



सक सुरक्षित जल - सुन्दर खुशहाल कल

CONSERVE WATER - SAVE LIFE



**Government of India
Ministry Of Water Resources**

**GROUND WATER INFORMATION BOOKLET
LAHAUL & SPITI DISTRICT
HIMACHAL PRADESH**



**CENTRAL GROUND WATER BOARD
NORTHERN HIMALAYAN REGION
DHARMSALA
2007**



Contributors

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Our Vision
Water security through sound management



GROUND WATER INFORMATION BOOKLET

Lahaul & Spiti District, Himachal Pradesh

CONTENTS

DISTRICT AT A GLANCE

- 1.0 INTRODUCTION**
- 2.0 RAINFALL & CLIMATE**
- 3.0 GEOMORPHOLOGY & SOIL TYPES**
- 4.0 GROUND WATER SCENARIO**
 - 4.1 Hydrogeology**
 - 4.2 Ground Water Resources**
 - 4.3 Ground Water Quality**
 - 4.4 Status of Ground Water Development**
- 5.0 GROUND WATER MANAGEMENT STRATEGY**
 - 5.1 Ground Water Development**
 - 5.2 Water Conservation & Artificial Recharge**
- 6.0 GROUND WATER RELATED ISSUES & PROBLEMS**
- 7.0 AWARENESS & TRAINING ACTIVITY**
- 8.0 AREAS NOTIFIED BY CGWA / SGWA**
- 9.0 RECOMMENDATIONS**

LAHAUL & SPITI DISTRICT AT A GLANCE

<i>Sl. No</i>	ITEMS	<i>Statistics</i>	
1.	GENERAL INFORMATION		
	i) Geographical area (sq km)	13,835	
	ii) Administrative Divisions (2001)		
	• Number of Tehsil & Sub-tehsils	2 & 1	
	• Number of CD Blocks	2	
	• Number of Panchayats	41	
	• Number of Villages	521	
	iii) Population (2001 Census)		
	• Total population	33,224 persons	
	• Population Density (pers/sq km)	2	
	• Rural & Urban Population	100% & Nil	
	• SC & ST Population (in percent)	8 % & 73%	
	• Sex Ratio	802	
	iv) Average Annual & Normal Rainfall (mm)	863 mm & 554.4 mm (2003)	
2.	GEOMORPHOLOGY		
	Major Physiographic units	<ul style="list-style-type: none"> • Structural Hills • Valley Fills • Fluvial Terrain • Glacio-Fluvial Terrain 	
	Altitude Range	3800 – 7000 m amsl	
	Major Drainages		
	• Chenab Basin	Chandra River, Bhaga River	
	• Satluj Basin	Spiti River	
3.	LAND USE (2001-02) sq.km		
	• Forest area	1353.69	
	• Total Cropped Area	33.77	
	• Net area sown	32.96	
4.	MAJOR SOIL TYPES	<ul style="list-style-type: none"> • Alpine Sward (Spiti) • Sandy Loam (Lahaul) 	
5.	IRRIGATION BY DIFFERENT SOURCES (MI census 2001-02) (sq km)		
		<u>No/Scheme</u>	<u>Area (sq km)</u>
	Dug wells & shallow TW	Nil	Nil
	Surface water (flow & Lift)	355	20.64
	Tanks	3	4

6.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.3.2008) <ul style="list-style-type: none"> • No. of Dug Wells • No. of Piezometers 	Nil Nil
7.	PREDOMINANT GEOLOGICAL FORMATIONS	<ul style="list-style-type: none"> • Quaternary Alluvium • Older Crystalline / Sedimentary / Metamorphic rocks
8.	HYDROGEOLOGY Major Water Bearing Formations <ol style="list-style-type: none"> 1. Consolidated sediments / Hard Rocks (Older crystalline / Sedimentary / Metamorphics) <ul style="list-style-type: none"> • Yield prospects • GW structures 2. Unconsolidated porous sediments (Alluvium) <ul style="list-style-type: none"> • Yield prospects • GW structures 	Covering major part Low (<3 lps) Springs & Handpumps Valley area (3%) High (10-30 lps) Springs & Handpumps
9.	GROUND WATER EXPLORATION BY CGWB (As on 31.3.2007) <ul style="list-style-type: none"> • No of wells drilled • Depth Range (m) • Discharge (lps) • Transmissivity (m²/day) 	Nil - - -
10.	GROUND WATER QUALITY Presence of Chemical constituents more than permissible limits (eg. EC, F, As, Fe)	Nil
11.	DYNAMIC GROUND WATER RESOURCES (2004) in MCM <ul style="list-style-type: none"> • Annual Replenishable Ground Water Resources • Net Annual Ground Water Draft • Projected Demand for Domestic and 	Not estimated due to localized aquifers - - -

