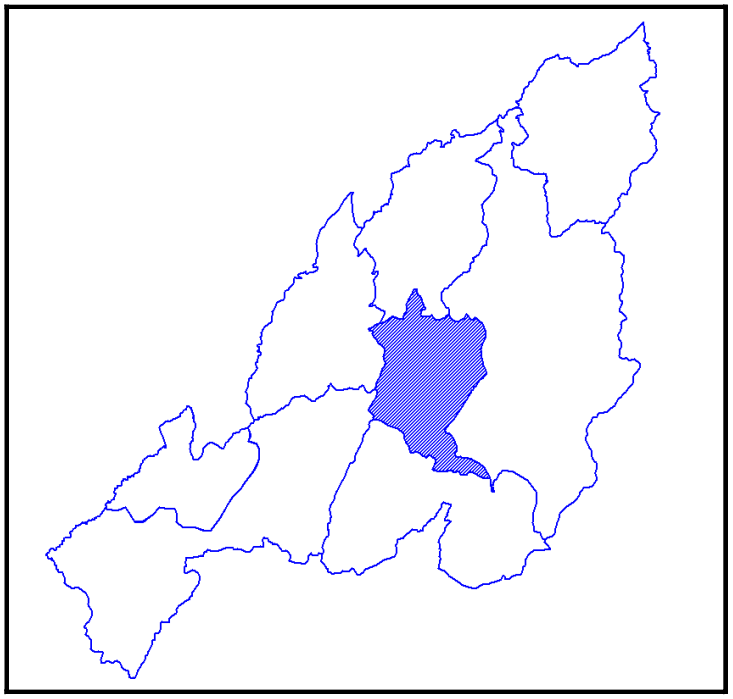
Technical Report Series: D **No:**

Ground Water Information Booklet
Zunheboto District, Nagaland



Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Guwahati
September 2013

DISTRICTGROUND WATER BROCHURE OF ZUNHEBOTO, NAGALAND

DISTRICT AT A GLANCE

Sl.No.	Items	Statistics
1.	**GENERAL INFORMATION**	
	a) Geographical AREA (Sq.Km.)	1255
	b) Administrative Divisions	
	i) Block	6
	ii) Sub-Division	2
	iii) No. of Villages	191(187 habited, 4 uninhabited)
	c) Populatiion as per 2011 Census)	Male-79056, Female-74899 Total-153955
	d) Average annual Rainfall (cm)	200
2.	**GEOMORPHOLOGY**	
	Major Physiographic Units	High hills with deep gorges
	Major Drainages	Tapu, Tizu, Tsutha
3.	**LAND USE (Sq.Km.)**	
	a) Forest Area	1073.0
4.	**MAJOR SOIL TYPES**	Alfisols, Spodosals, Alluvial, Non laterize, Organic
5.	**AREA UNDER PRINCIPAL CROPS (Sq.km.)**	Cereals-222.2 (Paddy-89,Maize-80) Pulses-37.2 (Tur-8.7, Urad-0.9) Oil seeds-91.7 (Soya beans-60.8) Commercial crops-11.4 (Sugarcane-6.5)
6.	**IRRIGATION DATA (Sq.km.)**	
	Irrigation by surface water	Total irrigated area (Net) – 33.0 Irrigated area under crops (Gross) - 40.5
	Irrigation by Ground Water	Nil
7.	**NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB**	
	No. of Dug Wells	Nil
	No. of Piezometers	Nil
8.	**PREDOMINANT GEOLOGICAL FORMATIONS**	Semi consolidated formation – Barail and Disang comprising of Sandstone, sand,silt and shale
9	**HYDROLOGY**	
	Major Water bearing Formation	Fractured and fissured zone of Semi-consolidated formation
10	**GROUND WATER EXPLORATION BY CGWB (as on 31.03.2013)**	
	No. of wells drilled (EW,OW,PZ,SH,Total)	Nil
	Depth of Range (m)	Nil
	Discharge (m^3/hr)	Nil
11	**GROUND WATER QUALITY**	
	Presence of Chemical constituents more	Nil

