

GROUND WATER INFORMATION BOOKLET
SOUTH DISTRICT OF SIKKIM
DISTRICT AT A GLANCE

<i>Srl. No.</i>	<i>Items</i>	<i>Statistics</i>
1. GENERAL INFORMATION		
i)	Geographical area (sq.km)	750 Sq.km.
ii)	Administrative Divisions (As on 2008)	
	➤ No. of Tehsil/Block	-
	➤ No. of Panchayat/villages/ward	243
	➤ No. of Panchayat Unit	42
iii)	Population (as on 2001 Census)	1, 31,525
	➤ Rural population	1, 27,579
	➤ Urban Population	3,946
iv)	Average Annual Rainfall (mm)	3496
 2. GEOMORPHOLOGY		
	➤ Major Physiographic units	Hill, Valley, Slope Gondwana rocks
	➤ Major Drainage System	Tista and Rangit
 3. LAND USE		
	➤ Forest area	420 Sq.km.
	➤ Net area sown	2519.70 Ha
	➤ Cultivable area	2104.62 Ha
 4. MAJOR SOIL TYPES		
		Mountain meadow, brown-red & yellow soil and lateritic soil.

5. AREA UNDER PRINCIPAL CROPS

S.No.	Name of the Crop	Area (ha) Cultivated	Production per ha (kg)
01	Rice	2340	1400
02	Wheat	1500	1300
03.	Maize	13,400	1380
04	Finger millet	1010	950
05	Barley	200	1500
06	Buck wheat	580	800

6. IRRIGATION BY DIFFERENT SOURCES

* (Areas and numbers of structures)

Dugwells	:	Nil
Tubewells/Borewells	:	Nil
Tanks/Ponds	:	13
Canals	:	Nil
Other sources	:	Spring
Net irrigated area	:	21.463 ha
Gross irrigated area	:	29.498 ha

7. NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (as on 31.3.2007)

No. of Dug wells	:	Nil
No. of Piezometers	:	Nil

8. PREDOMINANT GEOLOGICAL FORMATIONS

Recent alluvium (terrace deposit), Gondwana, Daling group of rocks.

9. HYDROGEOLOGY

Major water bearing formation : Fractured zones in various lithological units, weathered zones in phyllite, schist, gnessics and quartzite.

10. GROUNDWATER EXPLORATION BY CGWB (As on 31.03.2007)

▶ No. of wells drilled (EW, OW, Pz, SH, Total)

1. EW	:	27
2. OW	:	07
3. Pz	:	-
4. SH	:	-
5. Total	:	34
6. Transmissibility	:	5.32 m ² /day to 316.43 m ² /day
▶ Depth range (m) : 27.00 – 101.00 m bgl		
▶ Maximum : 101.00 m bgl		
▶ Minimum : 27.00 m bgl		
▶ S.W.L. (m bgl) : 0.66 – 27.00 m bgl.		
▶ Discharge (Litre per second) : 0.12 to 8 lps.		
▶ Drawdown (m) : 6.07 to 26.90 m		

11. GROUND WATER QUALITY

Presence of chemical constituents : Fe (iron) is at higher side in More than permissible limit some places.
Type of water : Ca-Mg-HCO₃ type

12. DYNAMIC GROUND WATER RESOURCES (2004) IN MCM

The ground water resources estimation has not been done as per GEC 1997 methodology in the South Sikkim. The district falls under Himalayan terrain and the slope is more than 20%.

13. AWARENESS AND TRAINING ACTIVITY : Nil

◆ Mass awareness programme organized –

- Date/year
- Place
- No. of participants

14. EFFORT OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING

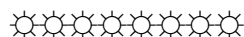
◆Project completed by CGWB : Nil
(No. and amount spent)

◆Project under technical guidance : Nil
of CGWB (no.)

15. GROUND WATER CONTROL AND REGULATION

◆No. of Blocks : Nil
◆No. of Critical Blocks : Nil
◆No. of Blocks notified : Nil

16. MAJOR GROUND WATER PROBLEMS AND ISSUES : Ground water development is limited due to presence of hard rocks having steep slopes. Quality of spring water is bacteriologically contaminated at few places.



