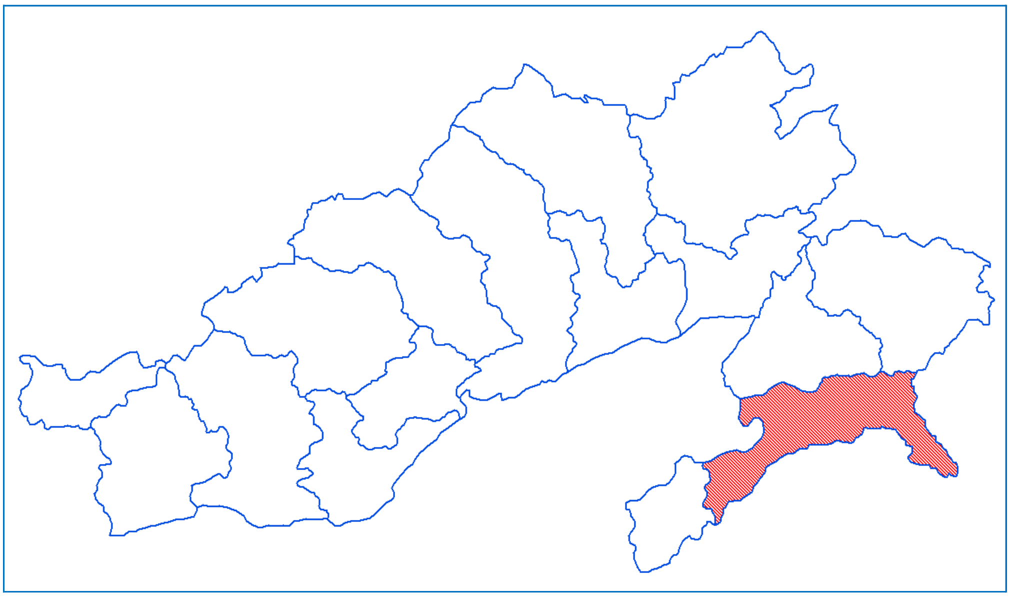
Technical Report Series: D No:

Ground Water Information Booklet
Changlang District, Arunachal Pradesh



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

CHANLANG DISTRICT AT A GLANCE

Sl.No	ITEMS	Statistics
1.	GENERAL INFORMATION	
	i) Geographical area (sq. km)	4662
	ii) Administrative Divisions (As on 31st March 2011) Number of Tehsils/Block Number of Panchayat/Villages	4 subdivisions and 5 CD blocks 315/334
	iii) Population (As on 2011 Census)	1,47,951
	iv) Average Annual Rainfall (mm)	2913.8
2.	GEOMORPHOLOGY	
	Major physiographic units	Alluvial plains, low to moderate linear ridges, moderate hills and high hills
	Major Drainages	Noa Dihing, Khaikha, Namphuk, Dapha and Tirap
3.	LAND USE (sq. km)	
	a) Forest area (Reserved Forest):	2785.45
	b) Net area sown	209.05
	c) Cultivable area	283.27
4.	MAJOR SOIL TYPES	Alluvial and residual soils
5.	AREA UNDER PRINCIPAL CROPS (As on 2005-2006) (in sq. km)	102.60
6.	IRRIGATION BY DIFFERENT SOURCES (Areas and numbers of Structures)	
	Dug wells	1
	Tube wells	9
	Tanks/ ponds	Data not available
	Canals	28
	Other sources	296 surface flow schemes
	Net irrigated area	50.16
	Gross irrigated area	50.16
7.	NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (As on 31-3-2013) No. of Dug Wells No. of Piezometers	4 Nil
8.	PREDOMINENT GEOLOGICAL FORMATIONS	Recent and sub recent alluvium
9.	HYDROGEOLOGY	Consolidated, semi-consolidated and