	than permissible limit	
	Type of Water	Good and can be used for domestic irrigation and industrial purposes.
12	**DYNAMIC GROUND WATER RESOURCES (as on March 2009) in ham**	
	Annual Replenishable Ground Water Resources	1940
	Annual Ground Water Draft	50.98
	Projected demand for domestic and industrial uses up to 2025	79.35
	Stage of Ground Water Development	2.92%
13	**AWARENESS AND TRAINING ACTIVITY**	
	Mass Awareness Progremmes organised	Nil
	Water ManagementTraining Programme organised	
14	**EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING**	
	Projects completed by CGWB (No. & amount spent)	Nil
	Project under technical guidance of CGWB (No.)	Nil
15	**GROUND WATER CONTROL AND REGULATION**	
	Number of OE Blocks	Nil
	No. of Critical Blocks	Nil
	No. of Blocks notified	Nil
16	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	The major ground water related problem of the dist is its availability, utilisation and management in the steep slopes. This has resulted in limited natural recharge creating water deficient areas in the district. The accessibility to the hamlets and villages is a difficult task that is the major impediment in developing the ground water resources in the district. The lack of proper drilling machineries and expertise technologies has compounded the problem further.

1.0 INTRODUCTION

Nagaland is the 16th State of Indian Union comprising of eight districts in total. Zunheboto is one of the eight districts being situated in the central part of the State. The name Zunheboto is derived from two words from sumi dialect namely Zunhebo which is the name of a flowering shrub with white leaves bearing ears like sponge containing sweet juice and to meaning hill top. The main tribes of the district are Sumis(the martial tribe of Nagaland) and Semas (famous for colourful war dances and folk songs).

The district headquarter is Zunheboto which lies between latitude $25^0$58' N and longitude $94^0$31" E. This is also the only town and urban centre situated at a height of 1874 m above mean sea level. It is bounded by Mokukchung district in the North and Wokha district in the South West. To the south of Zunheboto is the Phek district and to the east lay the Tuensang (Refer Plate 1).

As per 2011 Census, the total population is 153955 with 79056 males and 74899 females. The density of population is 123 persons per squre km. The sex ratio is 945 females among 1000 males. The literacy rate of the district is 59% with 49205 males and 41664 female literates.

The total geographical area of the district is 1255 sq. Km. It is basically a hilly one with altitude ranging from 300 to 2500 m above mean sea level. Geomorphologically, the district comprises of high hills with steep gorges and limited intermontane valley. The land utilisation statistics is presented in the Table No. 1.1.

Table – 1.1 Land Utilisation statistics of Zunheboto district

Land classification	Area (sq. km.)
Geographical area	1255
Reporting area	1255
Forest area	1073

Of the total forest area of 1073 sq. Km., moderately dense forests constitute 461 sq.km. and open forest occupies 612 sq. Km. Of the district. Very dense type of forest is absent in the district.

The main occupation of the people is agriculture and most of the people are cultivators. Cereals like paddy, maize etc., Pulses like tur, urad etc., Oil seed like Soya bean, groundnut, sesame, mustard etc. and Commercial crops like sugarcane, potato, ginger etc. are grown extensively. In 2010-11 about 222.2 sq. Km is covered by cereals, 37.2 sq. Km. By pulses, 9.17 sq. Km. By oilseed and 11.4 sq. Km by commercial crops. Weaving and spinning are other significant industries of the district.

As the terrain is hilly and difficult, people practice Jhum or shifting cultivation (slash and burn type) posing great environmental degradation. Terrace cultivation is also practiced to a lesser extend.

The rain fed agriculture is mostly practiced using old traditional cultivation methods and primitive tools. The mountain ecosystem of the district limits the scope for utilisation of water resources for irrigation purposes. Most of the irrigation is dome tapping only the surface water (Table 1.2) with no contribution from ground water. But ground water can play a very pivotal role in irrigation the crops.

Table - 1.2 Irrigated area (sq. Km.) by surface water in Zunheboto

Particulars	1997-98	1998-99	1999-00	2000-01	2010-11
Total irrigated area (Net)	30.5	31.0	32.5	33.0	38.0
Irrigated area under crops (Gross)	37.5	39.0	39.5	40.5	45.5

Thus a perusal of information available on irrigation by surface water shows an increase of area irrigated under crops from 37.5 sq.km. in 2010-11 to 45.5 sq. Km. In 1.11. However, a lot has to be achieved in this direction.