	industrial uses up to 2025	
	• Stage of Ground Water Development	-
12.	AWARENESS AND TRAINING ACTIVITY	-
	• Mass Awareness Programmes	Nil
	• Water Management Training Programmes	Nil
13.	EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING	Nil
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	Nil



GROUND WATER INFORMATION BOOKLET LAHAUL & SPITI DISTRICT HIMACHAL PRADESH

1.0 INTRODUCTION

Lahaul & Spiti is a scarcely populated district, located in northeastern part of the State. The district is entirely hilly and comprises of two major valleys viz. Lahaul & Spiti. The Lahaul valley is located in the northwestern part of the district while that the Spiti valley is located in southeastern part. The district, with its headquarter at Keylong lies between 31°44'57" & 32° 59'57" North latitudes and 76°46'29" & 78°41'34" East longitudes and is covered by Survey of India degree sheet 52C, 52D and 52L. The district is bounded by Jammu & Kashmir State in the north, Tibet (China) in the east, Kinnaur in the southeast, Kulu in the south & Kangra and Kulu in the northwest.

The district has a total geographical area of 13,835 sq km, covers about 25 % of the State geographical area and ranks 1st in area in the State. There are no towns in the district and has 521 villages of which 287 villages are inhabited and 234 are uninhabited. The district has been divided into 2 divisions viz. Keylong and Kaza. There are 2 tehsils [Keylong & Kaza] & 1 sub-tehsils [Udaipur].

As per 2001 census, the district has a population of 33,224 persons with population density of 2 persons per sq km. Population wise it ranks 12th in the State. The male and female population in the district is 18,441 and 14,783 respectively with a male/female sex ratio of 802. The schedule cast population in the district is 8 % and the schedule tribe population is 73 %.

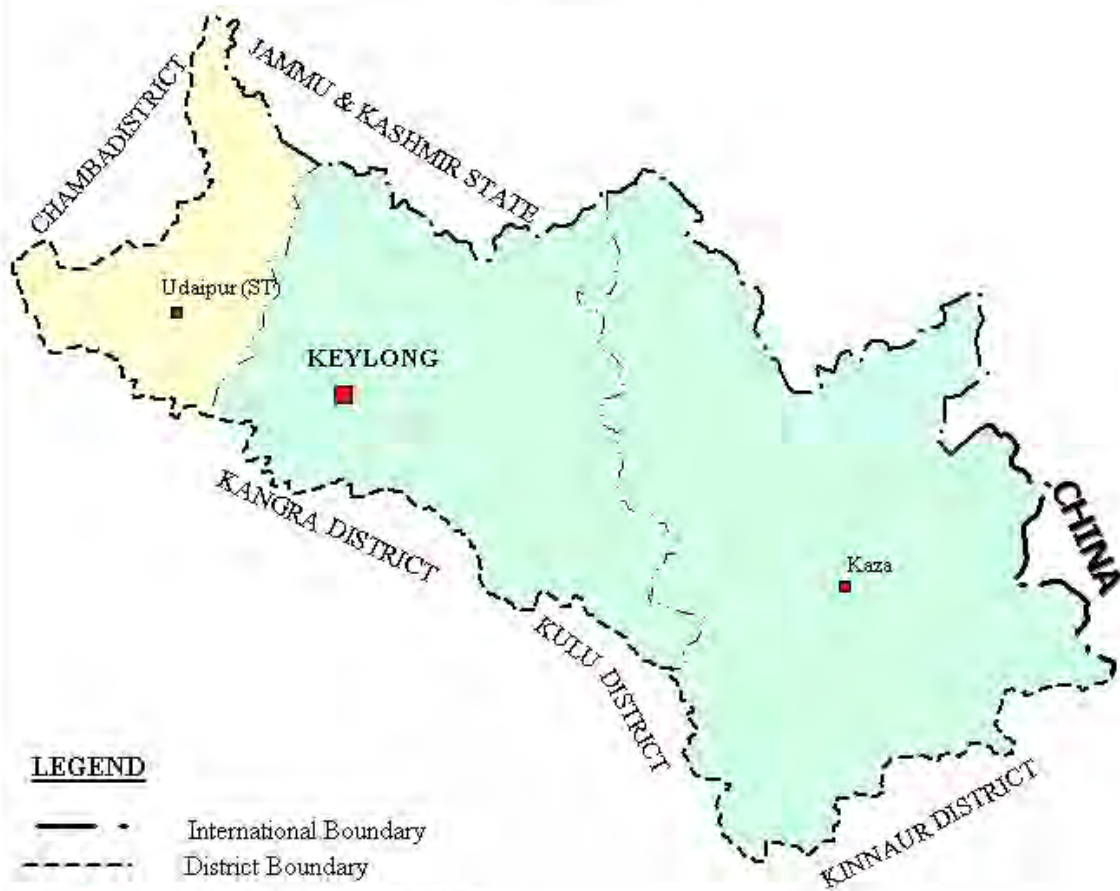
The major sources of irrigation are small water channels or the *Kuhls* in the district and an area of about 23 sq km is brought under irrigation by various sources like surface flow / lift irrigation schemes and tanks. A sizeable part of the cultivated area of the district is not having assured irrigation facilities and agriculturists have to depend on the vagaries of weather. Under the various plans, the construction of kuhls and lift irrigation schemes are being taken up in the district.