		unconsolidated formations
10.	GROUND WATER EXPLORATION BY CGWB (As on 31-03-2013)	
	No of wells drilled (EW, OW, PZ, SH, Total)	7 EW
	Depth Range (m)	55.0 to 134.0 m
	Discharge (litres per second)	1.5 to 17.1 lps
	Storativity (S)	
	Transmissivity (m^2/day)	467 to 2314 m^2/day
11.	GROUND WATER QUALITY	
	Presence of Chemical constituents more than permissible limit	Iron
	Type of water	Slightly alkaline (pH=6.8 to 7.9) and soft
12.	DYNAMIC GROUND WATER RESOURCES (2009) in mcm	
	Annual Replanishable Ground Water Resources	288.45
	Net annual Ground Water Draft	0.26
	Projected Demand for Domestic and Industrial Uses up to 2025	1.56
	Stage of Ground Water Development	0.098%
13	AWARNESS AND TRAINNING ACTIVITY	
	Mass Awareness Programme organized Date Place No. of Participants	Nil
14.	EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING	Nil
	Projects completed by CGWB (No & Amount spent)	Nil
	Projects under technical guidance of CGWB	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	High Fe content in some localities.

1.0 Introduction

The Changlang district of Arunachal Pradesh lies between the Latitudes 26°40'N and 27°40'N, and Longitudes 95°11'E and 97°11'E It is bounded by Tinsukia District of Assam and Lohit District of Arunachal Pradesh in the north, by Tirap District in the west and by Myanmar in the south-east (Map: 1). Administratively the district is divided into four subdivisions, *viz.*, Changlang, Jairampur, Miao and Bordumsa and within the subdivisions there are five community development blocks. There are 317-gram panchayats and under which there are 334 villages. As per 2001 census the population of the district is 1, 25,334.

All the rivers in the district flow to the Brahmaputra and the area comes under Brahmaputra basin.

The major Rivers are Noa-Dehing, Namchik and Tirap. Other Rivers are Namphuk, Dapha, Namphai, Tissu, Tarit, Tara, Tikeng, and Tiging. Most of the rivers after winding through the hills and valleys come down to the plains and join Buri-Dihing River. The Noa-Dihing River, which originates from Patkai Range flows east to west through the entire northeastern and northern stretch of the District. The Tirap rises from a high peak between Laju and Wakka and flows Southwest to Northeast passing through the Changlang town ultimately meet Buri-Dihing near Lekhapani in Assam. The drainage density is moderate to high indicating the compactness of the formations.

Major parts of the district are hilly with rugged terrain and have a thick forest canopy. Plain areas are found only in Miao, Diyun, Bordumsa and Kharsang circles and a few narrow strips of flat land in some parts of Changlang, Jairampur, Vijoynagar, Nampong and Namtok circles and compared to the total area of the district plain area is meager, i.e., only 530 sq.km. However, Irrigation and Flood Control Department of the state has commissioned nine minor irrigation schemes in Changlang, Kharsang and Diyun circles and total irrigated land is 451 sq.km by creating canals of total length 11, 810m as per 2001 census. There are one dug well constructed in 2000 – 2001 for irrigation purpose. Except that all other minor irrigation schemes are surface water flow schemes.

Central Ground Water Board, North Eastern Region, Guwahati has initiated its activities in the form of Systematic Hydrogeological Survey during 1987 – 88 and 1989- 90 covering an area of 3570 sq.km. and work had been carried out by Sri P. Kalita, Scientist – B and Sri U. Gogoi, Scientist –B. In the year 2005 -06, Sri N. Chusi, Scientist – B, CGWB, State Unit Office, Naharlagun, A.P., carried out the Ground Water Management Studies in the district covering an area of 3200 sq.km. Besides these works the apex organization has so far drilled in seven locations exploring down to a depth of 134 m.

2.0 Rainfall & Climate

The rainy season starts from April and continues up to September. There is a sharp variation in the quantity of rainfall at different places depending upon the geographical setting and topography of the area. The district experiences an average rainfall of 3800mm to 4866mm.