There is no major or medium irrigation projects. Some minor irrigation systems are in vogue like :

a) Diversion of rivers/streams along contour through M.I. channels.
b) Tapping water from rivers/streams and diverting through gravity channels.
c) Surface lift irrigation by pump sets from river/stream in hilly area. However due to steep hill slope and the presence of river being in the valley area, a high lift is involved. So due to power deficiency, high operational and maintenance cost surface lift irrigation is no economically viable.

The rivers belong to both Brahmaputra and Meghna basin. The drainage system is controlled by factors like topography and Geology. The drainage pattern is angular to sub-angular which is structurally controlled. For e.g. the Tizu river is a surficial expression of a major anticlinal axial trace that originates in Tuensang district orienting in the southern direction. Diyung or Tapu river is the longest river of Nagaland, flow along the western edge of the district. Tsutha or Tita river rises in NE part of the district draining the eastern part and joins Tizu river.

There is no major hydel/thermal project in the district, but a mini hydel power project is functioning in Tizu river around Nihoshe village.

2.0 Rainfall & Climate

The average rainfall of the district is about 200 cm. There are about nine rainy months. The highest rainfall is received in the month of July to August with occasional rain from September to October. The dry period is from November to April.

The climate varies in latitudinal and longitudinal directions and is influenced mainly by physiography. Monsoon climate is prevalent through out the year. Winter

is very cold with minimum temperature falling up to 1^0C. December and January are the coldest months of the year. Summers are moderately warm with maximum temperature recorded at 22^0C.

3.0 Geomorphology & Soil Type

The district is an undulatory and hilly one. There are hill ranges with steep slopes. The average altitude of the high hills is from 1000 to 2500 m above mean sea level and the habitation of the people is mostly concentrated at 1500 to 2000 m above mean sea level. The practice of settlement of people at hilltop can be attributed to security concern on account of age-old head hunting practice. Thus approachability to these villages/hamlets is coming in the way of development. About 152 villages are connected with approachable roads and 12 villages have no approachable roads at all. Road transport is the only means of communication.

These hilly terrains are divided into the following geomorphic units :

a) **High structural hills :** This geomorphic unit comprises of linear, curvilinear and irregular hills ranges comprising of semi-consolidated Disang formation. It comprises of Shale and Sandstone.

b) **Denudational structural hills :** This geomorphic unit comprises of long linear and highly dissected, round to flat-topped hills. It comprises of semi-consolidated Barial formation consisting of compact, fine to medium grained sandstone that are less susceptible to erosion.

Soils have been derived from the Tertiary group of rocks. Several types of soils are found to occur as the provenance differs widely. The most common type of soil is the alfisols or red sandy. They are mineral rich, fine-grained loamy type of soil. They have low capacity to hold nutrients. Other less common type of soils occurring sporadically are –

a) Spodosals occurring at high altitude
b) Alluvial soils deposited along river courses
c) Organic or forest soil
d) Non-laterite soil

4.0 Ground Water Scenario

4.1 Hydrogeology

Hydrogeologically the district is covered by semi-consolidated tertiary formations comprising of Disang and Barail Group (Refer Plate II) They have a general trend of NE-SW. The rocks of Disang and Barail formation form wide, long and arcuate belt of flyschoid sediments. They are deformed into open upright folds with vertical and sub-vertical axial plane. The anticline have narrower hinge than the

syncline that are very broad and rounded. They fold with gently plunge towards NNE direction. To the east of Mao anticline lies the axial trace of Zunheboto syncline.

4.1.1 Disang Formation : This formation consists of rocks like shale, sandstone. The shales are grey in colour and splintery in nature. They are flaggy, fine grained in nature that passes upwards into well-bedded sandstones. They are widely believed to be flysch type but the lithological attributes and their biota suggest distal characters. Co-relation and sub division of this type of formation is difficult due to paucity of fossils and the intense deformation that the rocks are subjected to. At many places the shale has been changed into slate due to metamorphism. Though different scholars have assigned different age for the formation but the rock represent the whole of Eocene age with the lower part extending down to Upper Cretaceous. Thus the sediments of Disang group represent trench facies with an age of Upper Cretaceous to Middle Eocene.

Due to tectonic activity experienced during past geological periods, the rocks show development of fractures. This forms secondary porosity and infiltration of ground water takes place in them.