GROUND WATER INFORMATION BOOKLET OF SOUTH SIKKIM, SIKKIM

1. INTRODUCTION

Administrative details

Administrative Set up of South Sikkim

Sl. No.	Particulars	Units (no.)
01.	Sub Division	02
02.	Constituency	07
03.	Zilla Panchayat Members	23
04.	Panchayat Unit	42
05.	Panchayat Ward	243
06.	Revenue Block	145
07.	Town	2
08.	Police Station	6
09.	Police Outpost	08
10.	District Court	01
11.	Lok Adalat	01
12.	Consumer Forum	01

LOCATION AND AREA:

The district is bounded by the latitude 27°14'20" and longitude 88°18'15" E. The total geographical area of the district is 750 sq.km. South district is the 2nd largest populated district next to East District of Sikkim. South District though having a smaller area is more thickly populated.

NAMCHI, the Administrative headquarters of South District, is a small town which is accessible from the neighbouring state of West Bengal. South District offers spell bounding views and excellent Trekking places. Namchi is 90 km., away from Gangtok, the state capital. The nearest Railway Station is New Jalpaiguri and the airport is at Bagdogra in West Bengal.

GROUND WATER BASIN:

The South District of Sikkim falls under Tista basin.

DRAINAGE:

The drainage of the district is controlled by the perennial Tista and Rangit rivers alongwith their tributaries. Tista the main river passes through the area which originates from the central crystalline zone defined by high mountain ranges which is covered by glaciers. The Tista and its tributaries drain different parts of the area. The rivers are perennial in nature which are fed by both snowmelt water and rain water. Rangit, another river originates from West Sikkim. During its southerly course it receives Melli Chhu, Namlong Khola, Rathang Chhu, Kalig Chhu, Rayong Khola, etc. The southerly flowing Tista is joined by Rangpchap Chhu at the extreme north of the South Sikkim. The type of drainage is trellis and dendritic. Most of the *Kholas* have originated from the higher altitudes and flow down by cutting deep gorges in lower altitude where they ultimately join with the main river Tista.

STUDIES OF CGWB:

Central Ground Water Board has completed Systematic Survey, Reappraisal Hydrogeological Survey and is continuing on Ground Water Management studies in the foothill. Groundwater exploration was carried

out in some parts of South District. The objective was to delineate the aquifer zones and to know the aquifer characteristic particularly in the fractures.

2. RAINFALL AND CLIMATE

The average annual rainfall is of the tune of 3496 mm with about 114 rainy days.

CLIMATE:

The climate in the district is in general cool throughout the year. It is very cold during winter months. Summer starts at the end of March and lasts upto middle of May,, when the atmospheric temperature rises to about 20°C. Monsoon generally sets at the end of June and continuing upto October. Maximum rainfall takes place during the month of June to September. The average annual rainfall is 3496 mm.

3. GEOMORPHOLOGY

The South District of Sikkim is mountainous forming part of Eastern Himalayas. It is characterized by Himalayan topography with a series of crisscross ridges and ravines. The altitude varies from 230 to 7000 m above MSL.

4. SOIL TYPES:

The soils of the district in general have derived from parent rocks such as Sandstone, Phyllite, Schist, gneisses and colluvial materials. Soils are generally acidic to very acidic in reaction having soil pH between 5.00 and 6.0.

5. AGRICULTURE:

In Sikkim, rice is the chief crop of the state. The South Sikkim is familiar with terraced farm lands growing rice, maize and barley as the main crops. Other crops like ginger, potatoes and oranges are also grown. One of the chief cash crops of the State is large cardamom.

