Technical Report Series: D **No:**

Ground Water Information Booklet
Kohima District, Nagaland

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

September 2013

KOHIMA DISTRICT
AT A GLANCE

Sl No.	ITEMS	STATISTICS
1.	**GENERAL INFORMATION**	
	i) Geographical area (sq. km) ii) Administrative divisions iii) Population (2011census)	1041 365017
	iv) Average annual rainfall (mm)	2000-2500
2.	**GEOMORPHOLOGY**	
	Major physiographic units Major drainages	High to moderate structural hills, Denudo- structural hills. Dzuza, Dzula, Dzutsuru, Dzucharu etc
3.	Total forest area (Ha)	286500
4.	**MAJOR SOIL TYPES**	Red Clayey soil
5.	**AREA UNDER PRINCIPAL CROPS,**	Cereals (3370 ha) Pulses (4030 ha) Oilseeds (5260 ha) Commercial crops (2150 ha)
6.	**IRRIGATION** (hectares)	
.	Net Area Irrigated	7057
7.	**NUMBERS OF GROUND WATER MONITORING WELLS of CGWB** (as on 31.12.2010) No of dug wells No of Piezometers	 2 1
8.	**PREDOMINANT GEOLOGICAL FORMATIONS**	Plio-Pleistocene, Tertiary group
9.	**HYDROGEOLOGY**	
	Major water bearing formation • (Pre-monsoon depth to water level during 2012) • (Post-monsoon depth to water level during 2012)	Semi-consolidated Tertiary formation 4.41 to 7.22 mbgl 3.98 to 4.68 mbgl
10.	**GROUND WATER EXPLORATION BY CGWB** (as on 31.12.2013)	Nil
11.	**GROUND WATER QUALITY** Presence of chemical constituents more than permissible limits	 Generally good and suitable for domestic and industrial purposes

12.	**DYNAMIC GROUND WATER RESOURCES** (2009) mcm Net Ground Water availability Net Annual Ground water draft Stage of Ground Water Development	 33.69 0.72 2.13 %
13.	**AWARENESS AND TRAINING ACTIVITY**	
	Mass awareness programme & water management training programme organized	Nil
14.	**EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING**	
	Project Completed by CGWB (No. & amount spend) Project under technical guidance of CGWB (nos.)	Nil Nil
15.	**GROUND WATER CONTROL & REGULATION** (No. of OE blocks / Critical blocks/ Semi-critical blocks/ Notified areas)	 Nil
16.	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	District is receiving good amount of rainfall but due to hilly nature most of it goes as runoff. As a result ground recharge is little. Ground water development and management in the steep slopes/ hilly areas of the district is a problem.

1.0 INTRODUCTION

Kohima district lies in the southern part of Nagaland covering an area of 3114 sq.km. . When Nagaland became a full fledged state on 1st December 1963, Kohima town was declared as the state capital. Since then, parts of Kohima district had been curved out to create different districts, Phek district (1973), Dimapur district (1998) and Peren district (2004). Presently, the total geographical area of the district is 1041 sq.km. The district is bounded by Wokha district in the north, Zunheboto and Phek district in the east, Manipur in the south and Peren and Dimapur district in the west. The average altitude of Kohima city is 1444 m above MSL. The total population of Kohima district is 365017 as per 2011 census.

Agriculture

Agriculture is the main occupation of the people in the district. Cereals like paddy, maize, millets, jowar etc and pulses like arhar, mong, peas, lentils etc are grown extensively along with seasonal vegetables and fruits. In addition, oilseeds like soya bean, groundnut, mustard and commercial crop like sugar, cotton, jute, potato, tea etc are cultivated. Table 2 presents the agricultural details of the district for the year 2006-07.

Table 2: Area and production of principal crops in the district

Crops	**Area (hectare)**	**Production (MT)**
Cereals	3370	53820
Pulses	4030	4960
Oilseeds	5260	4640
Commercial crop	2150	31370

Source: Statistical Handbook of Nagaland, 2007

Agriculture in the district is mostly practiced by age old traditional cultivation methods with and primitive tools. The mountainous topography limits the scope for utilization of ground water resources for irrigation purposes. As the district is hilly, jhum/shifting cultivation (slash and burn type) is practiced. However, terrace cultivation is also practiced to a lesser extend in moderately sloping area.