The district enjoys a sub – tropical to temperate climate. The climatic conditions vary from place to place due to mountainous nature of terrain. The altitudes also vary from 200 meters to 4500 meters over the peaks from sea level. Places like Miao, Kharsang, Jairampur, Bordumsa and Diyun, which are located in lower elevations and in the valleys, experience hot and humid climate in summer during June-August. In the hill areas the climate is moderate and pleasant. December to February months is cold. January is the coldest month when the average maximum and minimum temperature is about 22^0C and 13^0C respectively. August is the hottest month during which temperature may occasionally exceed 30.2^0C. The average maximum temperature is about 26.96^0C and minimum 18.63^0 C.

3.0 Geomorphology & Soil Types

Geomorphologically the district has been divided into two units, i.e denudational structural hills and alluvial plain. Major parts of the district are occupied by denudational structural hills consisting of Tertiary formations. The hill ranges form high hills and narrow but deep intermontane valleys. Topographic elevation increases from northeast to west and southwest. The elevation is about 300mamsl in the northwestern alluvial plains followed by low to moderate linear ridge of elevation ranging from 300 to 600mamsl. This is followed by moderate hill ranging in elevation from 600 to 1350mamsl. The high hills are ranging in elevation from 1350 to 4500mamsl. Daphabum is the highest peak with an elevation of 4500mamsl. The plains of Changlang district occupy about 530 sq.km. area in and around Miao and Bordumsa town. This plain has a regional gradient towards south – west.

The soils of the district are derived mainly from Tertiary groups of rocks. The parent rocks are sandstone, shale, siltstone and mudstone. Soils of the district are mainly acidic with very high organic carbon and poor in phosphate and potash contents. Soils are fertile and are classified into alluvial and residual soils. Alluvial soils are again classified into recent alluvial or entisol and older alluvium or oxisol and ultisol. Recent alluvial soils occur in the valleys and form continuous sheet along the banks of streams and rivers. The soil comprises of clay, silt and sand and occurs in Bordumsa – Miao plain. Older alluvium is found in the foothill areas and intermontane valleys. They comprises of sand and gravel admixture with clay and silt.

4.0 Ground Water Scenario

4.1 Hydrogeology

The district can be divided into three distinct hydrogeological units, *viz*., consolidated, semi-consolidated and unconsolidated (Map II) formations based on geology, hydrogeological character and topography. The Disang and Barail groups of rocks constitute the consolidated formations and this unit occupies nearly 80% of the district.

The semi-consolidated formation of the district is represented by the Dihing and Namsang groups and is exposed in the Manabum anticline. Out of the three anticlines in the Manbum area, the south Manabum is a large asymmetrical anticline. The Dihing Group is composed of pebble bed and a transition bed, which is composed of alternation of pebble layer and medium to coarse sand. Namsang Formation is composed of massive medium to coarse loosely bedded sandstone with thin clay layers, wood fossils, coal and thin conglomeratic layers. This unit occupies nearly 5% of the district.

Unconsolidated formation occupies nearly 530sq. km of the district and comprises about 15% of the total district area. The unconsolidated formation is comprised by recent alluvium consisting of gravel, sand, silt, clay, etc. Alluvium is exposed in the northeastern part of the district around Miao – Bordumsa area.

The groundwater potential of the consolidated formation is very limited. This unit acts as a runoff zone. However, a small part of rainwater percolates through the joints and fractures of these compact rock which in turn ooze out in the form of springs. Some of the springs emanating from the rocks of Barail Group along Margherita – Changlang road section has discharge ranging from 20 to 25 lpm. The discharge of the spring depends on the amount of precipitation and as such many of the springs are seasonal and perennial springs too show meager discharge during lean period. Due to lack of groundwater structures in the semi-consolidated hydrogeological unit, its groundwater condition is difficult to ascertain. This unit mainly forms run – off zone.

In the unconsolidated formation, ground water occurs under unconfined condition. Depth to water level increases towards the western part of the area and decreases towards east that conform the topographic gradient. The entire unit behaves as a single aquifer system and the aquifer material comprises mainly gravel, sand, silt and clay. The coarser materials increase towards the foothill region and the finer grades increase towards plains, ultimately merging with the plains of Assam. In this unit runoff is less than recharge to deeper aquifer in comparison to the consolidated and semi-consolidated hilly terrain. The availability of groundwater and its potential in the district is restricted to this unit only.