CGWB has carried out extensive hydrogeological studies both by conventional and non-conventional method in the district. So far groundwater exploration has not been carried out in the district.








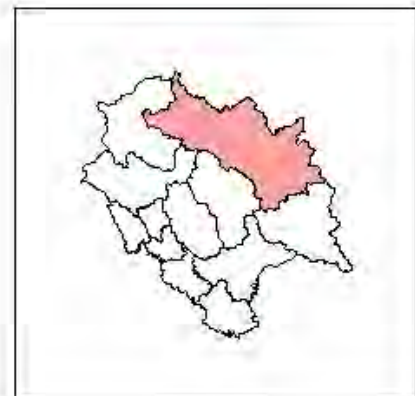
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Himachal Pradesh LAHAUL & SPITI DISTRICT INDEX MAP



LEGEND

-  International Boundary
-  District Boundary
-  Tehsil / Subtehsil Boundary
-  District Headquarter
-  Tehsil / Subtehsil Headquarter



2.0 CLIMATE & RAINFALL

Lahaul & Spiti district falls in the rain shadow area of Himalaya. The monsoon hardly penetrates and rarely reaches the valley in the form of mostly drizzle. The summer months are invariably dry.

In Lahaul valley, annual rainfall varies from about 100 mm to 400 mm. Southern part receives higher rainfall as compared to northern part. In Lahaul valley snowfall varies from less than 1 m to 6 m and may be higher at higher altitudes. Maximum temperature at Keylong ranges between 7° C and 23° C while minimum temperature from -10° C to +10° C in the month of February and July respectively. The lower areas of the valley are warmer.

In Spiti valley, average annual rainfall is about 12 cm. Snowfall varies from less than 1 m to 3 m annually with an average of 2 metre. At Kaza minimum temperature varies from +12° C to -22° C while maximum temperature from 26° C to -12° C.

3.0 GEOMORPHOLOGY & SOIL TYPES

The geomorphological set up of the area is highly complex. The terrain has an immature topography and is traversed by deep valleys and high hill ranges. The district can be divided into two major geomorphological unit viz. *Structural hills and valley fills*. Structural hills are underlain by rocks belonging to pre-cambrian, palaeozoic, Mesozoic and Cenozoic eras. The rocks are generally trending in NNE-SSW and NE-SW direction with steep slopes. Escarpments and hogbacks are common features.