Irrigation

Irrigation practices in the district is still at nascent stage. Most of the irrigation is done by tapping only the surface water with no or little contribution from ground water. There is scope for irrigation through ground water.

2.0 RAINFALL & CLIMATE

The climate is salubrious with winter cold and summer warm. The average rainfall of the district is about 2000 mm. There are about nine rainy months. Most of the rainfall is received in the month of July to August with occasional rain from September to October. Winter is very cold with minimum temperature falling down to 1°C. December and January are the coldest months of the year. Summer is moderately warm with maximum temperature recorded at 22°C.

3.0 GEOMORPHOLOGY & SOIL TYPE

Geomorphologically, the district can be categorised under the following heads

Low to Moderate Hills – Low lying dissected, sub-parallel hills aligned in NE-SW with limited valley formation are found to occur in the western part of the district. Rock types constitutes of sandstone, siltstone, shale and mudstone.

Moderate Structural Hills – Moderately high linear structural hills with narrow valleys occupy north central part of the district. Hills constitute of semi-consolidated sandstone, siltstone, shale and claystone and show high degree of erosion.

Denudo-Structural Hills – Linear, curvilinear and irregular shaped denuded hills associated with small valleys are found to occupy south-central part of the district. These are predominantly composed of semi-consolidated sandstone, shale with lesser degree of erosion.

High Structural Hills – Long linear parallel to sub-parallel rigid hills occupy central and south-western part of the district. These comprise hard and compact sandstone, shale, siltstone mainly having low erosional activity.

Soils

Soils have been derived from the Tertiary group of rocks. The most common type of soil found in the district is red clay soil.

4.0 GROUND WATER SCENARIO

4.1 Hydrogeology

Hydrogeologically the district is covered by semi-consolidated Tertiary group comprising of Disang, Barail, Surma and Tipam formation.

4.1.1 Disang Formation: This formation consists mainly of rocks like shale, sandstone. The shales are grey in colour and splintery in nature with interbedded sandstone. At places 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 sediment of Disang group represents trench facies with an age of Upper Cretaceous to Middle Eocene. Due to tectonic activity experienced during the past geological periods, the rocks developed fractures and joints. This forms secondary porosity and recharge to ground water takes place through these fractures and joints.

4.1.2 Barail formation: 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 of marine to estuarine origin in large parts. The rocks are of Upper Eocene to Oligocene in age. The top of the Barail formation is marked by a pronounced unconformity indicating upliftment and erosion. Due to tectonic disturbances the rocks have developed secondary porosity and fissured medium that is holding ground water.

4.1.3 Surma formation: This formation consists of low to moderate structural hills consisting of clay, shale, siltstone, mudstone and ferruginous sandstone with sandy shale and conglomerate. In this formation ground water is restricted to weathered mantle and fractures.

4.1.4 Tipam formation: This formation comprises of rocks like clay, shale, coarse to gritty ferruginous sandstone and conglomerate. They form moderate structural hills and the valleys underlain by Tipam sandstones form good yielding aquifer zones at greater depths.

4.2 Ground Water Resources

The Ground water resource estimation has been computed based on the guidelines and recommendations of GEC 97. 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 for ground water resource is done only for monsoon and non-monsoon season.

Recharge from sources other than rainfall such as ground water irrigation, recharge from ponds and tanks, check dams and 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 the (2011) is shown in Table 4 .

Table 4: Ground Water Resource Potential (mcm) in Kohima district of Nagaland:

Net ground water availability	Annual Ground Water Draft			Projected Domestic & industrial uses up to 2025	Ground water availability for future irrigation	Stage of ground water development
	Irrigation	Domestic & Total Industrial uses	Total			
33.69	0	0.72	0.72	1.57	32.12	2.13

4.3 Ground water quality:

Generally, the water is good and suitable for drinking, irrigation and industrial purposes. However, a scientific approach is required to carry out systematic chemical analysis of ground water in the district.