The unconsolidated alluvial formation, which occurs in the Bordumsa –Kharsang – Miao valley, is by nature a valley fill deposit of Recent to sub Recent time. The shallow aquifer which is limited horizontal extent can be traced down to the depth of 15 to 20m, however, with variation in thickness at places serves as the potential aquifer for shallow dug wells. The aquifer materials are boulders, pebbles, fine to medium grained sand, clay, silt and are under a veneer of top soil of 1 to 5m thick. The shallow aquifer is underlain by sandstone of Tertiary age. Ground water occurs in the shallow aquifer is under phreatic condition.

Central Ground Water Board, North Eastern Region, Guwahati has explored down to the depth of 134m in the district. The deeper aquifer consists of fine to medium sand, friable sandstone and interbedded mottled clay. Unlike shallow aquifer pebbles and boulders are rare, however, the confined layers often-localized in extent. Ground water occurs in semi-confined condition in deeper aquifer.

Depth to water level: 2006 (Pre and Post monsoon)

Seasonal Flucuations

In the four GWMS of CGWB in Changlang district, the decadal mean of depth to water level from April 1995 to 2004 when compared with April 2005 depth to water level shows water level of three GWMS rose from 0.44 to 2.93m and in one station water level fall down to 0.45m. The decadal mean of depth to water level from August 1995 to 2004 when compared with August 2005 depth to water level recorded a rise of water level of two GWMS from 0.38 to 1.78m whereas two stations recorded a fall of water level from 0.06 to 0.25m. Water level data collected during November 2005 when compared with mean water level of November 1995 to 2004 show that water level of GWMS show maximum rise of 1.34m and a minimum of 0.34m and the date of three stations show a rise while one station shows a fall of depth to water level to 0.34m. Water level data collected during January 2006 when compared with the decadal mean from January 1996 to 2005, indicated maximum rise of 2.22m and a minimum of 0.26m, i.e., three stations show a rise from 0 to 2.0m while one station shows a rise of more than 2m.

The specific yield of the unconfined aquifer in the alluvial tract can be presumed to be 12% as the alluvium is predominantly consists of sand and gravel. Central Ground Water Board, NER, Guwahati had drilled seven exploratory wells and the depth ranged from 55 to 134m. However, zones from 32 to 62m have only been tapped. It has been observed that deepest zones, i.e., 52 to 62m yields are less than the upper zones. The minimum and maximum discharge is 1.5lps and 17.10lps respectively. The transmissivity of the deeper aquifer tapping zones from 32 to 62m are 467m^2/day to 3111m^2/day.

4.2. Ground Water Resources

The dynamic ground water resource of the district has been estimated based on methodology recommended by GEC̉, 97. Since there is dearth of block or circle level hydrological data, the district is considered as single hydrogeological unit. The annual replanishable ground water resource of the district is estimated as 288.45 MCM. Net ground water availability of the district is 259.60 MCM while net ground water draft for all uses is 0.26mcm. Projected demand for domestic and industrial uses up to 2025 is 1.56 MCM. Ground water availability for future irrigation use is 257.79 MCM. Stage of ground water development is thus negligible (0.98%) and the district can be categorized as safe.

4.3 Ground Water Quality

Ground water from shallow aquifer is slightly alkaline in Bordumsa – Kharsang – Miao valley (pH= 6.8 to 7.9) and also in the hilly terrain (pH=7.2 to 7.8). Electrical conductance (EC) of ground water in the valley area varies from 58 to 654 μS/cm and in the hilly areas this value ranges from 118 to 544 μS/cm. The ground water is soft in both the valleys and in hilly terrain. Fluoride content is within permissible limit both in the valleys (0.01 to 0.12 mg/l) and in the hilly terrains (0.05 to 0.20 mg/l). Iron content generally varies from 0.03 to 0.93 mg/l, but in some localized pockets it concentration is exceed the permissible limit.