6. GROUND WATER IRRIGATION AND PRACTICES:

The cultivation is done both by surface and by rain water conservation. The sources of surface irrigation are Jhora (in Hilly area), river lift irrigation, storage tank. From age old times, irrigation depends mainly on springs and *Kholas*. Majority of the springs got dried up if sufficient monsoon does not take place. Central Ground Water Board has proved the ground water potentiality of the rock types prevailing in the area for bored wells, the feasibility of irrigation from such wells can be studied. The major cropping pattern of the district is maize, rice, millet etc., in Khariff period, and wheat, barley, mustard etc., in Rabi period. The district topography is rugged in nature and steep slope, and no such water supply system for irrigation except monsoon rainfall. The farmers are forced to cultivate fruits, vegetables, cardamom, potato, ginger etc., which are favourable for the physiography and climate of the district.

7. NO. OF GROUND WATER MONITORING WELLS OF CGCWB:

There is no monitoring well of CGWB in South Sikkim, Sikkim.

8. GEOLOGY:

The geological formation of South Sikkim district comprises Quaternary deposits of alluvium in river terrace are developed sporadically along the streams and rivers. The Gondwana rocks occur in the South Sikkim area around Namchi. The rock types are shale, sandstone, quartzite, coal. Among the Daling group Buxa formation is younger and consists of quartzites variegated slates, black slates and dolomite. Buxa formation is the oldest rock group represented by an

alternative sequence of metamorphosed pelitic-semi-pelitic to psammitic rocks comprising chloritic phyllite, micaceous phyllite, grey massive quartzite and variegated states.

9. GROUND WATER SCENARIO

HYDROGEOLOGY:

The repository of ground water in the South district of Sikkim is the fracture and joint plains. The presence of innumerable perennial springs with various discharges is also suggestive of the occurrence of ground water in various rock formations and weathered zones in the phyllite, schist, gneisses and quartzite.

Due to higher relief and steeper gradient of the area, ground water comes out as seepages and springs, wherever the land surface intersects local ground water body. The area is characterized by high rainfall, with the result that the primary source of ground water is from natural precipitation. Direct infiltrations and rainfall through joints, fracture, weathered zones of the rocky and through soil covers is the principal mode of recharge of the springs. Due to higher slope most of the precipitation in the area flows off as surface-run off through streams, *kholas* and through intermittent springs. The movement of groundwater is mainly controlled by structural set up of the area and by the physiography.

10. GROUND WATER EXPLORATION IN SOUTH DISTRICT OF SIKKIM:

Central Ground Water Board had undertaken exploratory drilling programme in South and East Sikkim to identify the potential fracture zones and to assess the quantum of ground water to be extracted from the successful borehole. Exploration was initiated during 1984. Total 27 nos. of exploratory borehole and 7 nos. of observation wells were drilled in

South district, Sikkim in different geological formations such as Gondwanas, Daling formation and Buxa formation. Among all the exploratory wells, five numbers of exploratory wells encountered in Gondwana and Daling formation recorded encouraging yield. The discharge were recorded 5 to 8 LPS or 300 LPM to 480 LPM. The yield from other exploratory well were observed low i.e., 0.25 to 1.4 LPS. The low discharge well can be used for hand pump. The drawdown of the successful exploratory well varies from 5 to 10 meters. The potential fractures encountered at the depth range of 27.00 meter, 38 m to 91 m bgl. From aquifer performance data in four boreholes tested so far Transmissivity is seem to vary from 5.32 m²/day to 316.43 m²/day for the Gondwana rocks and 16.14 m²/day to 199.9 m²/day for the Daling rocks. Moreover the Storativity figure of 5.1328×10^{-4} for the Gondwana rocks at Kazitar show that groundwater occurs under confined condition and is coming from deep seated fracture zones.

11. WATER SUPPLY SYSTEM IN SOUTH DISTRICT:

The South district of Sikkim water supply system solely depend upon "Surface Water Sources". The basic water supply system consists of –

- a) Tapping of water sources located at higher reaches.
- b) Transporting the raw water through gravity from the sources to the lower reaches finally distributed to consumer points through zonal distribution system.
- c) The people of the villages situated on the hill slopes, depend mainly on the springs and or nearly perennial *kholas* for their drinking water supply. The rural works department of the State Government has implemented schemes for water supply. The spring water collected in storage tank from where it is supplied to various villages situated at the same or lower altitudes by gravity.