4.4 Status of Ground Water development:

In the district, most of the water supply is met through springs and streams. Central Ground Water Board has not carried out any drilling in the district. However, the State Government had carried out exploration activities in and around Kohima city to augment the water supply. Some of the tube well drilled by Department of Geology and Mining, Government of Nagaland is given in table 6.

Table 6: Details of wells drilled by DGM, Nagaland

Well Location	**Depth of drilling/ Constructed**	**DTWL Mbgl**	**Drawdown (m)**	**Discharge** (ltr/hr)
Raj Bhavan Complex	**58.37**	39.80	**5.98**	7000
Indira Gandhi Stadium	**62.00**	26.46	**6.88**	7500
Planning & Co-ordination Residential Complex	**59.50**	27.30	**7.40**	9000
Nagaland Assembly Secretariat Complex	**120.00**	4.30	**28.50**	6000
Administrative Training Institute	**113.00**	Well Abandoned		

5.0 GROUND WATER MANAGEMENT STRATEGY

The ground water development is mostly confined to the valley portion as they are the most promising zones for ground water development. The peneplained surfaces, buried pediments and the valley fills are the most favorable places for ground water development. The narrow, linear valleys and inter montane valley offers scope for development of ground water. Structures like ring/ dug well, shallow and deep bore well are the feasible ground water structures. As ground water is poorly developed/ exploited, dugwells are the preferred structures as of now in low-lying areas and valleys. Hydrogeological studies indicate that lineament, joints, fractures and fault are the main controlling factors for the occurrence and distribution of ground water. These structures can be tapped for ground water development. However, the potential zones / fractures must be confirmed by electrical resistivity survey before deploying suitable drilling rigs.

Ground water development in hilly and steep areas is yet to pick up. Approachability is one of the main constrain that is hindering ground water development. 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.

6.0 GROUND WATER RELATED ISSUES AND PROBLEMS

The district being hilly with negligible valley area the scope for ground water exploration and development is negligible and marginal. The district receives good amount of annual rainfall but due to steep slopes most of this rainwater goes as surface runoff. This resulted in very limited natural recharge to ground water. One of the major problems in the hilly district is utilization and management in the steep slopes. The accessibility of the hamlets and villages is a difficult task, which is another major impediment in developing the ground water resources.

7.0 RECOMMENDATIONS

i) Stage of development of ground water in the district is 2.13% and it is mainly restricted to the valley portion. Ground water development is being done through dug wells and bore wells in the low-lying intermontane valleys.

ii) The peneplained surfaces, buried pediments and the valley fills are the most favorable locales for the development of ground water. The narrow, linear valleys and intermontane valley offers scope for development of ground water.

iii) Hydrogeological studies indicate that lineament, joints, fractures and fault are the main controlling factors for the occurrence and distribution of ground water. These geological structures can be tapped for ground water development.