4.1.2 Barail Formation : The name has been derived from the Barail ranges of North Cachar hills that form the watershed between Brahmaputra and Surma valley. It consists of arenaceous sediments like massive sandstone, shale and sandy shale. The fossil content is poor in this type of formation though they are marine to estuarine in large parts. The rocks are Upper Eocene to Oligocene in age. The top of the Barail formation is marked by pronounced unconformity indicating up liftment and erosion. Due to tectonic disturances the rocks have developed secondary porosity and fissured medium holding ground water.

Thus from hydrogeological point of view the occurrence of ground water in the semi-consolidated formations is related to the formation of secondary porosity and fissured medium. They are found to form moderate yielding aquifer in the valley areas.

4.2 Ground Water Resources

The ground water resource estimation has been computed based on the guidelines and recommendations of GEC 97. Two approaches have been adopted in this methodology :

a) Water level fluctuation method
b) Rainfall infiltration method

As the data on ground water level is insufficient, the rainfall infiltration method is used for calculating the resource estimation. As per the Rainfall Infiltration Factor method, recharge from rainfall is given by the following formula :

$(R_f) = RIF * A * NMR$

Where RIF = Rainfall infiltration factor

A = Area of computation for recharge
NMR = Normal monsoon rainfall

The hilly areas with slope greater than 20% have been excluded from the computation, as they are not worthy of ground water recharge. As there is no poor quality, command/non command areas, so computation of ground water resource is done only for monsoon and non-monsoon season.

Recharge from sources other than rainfall, ground water irrigation, recharge from ponds and tanks, check dams nalla bunds is taken as **nil** for the district. The total annual recharge is obtained as the arithmetic sum of recharge from rainfall and the recharge from sources other than rainfall. Thus Ground Water Resource Potential for Zunheboto district of Nagaland (as on March 2009) in ha m is as follows (Table4.2.1 and 4.2.2).

Table 4.2.1 – Net ground water availability of Zunheboto district of Nagaland (ha.m)

Annual replenishable Ground Water Resources				Total annual ground water recharge	Natural discharge during non-monsoon season	Net ground water availability
Monsoon season		Non Monsoon season				
Rainfall Recharge	Recharge from other source	Rainfall recharge	Recharge from other source			
1358	0	582	0	1940	194	1746

Table 4.2.2 – Ground Water Resource Potential (ha.m) in Zunheboto district of Nagaland

Net Ground Water availability	Annual Ground Water Draft			Projected domestic & industrial uses up to 2025	Ground water availability	Stage of ground water development
	Irrigation	Domestic & total industrial uses	Total			
1746	0	50.98	50.98	79.36	1666.52	2.92%

The ground water resource estimation indicates that the net ground water availability in Zunheboto district is 1746 ha. m. About 1830 ha. M of ground water is available for future irrigation. So there is tremendous potential for ground water usages in Irrigation sector. In 2025, the projected domestic and industrial use of ground water will be 79.36 ha. m. The stage of ground water development is only 2.92% and there is scope for ground water potential and exploitation.

4.3 Ground Water Quality

The water is good and can be used for drinking, irrigation and industrial purposes. There are no reports of poor water quality in the district.

Central Ground Water Board has not carried out any water sampling in the district. There is dearth of data on water quality. However a scientific approach is required in tandem by different Government agencies to carry out water sampling and their analysis to form a database on water quality.

4.4 Status of Ground Water Exploration and Development

Ground water exploration has been initiated in Nagaland but Central Ground Water Board has not carried out any drilling in Zunheboto district. The department has carried out drilling only in Kohima and Mokukchung district.

As per data available from State agency, out of 191 villages, there are 141 numbers of villages with water supply. As the village people reside on hilltops and ridges a lot of effort has to be made for providing water to them. Most of the water sources like springs and streams are situated at foothills that are non-perennial in nature drying up in winter and are not free from pollution. However, being a hilly area with negligible valley area the scope for Ground Water Exploration and Development is negligible and marginal.

5.0 Ground Water Management Strategy

5.1 Ground Water Development

The ground water development is mostly confined to the valley portion as they are the most promising zones for ground water development. As the valley portion in the Zunheboto district is negligible so the development of ground water is yet to be initiated. Development in other hilly and steep areas is yet to pick up, as approachability is one of the main constrain hindering the status of Ground Water Development. Also because of rough and rugged terrain condition, movement of drilling rig/machineries are very difficult. However the steep slopes can be targeted for water and soil conservation methods that will aid in storing run off as well as intercepting the base flow.