4.4 Status of Ground Water Development

The district population extracted ground water from dug wells mainly in Khagam and Bordumsa/Diyun CD blocks. In Khagam CD Block the dug well depth varies from 2.82m to nearly 10m and the diameter of the wells ranges from 0.90m to 1.50m. In Bordumsa/Diyun CD Block wells are generally 3.50m to 6.50m deep and the diameter is generally 1.20m to 1.50m. However their discharge cannot be evaluated as the population generally use rope and bucket to lift water. Central Ground Water Board has drilled several wells in the district within a depth range of 55m to 134m. The agency has drilled two wells at Khagam, two at Bordumsa/Diyun, one each at Kharsang, Khimiyang and at Namphong- Manmao CD blocks. The discharge of the wells ranges from 90 to 1026 lpm. The WR Department of Govt. of Arunachal Pradesh had also constructed 6 deep tube wells in the district. Of which two are at Kharsang and four are at Bordumsa/Diyun CD blocks. WRD constructed these wells for irrigation purpose and they handed over all these nine wells including the three constructed by CGWB to the farmers. The wells have been energized by WRD with diesel operated submersible pump. All the information of wells constructed by WRD is not available and data pertaining to two wells are only supplied by WRD. As per the information the well constructed at Bordumsa/Diyun CD block is 57.25m depth and compressor discharge is 1300lpm. A 15HP 2-stage diesel operated submersible pump has been installed in the well with the hope of creating an irrigation command area of 16 to 20 hectre. The well constructed at Khagam CD block is 57.25m depth and compressor discharge is 1800 to 2300lpm. A 25HP 3-stage diesel operated submersible pump has been installed in the well to create an irrigation command area of 30 hectre. As per 2001 census report, out of 336 villages safe drinking water facilities have been provided to 306 villages. However, due to lack of data the sources of drinking water supply source cannot be ascertained. From the earlier works of CGWB, it can be said that in the hilly terrain the drinking water supply is provided through gravity system from nearby stream or springs. The PHED has constructed either dug wells or shallow tube wells (fitted with hand pumps) for water supply. However, presently the population gradually shifts from dug well to tube wells.

5.0 Ground Water Management Strategy

5.1 Ground Water Development

The problem of ground water development in the district varies depending upon topographic and geologic conditions. The availability and mode of occurrence of water in the hilly terrain (almost 85% of the total area of the district) is different from valley portion. The hilly terrain is occupied by the shales of Disang Group, arenaceous Barail Group, mainly clay dominated Tipam Group, and friable sandstone of Namsang and pebbly Dihing groups of rocks. As such the hilly terrain is hydrogeologically not very promising for ground water development. However, in the hilly terrain the weathered zones, joints and fractures are suitable spots for ground water exploration. These can be tapped in the accessible areas by drilling down to a depth of 50 to 100 mbgl and constructing well of 152.4mm diameter. As the area is hilly with steep slopes, it has little prospect for ground water infiltration and large-scale prospect for ground water development may not be possible here. For providing drinking water facilities in these areas local perennial springs can be developed by constructing water points. Water points normally consist of a storage chamber and a wash basin. The water point can be built if the discharge during lean period is at least 1 litre/min during dry season and the elevation difference is at least one metre between spring catchments. If the spring discharge is more than 15 litre/min in dry season there is no need of a storage chamber. However, proper drainage for all overflowing and used water should be provided. Care should be taken for laying a good foundation, especially in swampy areas and on hill sides. Moreover in the narrow linear valleys dug wells can be constructed to meet the domestic requirements.

In the alluvial areas of Miao – Bordumsa, deep tube wells within a depth range of 150 to 200m and 304.8mm (12//) diameter may be constructed. Shallow tube wells are also feasible within 50m-depth and 152.4mm (6//) diameter with an expected yield of 25 to 30m^3/hr. The discharges of the deep tube wells are expected to be about 100m^3/hr or more.

5.2 Water Conservation and Artificial Recharge

There is no water conservation and artificial recharge structure in the district a as there is little scope of recharge to the aquifers.