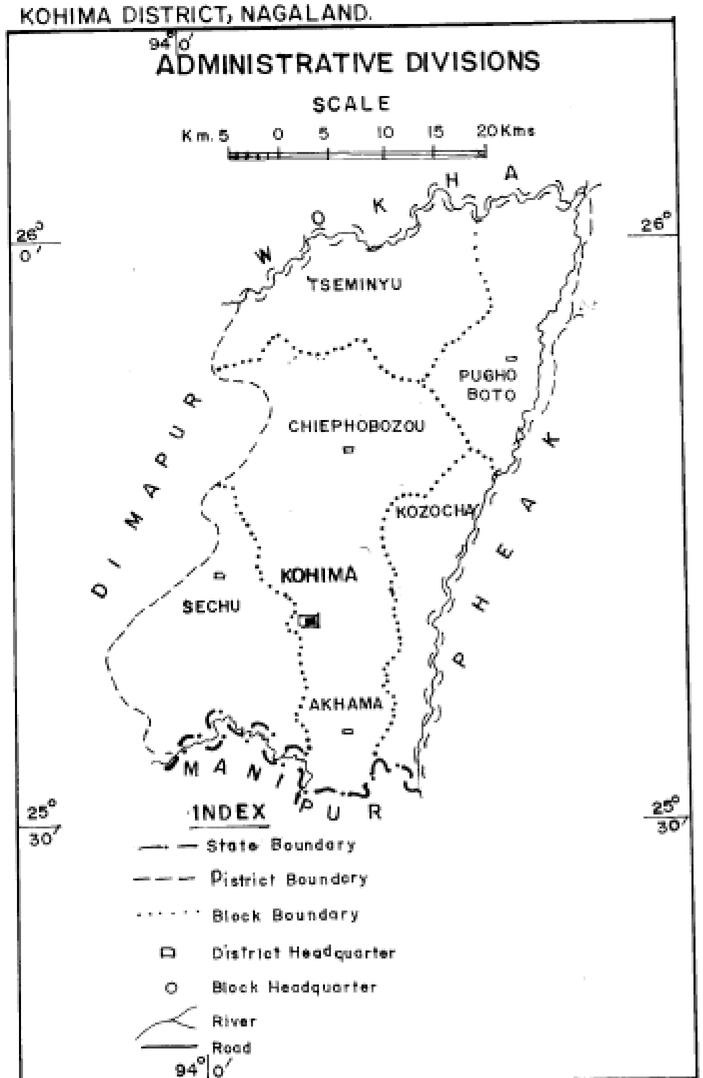
iv) The potential zones / fractures must be confirmed by electrical resistivity survey before deploying suitable drilling rigs.

v) Structures like ring/ dug well, shallow and deep bore well are the feasible ground water structures. However priority should be for the construction of dug wells having depth in the range of 10 to 15m and diameter in the range of 2 to 5m depending upon their requirement. The well has to be properly curbed to avoid collapse of weathered zone. Bore well can be drilled in such formation down to a depth of about 100-150m tapping about 2 to 4 fractured zones.

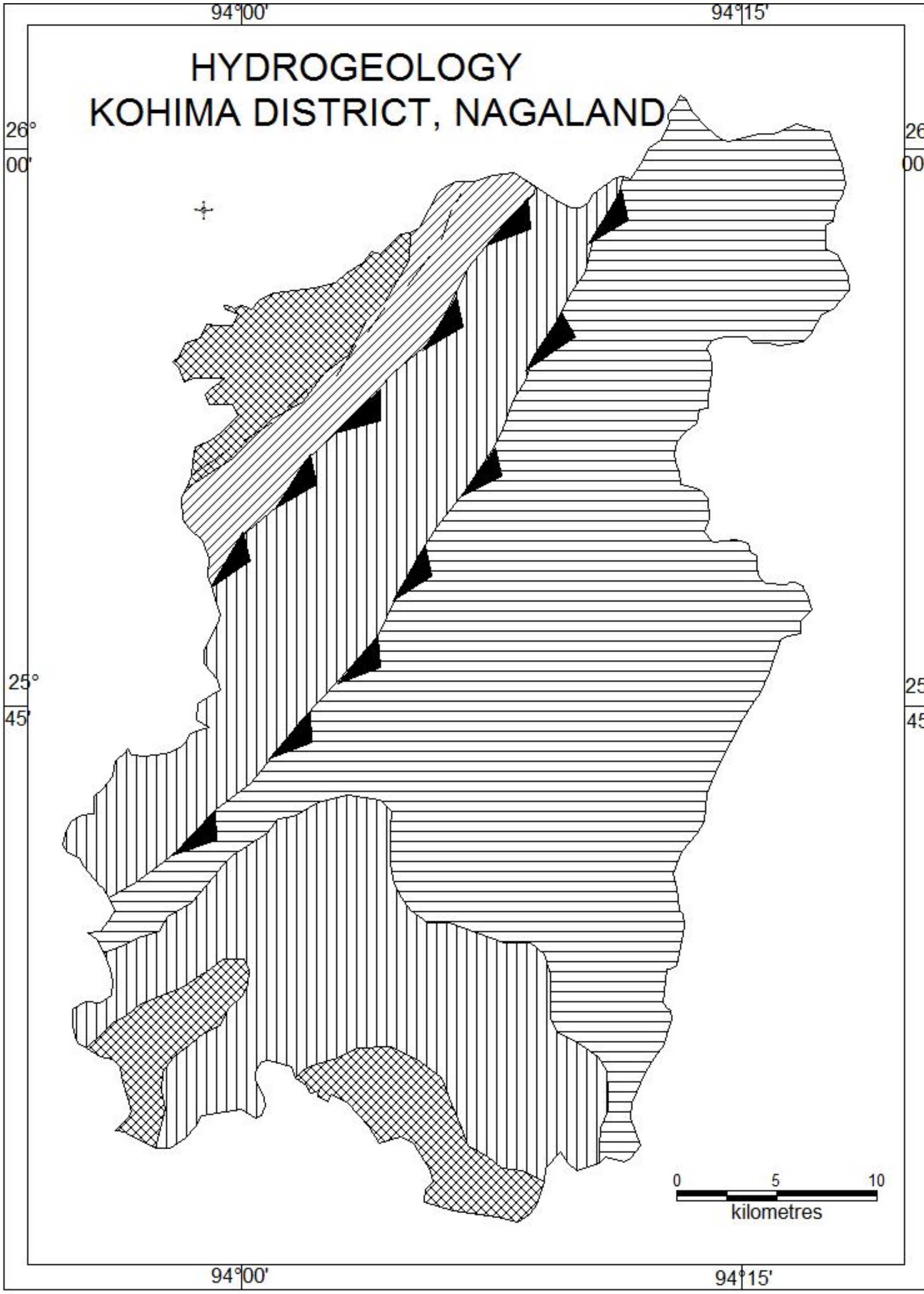
vi) Springs play a major role to meet the water requirement of rural people. It is found that the location of the spring is mainly in foothills and intermontane valleys. It may be recommended that the development of springs having high discharge will help in mitigating the water requirement of the people to a great extent.