Spring can be play a pivotal role in meeting the water requirement. Proper development and scientific approach of spring is required to augment the existing water supply. Moreover rainwater can be harvested through construction of suitable roof top rain water harvesting structures**.**

6.0 Ground Water Related Issues and Problems

The major ground water related problem in the hilly district is its availability, utilisation and management in the steep slopes. This has resulted in limited natural recharge creating some water deficient areas. The accessibility of the hamlets and villages is a difficult task, which is the major impediment in developing the ground

water resources. The lack of proper drilling machineries and expertise technologies has compounded the problem further.

7.0 Recommendation

Zunheboto district is a hilly one with negligible valley areas. In such tough and rugged terrain, studies of satellite imageries and aerial photographs can be of great help. Lineaments such as faults, fractures that are not identifiable on the ground can be of great importance in ground water prospecting if they are studied on imageries in conjunction with topography and drainage studies. The steep slopes can be targeted for water and soil conservation methods that will aid in storing run off as well as intercepting the base flow. In the foothills where most of the precipitations get wasted as surface runoff, the area can be effectively utilised for augmentation of ground water by constructing conservation structures such as gully plugging, check dams, check weirs and counter bunding.

As the district is covered under ground water exploration programme, scientific studies in tandem with modern sophisticated equipments are essential for selection of sites for bore well. This will help in generating database for hydrogeological parameters and developing strategies for ground water development. Existing ground water structures are to be identified and water level is to be monitored under National Hydrograph Network Stations Monitoring Programme. Such structures can also be included under participatory Ground Water Monitoring Programme by involving the local people.

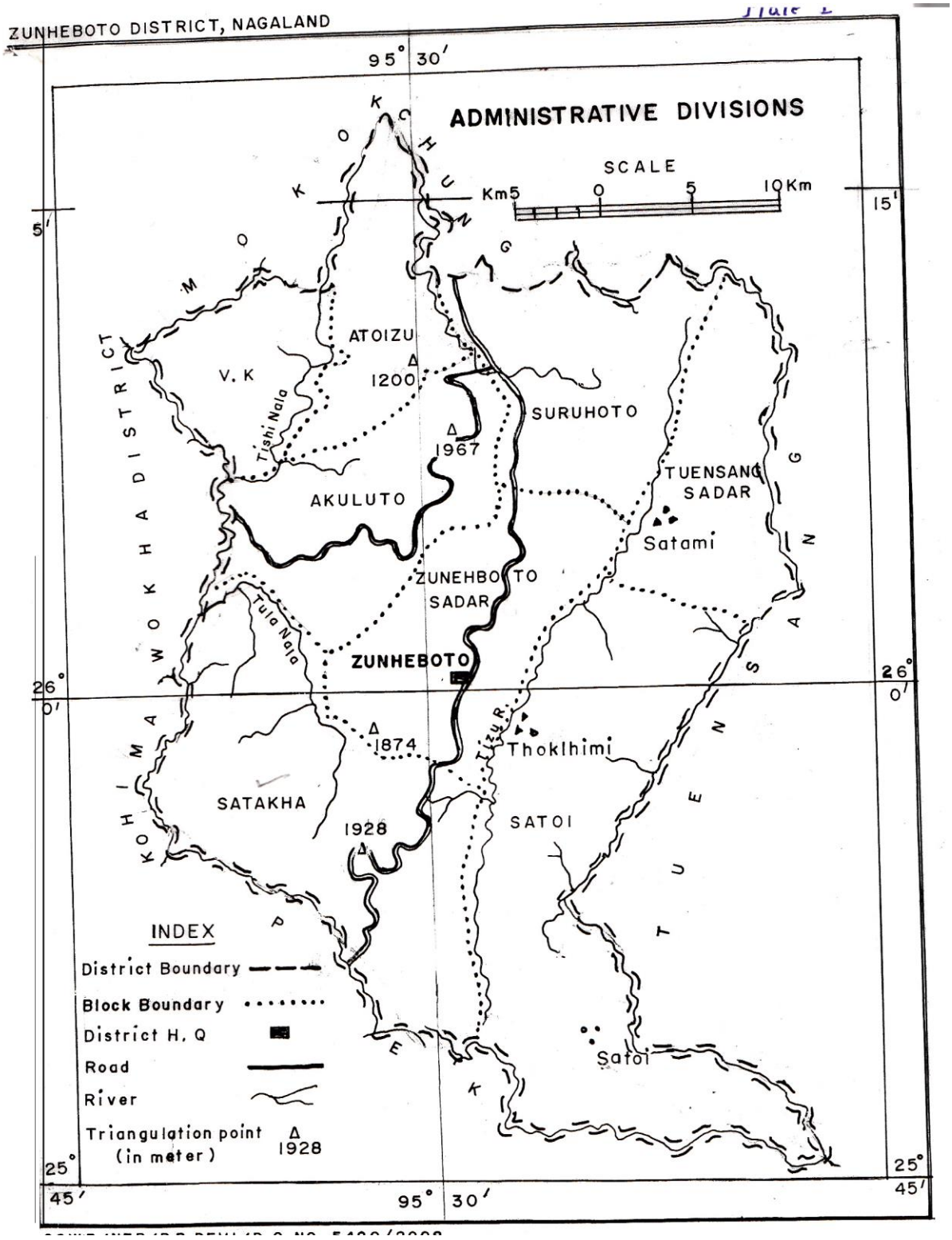
Common people are to be educated in the field of roof top rainwater harvesting, ground water extraction structures, creation of in situ water harvesting and storage tanks. General awareness is to be created among the local people about the natural hazards of shifting cultivations like land, soil and environmental degradations. Terraced cultivation is to be popularised in place of shifting cultivation. Awareness is to be generated among the mass for proper utilisation, management, pollution and artificial recharge aspect of ground water.

