasible at favorable areas.

- Traditional resources like springs need to be revived, developed & protected on scientific lines for various use. The discharge of such springs can be sustained by construction of small check dams or

subsurface dykes across the nalas/tributaries in the downstream at favorable locations.

- Small ponds/tanks/talavs 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 since the district receives ample rainfall. Because of hilly terrain, maximum rainfall goes of as runoff, and a very small quantity contributes towards ground water replenishment.

- Rainwater harvesting in general & RTRWH in particular is an ideal solution for augmenting water resources particularly in sloppy hilly & chronic water scarce areas. There is thus need to create awareness for water conservation and augmentation and proper waste disposal for protecting water sources.

- People's participation is a must for any type of developmental activities. So they should be made aware for proper utilization and conservation of water resources available. In addition, micro level efforts are required for proper implementation of development programme.

SAVE WATER – SAVE LIFE

For Technical Assistance Relating to

Rainwater Harvesting
&
Artificial Recharge to Ground Water

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