Valley fills include both fluvial deposits and moraines. These deposits occur as narrow and elongated strips along the main streams. The glacial deposits are under the influence of running water and has been termed as glacio-fluvial deposits. fluvial terrain is demarcated in the lower reaches of both the Chenab and Spiti rivers. These are having thick vegetation. The width of these deposits is generally less than 3 km and are not uniformly distributed.

Glacio-fluvial deposits are confined to the upper reaches of drainage system of the watersheds. These areas are either along the snowline or near to it. Mostly these are demarcated along the river/stream courses. These valleys are broad and gently sloping, generally devoid of any vegetation cover. The width of these deposits is more in northern parts in Lahaul valley. In Spiti valley, the important glacio-fluvial deposits are along Kasima nadi, Puigulung Takpo, Perang river and Khemenger river.

Glaciers are widely distributed over the central and northern parts of the district. The main glaciers are aligned in EW or WNW-ESE direction with their offshoot glaciers in north-south direction feeding the tributaries of various rivers in either direction. Bara Shingiri



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glacier is located in the southern part along the Great Himalayan Ranges contributing water to both Chenab and Spiti rivers.

Himachal Pradesh LAHAUL & SPITI DISTRICT PHYSIOGRAPHY & DRAINAGE



Geng's Tang and Kelas Buk glaciers occupy the eastern part in catchment of Chenab also occur in the Central part. The other minor glaciers in the southern parts are Talshah, Tapri-Lamini, Raighar and Sara Ugma glaciers.

Most of the soils in Spiti may be called alpine sward as the upper stratum of earth and vegetable mould is filled with incompletely decomposed roots of grass and other small plants. The depth of the fertile undisturbed horizon varies from 0.3 m to 0.6 m. Due to melting of the snow from the upper slopes; soil has been carried down to the lower slopes where the depth of the soil is deeper. The land in Spiti is fertile. The nature of soil varies from place to place. The nitrogenous and phosphatic contents vary from medium to high. This is due to the scarcity of rainfall, high altitude, weathering of the mountain rocks from where water emanates from irrigations the fields.

In Lahaul valley, the quality of land and its produce is homogeneous throughout the tract. The nature of the soil varies little and it may be described as a light sandy loam.

4.0 GROUND WATER SCENARIO

4.1 Hydrogeology

The hydrogeological framework of the area is essentially controlled by geological setting, distribution of rainfall, snowfall and porosity of rocks constituting aquifers. Geologically, the area is underlain by the rocks of Proterozoic era to the quaternary period. Hydrogeologically, all these formations can be divided into units namely fissured and porous formations.

Fissured formations are constituted by hard rock formations ranging in age from Precambrian to Mesozoic and composed mainly of granites, gneisses, slates, phyllites, quartzites, schists and limestones. These rocks are generally massive and devoid of any primary porosity. However due to tectonic activity, secondary porosity has been developed along fractures, joints and faults zones. Weathered zones rarely form any aquifer because of their poor thickness. Sometimes contact zones of rocks units forms poor to moderate aquifer. These are developed occasionally for localized and domestic water needs in low topographic areas. Ground water occurs generally under unconfined conditions and ooze out in the form of springs. Discharge of the springs varies from mere seepage to more than 20 lps with temperature varies from less than 10°C to 25° in normal temperatures springs and 26°C to 60°C in hot water springs. This spring water is utilized for drinking and irrigation purposes.

Porous formations includes both fluvial and fluvio-glacial deposits. There is no development of the alluvial terrains in the valley as most of their river courses flow through narrow valley portions between well defined compact and hard rock valley walls. In broader valleys, like on the right banks of Bhaga and Chandra Bhaga Rivers where older glacial terrain exists, large cultivations are being practiced. The width of these deposits varies from less than 500m to about 2.5km with increasing thickness of sediments towards