vii) In the hilly portions of the district, roof top rainwater harvesting should be adopted effectively to meet the demand of the people residing on hilltops. In the foothills of the state where most of the precipitation get wasted as surface runoff, the area can be effectively utilized for augmentation of ground water by constructing structures such as check dams, gabions and check weirs. In doing so, the water level on the upstream can be raised to a considerable extent, saturating the dry zone of the aquifer. Gully plugging and contour bunding will be effective means of augmentation of ground water.

KOHIMA DISTRICT, NAGALAND.



C.G.W.B.N.E.R.D.O.No - 5410/08 M. Borpujari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HYDROGEOLOGY
KOHIMA DISTRICT, NAGALAND
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LEGEND

AGE	FORMATION	LITHOLOGY	AQUIFER DISPOSITION	GROUND WATER POTENTIAL
UPPER TO MIDDLE MIOCENE	Tipan	Moderate structural hills consisting of clayshale, coarse to gritty ferrugenous sandstone and conglomerate	The valley Underlain by Tipan sanstone form good aquifers	Good recharge zone from high to moderate yield at deeper depth
LOWER MIOCENE	Surma	Low to moderate structural hills consisting of clay, siltstone, mudstone and ferrugenous sandstone with sandy shale and conglomerate.	Ground water restricted to weathered mantle and fracture development	Fissured Media --Runoff zone, ground water occurs as spring. Infiltration to ground water movement is controlled by development of secondary porosity in rocks cause due to action of tectonic element
UNCONFORMITY				
UPPER EOCENE TO OLIGOCENE	Barial	Denudo-structural hills, long linear ridges and highly dissected round to flat topped hills consisting of bedded compact fine to medium grained sanstone mostly less susceptible to erosion	Ground water restricted to weathered mantle and fracture	Fissured Media --Runoff zone, ground water occurs as spring. Infiltration to ground water movement is controlled by development of secondary porosity in rocks cause due to action of tectonic element
UPPER CRETACEOUS TO MIDDLE EOCENE	Disang	Highly structural hills, linear, curvilinear and at places irregular hill ranges and narrow inter-montane valleys consisting of shale and sandstone		

LINEAMENT

THRUST