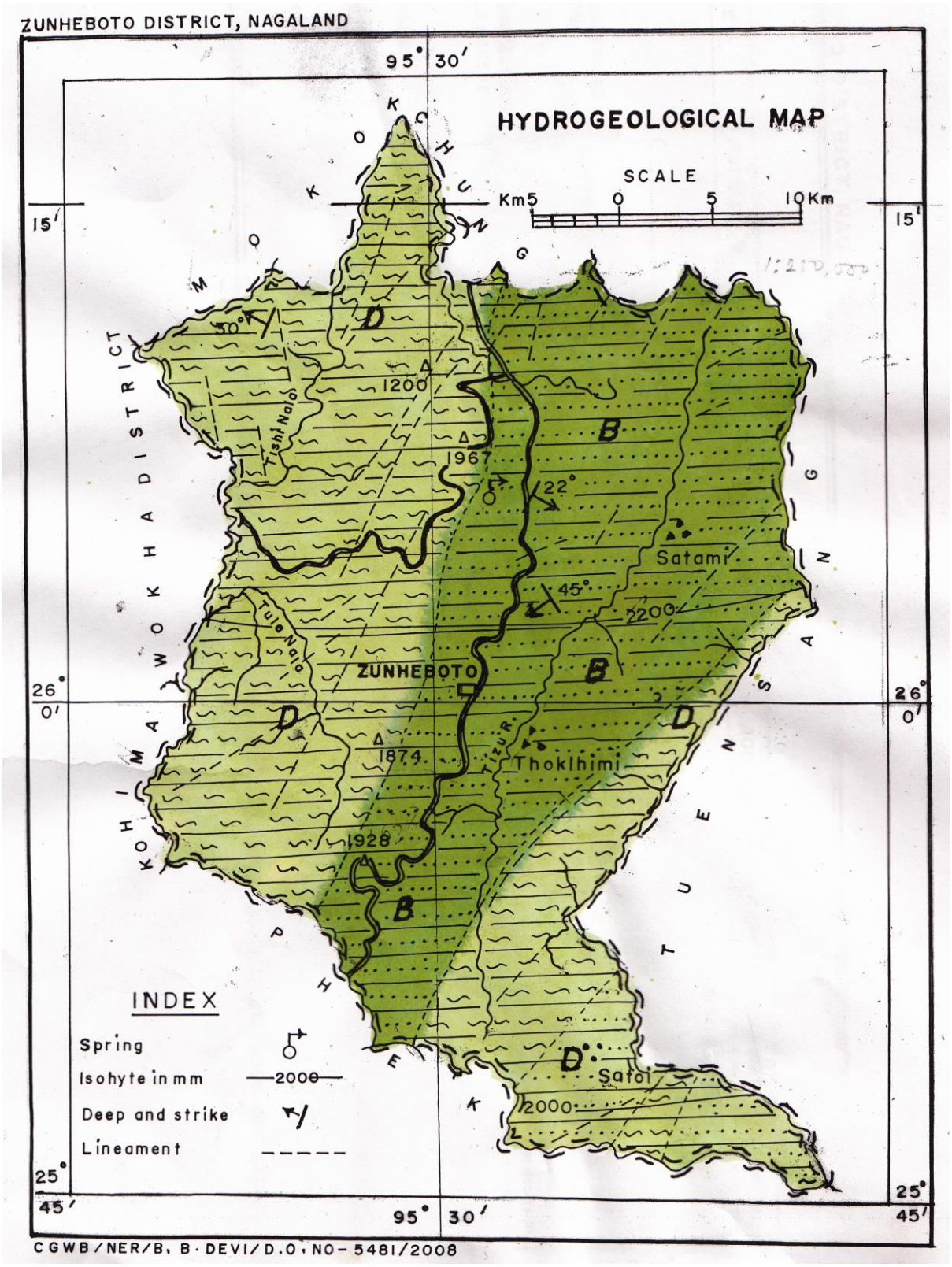
There is dearth of chemical analysis results. So ground water quality monitoring programme can be initiated in the district. Sites are to be identified, samples are to be collected and analysed for drinking water standards.