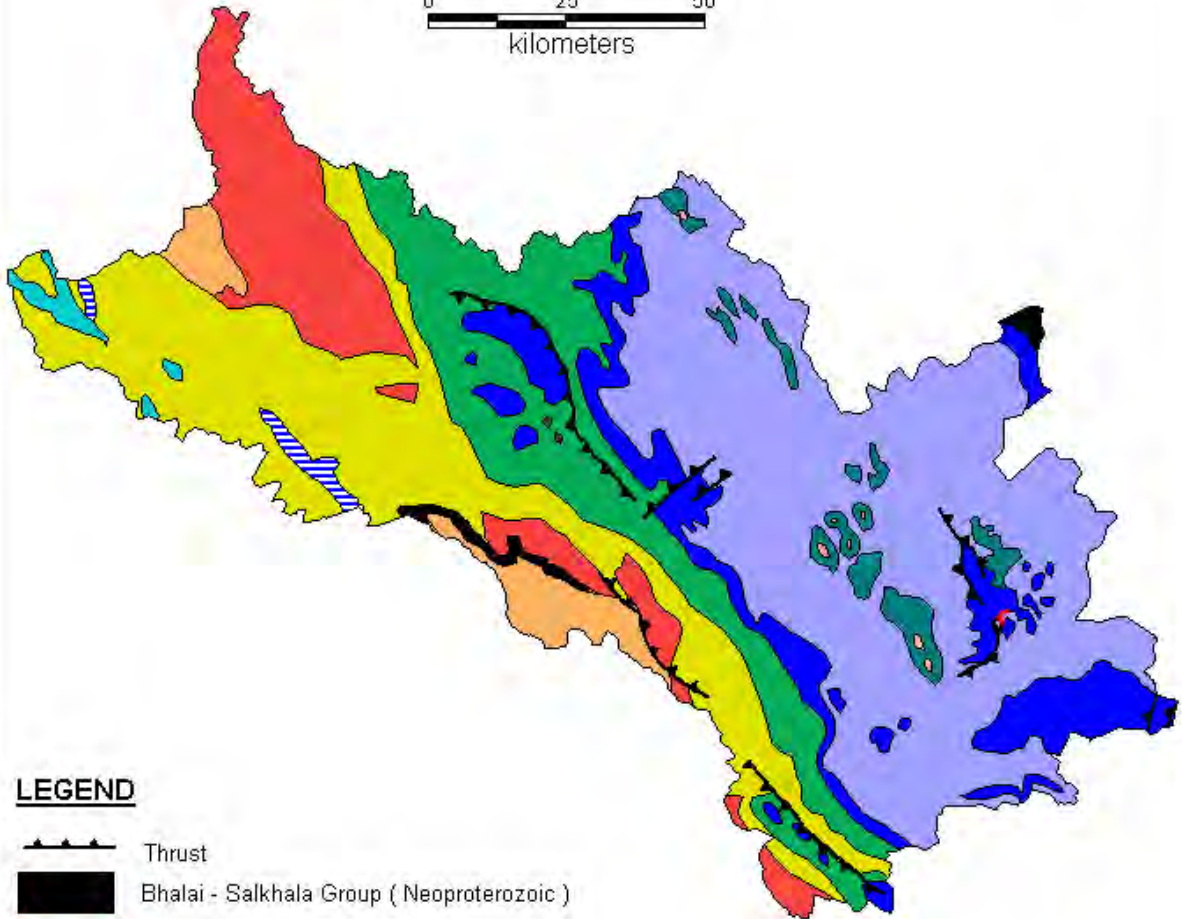


the center of valley. These deposits are isolated and discontinuous and forms potential ground water aquifer.











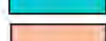

Himachal Pradesh LAHAUL & SPITI DISTRICT GEOLOGY



0 25 50
kilometers



LEGEND

-  Thrust
-  Bhalai - Salkhala Group (Neoproterozoic)
-  Spiti Formation (Jurassic)
-  Tandi Group (Permo Triassic Jurassic)
-  Lilang Group (Triassic - Jurassic)
-  Kuling Group (salooni Formation) / (Devonial to Permian)
-  Kunzamla/Thango/Takche Formation (Lower Cambrian to Silurian)
-  Dalhousie-Mandi-Karsog Granitoids (Lower Cambrian to Silurian)
-  Batal Formation (Neo - Terminal Proterozoic)
-  Manjir Formation (Neoproterozoic)
-  Giumal - Chikkim Formation (Cretaceous)
-  Vaikrita Group (Mesoproterozoic)