CHARACTERISTIC OF SPRING IN SOUTH DISTRICT OF SIKKIM:

The Spring occurring in the South district are mainly gravity type and the resulting hydraulic force that brings the water to the surface. The springs present in the area are situated at different elevations. The movement of spring water is mainly controlled by structural set up like joint/fracture/fissure/cracks etc. All spring sources in the area are of perennial nature. The altitude of the identified water sources varies from 1100 to 5400 meter above mean sea level. The discharge of the spring water varies from 8 LPM to 130 LPM

12. GROUNDWATER QUALITY:

Ground water occurs mainly as spring and from the chemical analysis it was observed that the ground water is fresh and suitable for domestic irrigation and industrial uses. In general the spring water is Ca-Mg-HCO₃ type. The quality of spring water is tabulated below –

S.No.	Chemical Constituents	Springs	ICMR Standard for drinking	
			Higher & Desirable Limit	Maximum Permissible Limit
1	2	3	4.a	4.b
1.	Ph	8.2	7.0 – 8.5	6.5 – 9.2
2.	Sp. Conductance in μ/cm at 25°C	26 - 287	800	-
3.	TDS (ppm)			
4.	Total Hardness as CaCO ₃ (ppm)	15 – 130	300	600
5.	Calcium (ppm)	4 – 30	75	200
6.	Magnesium (ppm)	1.21 – 7.29	50	100
7.	Sodium (ppm)	0.2 – 0.7		
8.	Potassium (ppm)	0.4 – 2.9		

9.	Iron (ppm)	0.05 – 0.17	0.1	1.00
10.	Silicon (ppm)	5 – 13	-	-
11.	Bi-carbonate (ppm)	6 – 146	-	-
12.	Chloride (ppm)	7 – 19	200	1000
13.	Sulphate (ppm)	0.43 – 4	-	-
14.	Nitrate (ppm)	1.37 – 2.03	20	100
15.	Fluoride (ppm)	0.12 – 0.29	1.0	-

From the above table, it is observed that quality of ground water collected from the different spring source and the analyses results reveal that quality of water is within the permissible limit of the ICMR standard for drinking water and other domestic use.

CHEMICAL CHARACTERISTICS OF SPRING WATER IN SOUTH DISTRICT OF SIKKIM

- ❖ Water is mostly fresh
- ❖ Generally very soft
- ❖ Mostly Ca-Mg-Hco₃ type of water
- ❖ Fluoride and nitrate is not a problem
- ❖ In a few cases high iron has been observed specially in Namchi Bazar (Kazitar) in South district of Sikkim.
- ❖ Regarding suitability of irrigation from spring and *Khola* water, it is observed that they fall within permissible limit ranging from 0.018 to 2.8 (SAR values).

13. GROUND WATER MANAGEMENT STRATEGY AND RECOMMENDATION. GROUND WATER DEVELOPMENT:

Ground water development in South Sikkim District is very low and in the hilly area the rain water is available in abundance which goes waste

as a rejected recharge. Rainwater conservation i.e., Roof Top Rain Water Harvesting is an option for the villagers. The collected rain water can be used for drinking and other domestic purposes.

PRESENT GROUND WATER UTILIZATION IN THE SOUTH DISTRICT OF SIKKIM.

The area is dominantly inhabited by rural population. The people of the villages situated on the hill slopes, depend mainly on the springs and or nearly perennial *Kholas* for their drinking water supply. The rural works department, Govt. of Sikkim has implemented schemes for water supply to villages in the investigated areas. Springs are mainly tapped for this purpose. Water from these sources are collected in storage tanks from where it is supplied to various villages situated at the same or lower altitudes by gravity. Apart from the schemes implemented by the Rural Works Department, Govt. of Sikkim, there is other local water supply arrangements implemented and maintained by Gram Panchayats and other local agencies. Perennial *nalas* are chiefly tapped for this purpose.

FUTURE GROUND WATER DEVELOPMENT AND MANAGEMENT ASPECTS.