Spring occurring in the slope of hill ranges can play a pivotal role in meeting the water requirement for drinking and irrigation purposes. These springs can be developed scientifically for providing water and efforts should be made to make it pollution free. A systematic and scientific approach is required in this direction.

Development of ground water in the district is only 3% and is at the nascent stage. There is scope of ground water development for drinking, irrigation and industrial purposes. It can mainly be done through dug well and bore well in the available intermontane valley areas. As ground water is poorly developed, dug wells are the preferred structures as of now. Both Central and State Government agencies

have to carry out scientific investigations and exploration to harness the ground water resources.


ZUNHEBOTO DISTRICT, NAGALAND
ADMINISTRATIVE DIVISIONS
SCALE
Km5 0 5 10Km
95° 30′
5′
15′
26° 0′
25° 45′
KOHIMA DISTRICT
WOKHA DISTRICT
TUENSANG
ATOIZU
V. K
Δ 1200
Tishi Nala
SURUHOTO
Δ 1967
AKULUTO
TUENSANG SADAR
Satami
ZUNEHBOTO SADAR
Tula Nala
ZUNHEBOTO
Δ 1874
Thoklhimi
SATAKHA
1928 Δ
SATOI
Satoi
INDEX
District Boundary
Block Boundary
District H. Q
Road
River
Triangulation point (in meter) Δ 1928


ZUNHEBOTO DISTRICT, NAGALAND
HYDROGEOLOGICAL MAP
SCALE
Km5 0 5 10Km
95° 30'
15'
26° 0'
25° 45'
KOHIMA DISTRICT
WOKHA DISTRICT
MOKOKCHUNG
TUENSANG
PHEK
ZUNHEBOTO
Satami
Thoklhimi
Satoi
Tizu R.
Tsehi Nala
Tule Nala
1200
1967
1874
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2200
30°
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INDEX
Spring
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Deep and strike
Lineament
CGWB/NER/B. B. DEVI/D.O. NO-5481/2008

ZUNHEBOTO DISTRICT, NAGALAND

Legend

AGE	FORMATION	LITHOLOGY (with geomorphic unit)		AQUIFER DISPOSITION	GROUND WATER POTENTIAL
					Fissured Media
		UNCONFORMITY			
UPPER EOCENE TO OLIGOCENE	Semi-Consolidated BARAIL	Denudo-structural hills, long linear and highly dissected round to flat topped hills consisting of beded compact, fine to medium grained sandstone mostly less susceptible to erosion.			
UPPER CRETECEOUS — MIDDLE EOCENE	DISANG	High structural hills, linear, curvilinear and at places irregular hill ranges and narrow montane valleys consisting of shale and sandstone.		Ground water restricted to weathered mantle and fractured-development.	Run off zone, Ground water occurs as spring in filtration to ground water is controlled by development of secondary porosity in rocks caused due to action of tectonic elements.