<u>Era</u>	<u>Age</u>	<u>Group / Formation</u>	<u>Lithology</u>	<u>GW structure / Yield Potential</u>
Cenozoic	Quaternary	Fluvial / Fluvio-glacial / Alluvium	Sand, silt, pebbles, cobbles, boulders	<ul style="list-style-type: none"> ➤ Springs are the natural sources. ➤ Shallow dugwells / shallow tubewells structure feasible. ➤ Moderate to High yield potential (10-30 lps).
Mesozoic	Cretaceous	Giumal-Chikkim Formation	Sandstone, siltstone, shale, conglomerate.	<ul style="list-style-type: none"> ➤ Springs are the natural sources. ➤ Shallow borewells feasible. ➤ Low to moderate yield potential in borewells (1-5 lps)
	Jurassic	Spiti Formation	Shale, sandstone and siltstone.	
	Triassic-Jurassic	Lilang Group / Kalhel Formation	limestones, shales, dolomites and sandstones.	
	Permo - Traissic-Jurassic	Tandi Group	Limestone	
Palaeozoic	Devonian to Permian	Kuling Group	Quartzites, Sandstones and Black Shales	<ul style="list-style-type: none"> ➤ Springs are the natural sources. ➤ Shallow borewells feasible. ➤ Low to moderate yield potential in borewells (1-5 lps)
	Lower Cambrian to Silurian	Kunamla-Thango-Takche Formation	Shale, schist, sandstone, dolomite	
	Lower Cambrian to Silurian	Rohtang Granitoid	Granitoids	
Proterozoic	Neoproterozoic to Terminal Proterozoic	Batal Formation	Shales, phyllites and Quartzites	<ul style="list-style-type: none"> ➤ Springs are the natural sources. ➤ Shallow borewells feasible. ➤ Low to moderate yield potential in borewells (1-5 lps)
	Neoproterozoic	Manjir Formation	Sandstone, limestone, shale	
	Neoproterozoic	Bhalai Formation (Salkhala Group)	Slates, schists slates, phyllites, quartzites.	
	Mesoproterozoic	Vaikrita Group	slates, phyllites, quartzites, schists	

Ground water generally occurs under unconfined to semi-confined conditions. Recently State Irrigation and Public Health Department has drilled shallow borewells fitted with the handpumps. The depth of these tubewells varies from 35.40 to 70.12 m bgl. Depth to water

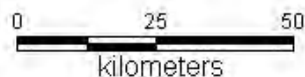


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level varies from 7.84 m bgl at Koksar village to 59.38 mbgl at Maragaon village while discharge ranges from 12 to 20 lpm.

Himachal Pradesh LAHAUL & SPITI DISTRICT HYDROGEOLOGY



LEGEND

- Thrust
- Lineaments
- Springs
- Hot Spring
- Drainage
- Triangulation points

<u>AGE</u>	<u>FORMATION</u>	<u>GROUNDWATER CONDITION</u>
Quaternary	Alluvium / Valley Fills	GW under water table to semi-confined condition, High yield (10-25 lps), wells and tubewells feasible, Groundwater quality good.
Proterozoic to Tertiary	Older crystallines sedimentaries / Metamorphics	GW under water table to semi-confined condition, Fissured high elevation aquifers Low yield (< 5 lps) , springs & handpumps

Water table follows the topography and the formations encountered are valley fill deposits consisting of sand, gravels, pebbles & cobbles. There are two locations, which are worth mentions from the point of view of development of ground water viz. Jispa and Udaipur.

Jispa lies on the right bank of Bhaga river with a gently sloping ground formed by the deposition of scree material brought down from hills in the north east due to melting of the snow. This unconsolidated accumulation of sediments may form a site for exploring the possibility of the construction of suitable ground water structure i.e. open dugwell or a tubewell depending upon the availability of adequate saturated thickness of the sediments.

Udaipur town and the Chandra Bhaga river exists a gently sloping alluvial plains merging with the river large amount of debris consisting of huge boulders and finer clastics is brought down by Miyar Nala and deposited in this valley called Patten valley. This alluvial flat plains is located with in few meters height from the river level and is suitable for development of ground water resources.