As mentioned earlier, nearly 85% of the district is hilly and valley portion shares only 15%. There is limited scope of groundwater development in the hilly terrain and the scope of groundwater recharge in the hilly terrain requires a more rigorous study encompassing the hydrogeological as well as water requirement aspects of the area. In the hilly terrain the population density is sparse. The water requirement of the hilly populace can be fulfilled by spring water and rain water can be conserved for utilization in the lean period when springs are either dried out or their discharge drops. In case of valley portion where population density is high there is abundant ground water and there is little scope for groundwater recharge. However, in some areas in Bordumsa block where iron content is more than the prescribed limit, rain water can be harnessed for drinking water supply.

6.0 Ground Water related issues & problems

7.0 Awareness & Training Activity

7.1 Mass awareness programme (MAP) & Water Management Training programme (WMTP) by CGWB

CGWB has not organized any Mass Awareness (MAP) and Water Management Training Programme (WMTP) in the district.

7.2 Participation in Exibition, Mela, Fair etc

In the district ground water related exhibition, mela, fair, etc. are not organized.

7.3 Presentation & Lectures delivered in public forum/ Radio/ T.V./ Institution of repute/ Grassroots associations/ NGO/ Academic institutions etc.

8.0 Areas notified by CGWB/ SGWA

Nil.

9.0 Recommendations

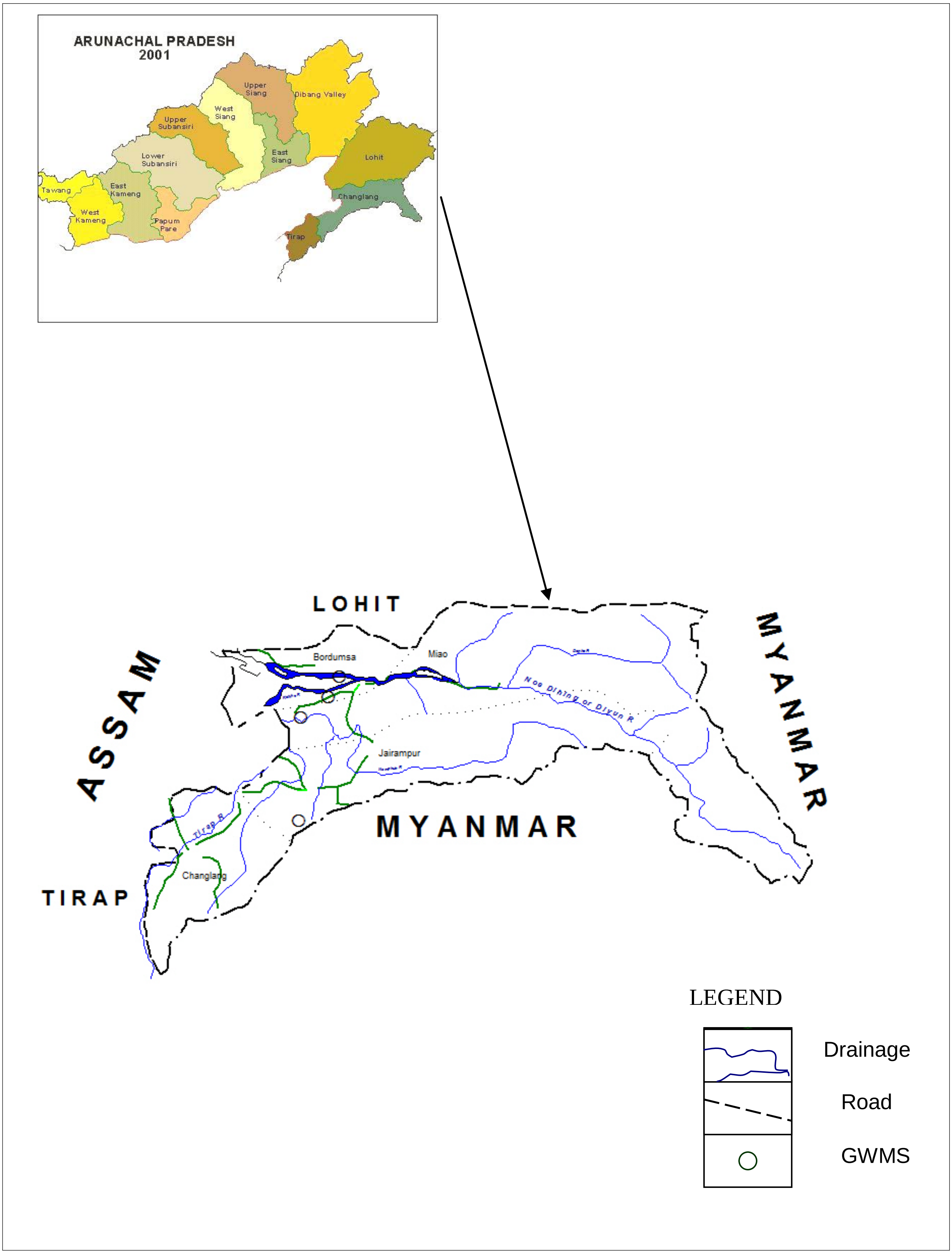
a) The groundwater potentiality of Dihing Group of rocks and also the Barail Group of rocks are not yet explored. The Dihing Group of rocks is to be explored by deploying percussion rig due to its gravelly nature. The Barails are hard-consolidated rock and the secondary porosity like joints, fractures are potential ground water repository. The group has to be drilled using DTH rigs and both the vertical and lateral extent of these fractures are need to be deciphered for meaningful exploration.