There is a lot of scope for safe development of ground water in the studied area as plenty of water resources have not been harnessed for domestic, irrigational uses.

1. Tapping of water sources located at higher reaches of the hilly terrain in the district to be increased as the population growth is of increasing trend.
2. Part of the town water supply demand can be overcome by constructing "Jack Well" on upstream side of the river bed.

A portion of the unutilized resource can be safely harnessed in the hilly areas of the district.

14. AWARENESS & TRAINING ACTIVITY, MASS AWARENESS PROGRAMME (MAP) AND WATER MANAGEMENT TRAINING PROGRAMME (WMTP) BY CGWB.

At Namchi one Mass Awareness Programme was conducted.

PARTICIPATION IN EXHIBITION, MELA, FAIR ETC.

Nil

PRESENTATION AND LECTURES DELIVERED IN PUBLIC FORUM/RADIO/TV/ INSTITUTION OF REPUTE/GRASSROOTS ASSOCIATIONS/NGO/ACADEMIC INSTITUTION ETC.

National Seminar on Geology Mineral and Water Resources of Sikkim.

Organized by Geological Survey of India, Sikkim Unit on 11th August, 2006.

Presentation: Groundwater condition and feasibility of Tube wells construction in Sikkim.

AREAS NOTIFIED BY CGWA/SGWA.

No area of South Sikkim district has been notified by CGWA/SGWA.

15. WATER CONSERVATION AND ARTIFICIAL RECHARGE.

- ❖ During IX Plan under Central Sector Scheme five numbers of Roof Top Rain Water Harvesting Structures were constructed at five government schools located in and around Sadam area, South Sikkim. .

ARTIFICIAL RECHARGE IN HILLY TERRAIN:

- ❖ In hilly terrain artificial recharge to ground water by rain water is to be avoided because the injected rain water before recharging the ground water might find its way to a stream or it may come out through cracks, fractures etc., causing damages like landslide, collapsing of building etc.
- ❖ In hilly terrain conservation of rain water is a better option and should be conserved in structures above the ground.

16. GROUND WATER RELATED ISSUES AND PROBLEMS IN SOUTH DISTRICT OF SIKKIM.

- ❖ The occurrence of Iron (Fe) in ground water is more than permissible limit (100 mg/l) has been observed in Namchi, South Sikkim.
- ❖ The springs traditionally meet the water demand of local populace. As far as practicable, the spring source must be cleaned, storage tanks of adequate capacity be built up. Wastage of water be minimized and some treatment (both chemical and bacteriological) be done before use for drinking. Sometimes filtration lacunae may cause water borne diseases in the areas.

17. RECOMMENDATIONS:

In the hilly area a separate planning and management to be made for the withdrawal of ground water and for water conservation.

- ✓ Ground water occurs in the hilly area in structurally weak planes mainly joints fractures and small scale faults.

- ✓ The catchment area is characterized by soil covered dense forest. The large and extended catchment area form the reservoir for groundwater supply for springs and *kholas*. The springs and *kholas* are the major source of water supply to the urban and rural community.
- ✓ Structurally weak planes have to be demarcated precisely with the help of remote sensing and geophysical prospecting by spot resistivity survey with “Sp” profiles will help to determine suitably to locate the ground water structure.
- ✓ High hill area like Tendong Hill and Malnam Hill in south district of Sikkim (located in Map) where no ground water structure is feasible, perennial spring can be developed.
- ✓ By conserving battery of perennial spring in an Artificial tanks in the topographical low area may be the best solution in solving domestic water requirements.
- ✓ Rain water conservation i.e., collecting water which can be adopted by the villagers who have homes in the sloping roofs.
- ✓ A filter unit at the top of the tank cleans the water. The tank has a cover to avoid pollution from external sources. The filtered water is collected in a clean vessel places in a small pit dug in the ground, beneath the top of the storage tank.
- ✓ Construction of Jack Well in the vicinity of the river may be encouraged.
- ✓ Conservation structure always helps for gardening and small cultivation land.