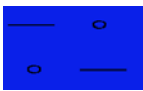
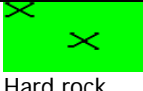







Springs are widely distributed all over the area in all types of formation at varying altitudes. These are the major sources of water supplies both for irrigation as well as for domestic purposes. Springs are of both fracture and seepage types. The fracture types of springs exist in the low topographic areas either along structurally weak zones or at the contact of geological formations where as seepage type of springs are formed on the slope of hills covered with loose material such as talus and scree. These springs are both perennial and seasonal with varying discharges and temperatures. Springs get recharged from rainfall and snowfall. Discharge of these springs generally increases during the summers. Irrigation and domestic water supply needs are met from these springs. The discharge generally varies from seepages to more than 20 lps with temperature varying from less than 10⁰ C to 25⁰C in normal temperatures springs and 26°C to 60°C in hot water springs.

4.2 Ground Water Resources

Snowfall / 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 due to their discontinuous aquifer systems.



	Wells feasible	Rigs suitable	Depth of Well (m)	Discharge (lpm)	Suitable artificial Recharge structures
 Soft rock aquifers	Tube well	Percussion & Percussion cum Rotary Manual	100-120	1200-2500	Check dam, Check dam cum ground water dam, Recharge shaft
	Dug well		10-20	300-500	
 Hard rock aquifers	Dug well	Manual	10-20	300-500	
	Spring development		30-2000		
 Spring			 Reservoir		
 Major drainage			 Fault/lineament  Tehsil boundary  District boundary  State boundary		

4.3 Ground Water Quality

National Hydrograph Network Stations has not been established in the district so far. However, the water samples collected from various sources like spring and handpumps during the various hydrogeological studies reveals that the overall ground water quality is good and is suitable for all type of uses.

S. No	Parameter	Range	
		Min	Max
1.	pH	7.35	7.80
2.	EC	91	141
	T.D.S	23	90
3.	HCO ₃	11	34
4.	Cl	2.1	5.30
	SO ₄	4.5	30
5.	NO ₃	2	3
6.	F	0.16	0.30
7.	Ca	3.3	17
8.	Mg	1.20	5.20
9.	Na	0.35	1.40
10.	K	0.45	1.30
11.	TH as CaCO ₃	15	65

The EC in ground water is below 1000 $\mu\text{S}/\text{cm}$ at 25° C. Other chemical parameters are also within the permissible limits. Thus it can be concluded that the over all quality of ground water is good and suitable for domestic and irrigation use.

4.4 Status of Ground Water Development

The major chunk of demand for domestic and irrigational use is fulfilled by means of either spring or nallah sources. Most of these sources are perennial with low to moderate seasonal fluctuation. At places they are tapped by the irrigation department for implementing water supply schemes.

Ground water exploration has not been carried out by CGWB in the district because of hard approachability for the heavy machinery. However state Irrigation department has drilled number of shallow bore wells fitted with handpump in various parts of the district for domestic use. The depth of these bore wells ranges between 100 to 200 feet. At places where the discharge is sufficient, depending upon the need, they are energized. These handpumps are installed in hard rock hilly terrain and also along the river valleys.

5 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 nallas, 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 small depth bore wells fitted with handpumps in these areas. High hill ranges occupy 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 valleys areas particularly in the Lahaul and Spiti valley. Handpumps 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, hydrogeology 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 / snow harvesting structures can be adopted.

6 GROUND WATER RELATED ISSUES & PROBLEMS

The entire district is hilly and mountainous and comes under the rain shadow area of Himalaya. 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 in the district are localized and need to be treated independently by taking micro level studies in a particular area.

7 AWARENESS & TRAINING ACTIVITY

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

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

Participation in Exhibition, Mela, Fair etc

CGWB has not participated in exhibition, Melas so far.

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 AREAS NOTIFIED BY CGWA / SGWA

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

9 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 nallas 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 needs 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 nallas/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.
- Snow water harvesting practices can be adopted in hilly areas since the district receives ample snowfall.
- There is need to create awareness for water conservation and augmentation and proper waste disposal for protecting water sources



For Technical Assistance Relating to
Rainwater Harvesting
&
Artificial Recharge to Ground Water

Contact:

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