b) In the hilly terrain spring water should be effectively tapped to mitigate the drinking water need of the scattered hamlets and the urban as well as rural populace. For providing drinking water facilities in these areas local perennial springs can be developed by constructing water points. The water point can be built if the discharge during lean period is at least 1 litre/min during dry season and the elevation difference is at least one metre between spring catchments. If the spring discharge is more than 15 litre/min in dry season there is no need of a storage chamber. However, proper drainage for all overflowing and used water should be provided. Care should be taken for laying a good foundation, especially in swampy areas and on hill sides. Moreover in the narrow linear valleys dug wells can be constructed to meet the domestic requirements.

c) In the alluvial areas of Miao – Bordumsa, deep tube wells within a depth range of 150 to 200m and 304.8mm (12$^{//}$) diameter may be constructed. Shallow tube wells are also feasible within 50m-depth and 152.4mm (6$^{//}$) diameter with an expected yield of 25 to 30m^3/hr.

d) Roof top rainwater harvesting should be practiced in the hilly area and surplus rain water can be conserve to mitigate the drinking water problem during lean period when spring discharge drops considerably. Moreover, where iron content in the ground water is above permissible limit in the valley area like in Bordumsa area, harnessing rain water may be a good option to fulfill the demand of safe drinking water.

ADMINISTRATIVE MAP OF CHANGLANG DISTRICT



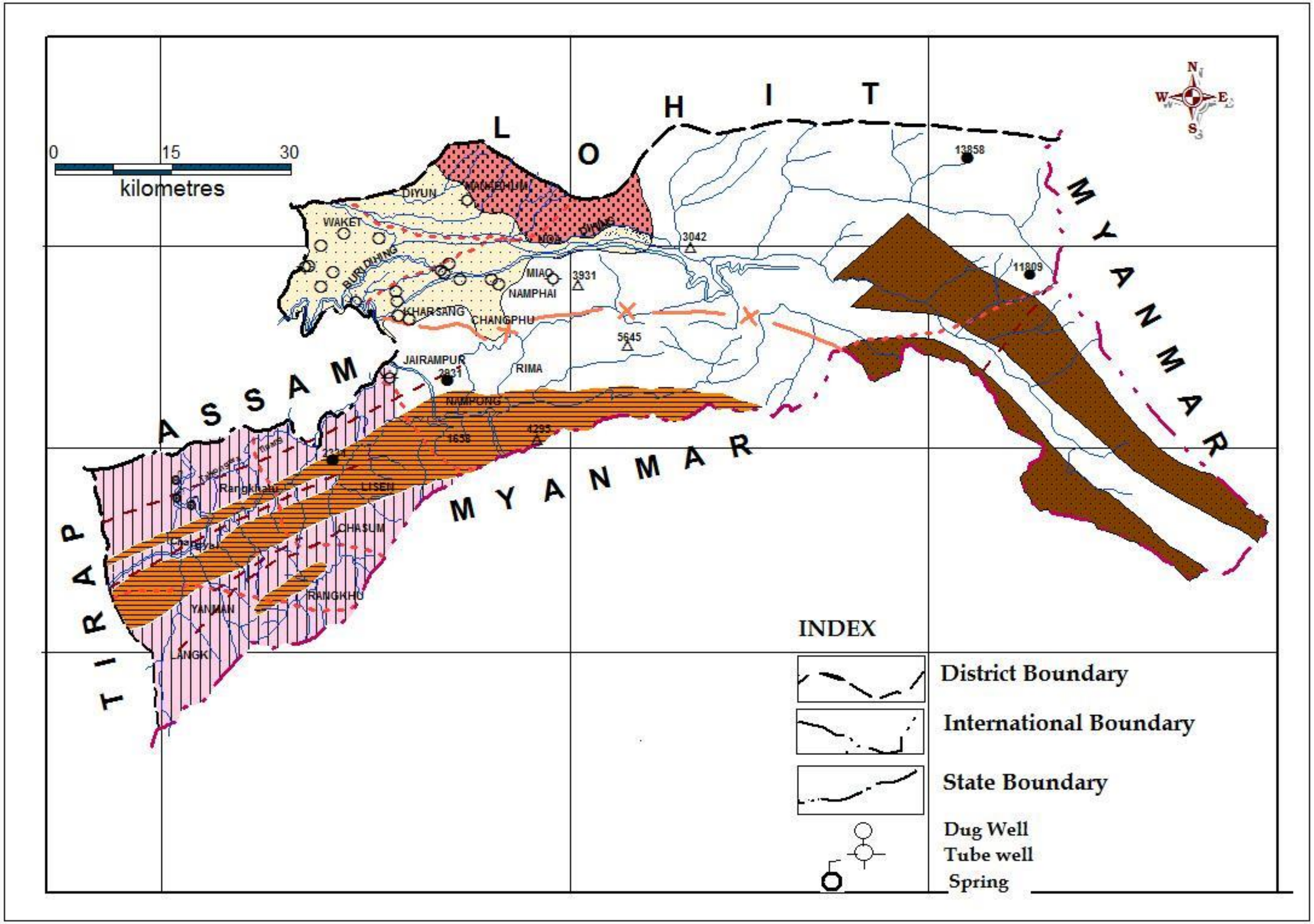
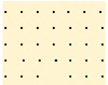
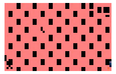
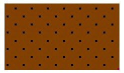
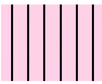
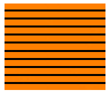


Fig.2: Hydrogeological Map of Changlang District, Arunachal Pradesh

INDEX	FORMATION/ GROUP	GEOMORPHIC UNIT	Age	LITHOLOGY	GW PROSPECTS
	Alluvium	Plain	Recent	Unconsolidated sediments of gravel, pebbles, sand, silt, etc.	Ground water under unconfined condition. Dug well feasible within 10 to 15m depth. Shallow tube well within 50m depth expected to yield 20-25m^3/hr.
 	Dihing/Undifferentiated. Neogene sediments	Dendudational Hills	Miocene Pleistocene		Ground water in isolated pockets of fractures, joints, etc. Spring development: spring discharge varies from 20 to 25 lpm, partly recharge zone in semi-consolidated formation.
	Barail Group	Dendudational Hills	Oligocene	Red shales, sandstones and silty beds	
	Disang Group	Dendudational Hills	Eocene	Splintery shales, silty beds	