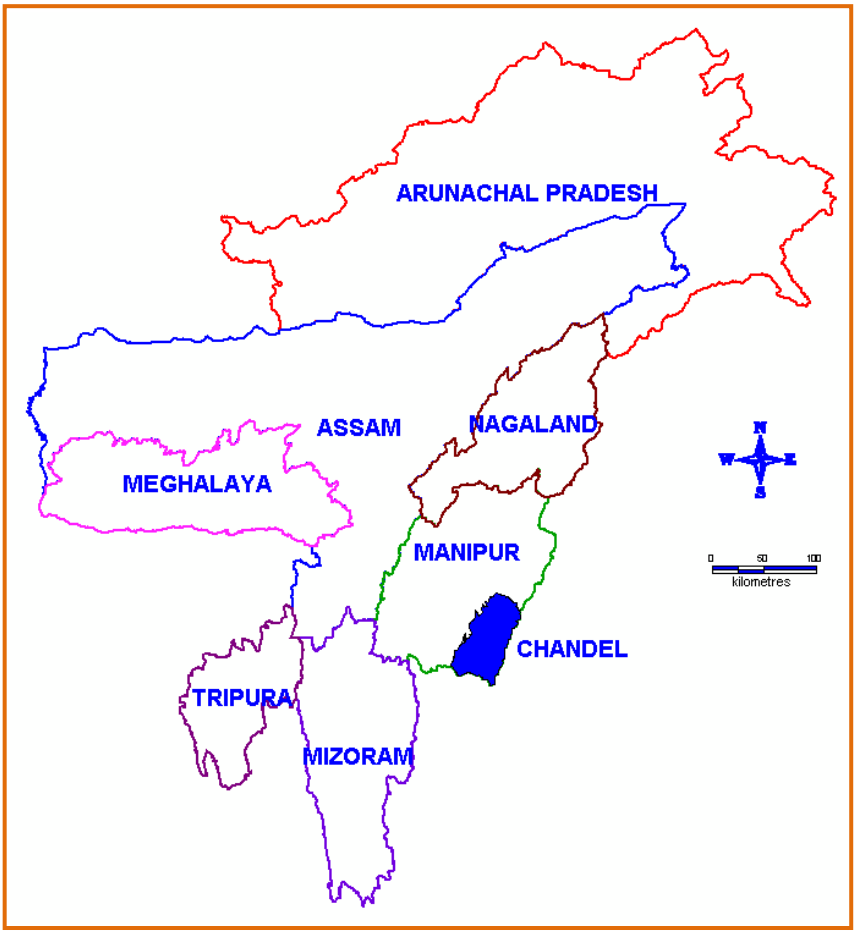
Technical Report Series: D **No: 06 /2013-14**

Ground Water Information Booklet

Chandel District, Manipur



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

Ground Water Information Booklet
Chandel District, Manipur

DISTRICT AT A GLANCE

Sl. No.	ITEMS	STATISTICS
1	GENERAL INFORMATION	
	i) Geographical Area (in sq.km.)	3,313
	ii) Administrative Division (as on 31 March 2013) Number of Tehsil/CDBlock	5 (including Khengjoi T.D.Block) 361 villages
	iii) Population (as per 2011 Census)	1,44,028
	iv) Average Annual Rainfall (mm)	1,036
2	GEOMORPHOLOGY i) Major Physiographic Units ii) Major Drainages	North-south parallel hill ranges bordering Myanmar i) Akonglong River & its tributaries viz, Chamu and Chingai. ii)Yu River & its tributaries like Maklang,
3	LAND USE (sq. km.) i) Forest Area ii) Net Area Sown iii) Cultivable	 i) 2689 ii) 88.20 iii) 94.40
4	MAJOR SOIL TYPES	Older alluvial soil and Red gravelly sandy and loamy soil. 2 types: Residual & Transported
5	AREA UNDER PRINCIPAL CROPS in	-
6	IRRIGATION BY DIFFERENT SOURCES i) Dug Wells/STE ii) Tube /Bore Wells/DTW iii) Tanks/Ponds iv) Canals/LIS v) Other Sources vi) Net Irrigated Area	 NIL NIL NIL MIS surface flow : 1,476 ha irrigation potential created NIL NIL
7	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB	03 NHS in Chandel district, but no monitoring has been carried out since 1991 due to disturbed law & order in the
8	PREDOMINANT GEOLOGICAL	Consolidated and semi-consolidated rocks
9	HYDROGEOLOGY i).Major water Bearing Formations	Semi-consolidated formation i.e. Disang

	ii)Pre-monsoon Depth to Water Level iii) Post-monsoon Depth to Water Level iv) Long term Water Level Trend in 20 yrs	conglomerat e Nil, as there are no ground water monitoring structures of CGWB located in the hill district. Not
10	GROUND WATER EXPLORATION BY CGWB (as on 31-03-2013) i) No of Wells Drilled ii) Depth of construction(m) with zone iii) Discharge (lpm)	Nil as no ground water exploration is carried out by CGWB in the hill district.
11	GROUND WATER QUALITY i) Presence of Chemical Constituents more than Permissible Limit (e.g. EC, F, Fe, As) ii) Type of Water	All elements are within the permissible limit. Good and potable
12	DYANMIC GROUND WATER RESOURCES (as on March 2009) in mcm i) Annual Replenishable Ground Water Resources ii) Net Annual Ground Water Draft iii) Projected demand for Domestic	GEC'97 could not be adopted and ground water resources of the district could not be calculated because hill slopes are more than 20% as per GEC'97.
13	AWARENESS AND TRAINING ACTIVITY i)MassAwarenessProgrammes Organised ii) Date iv) Place	NIL
14	EFFORTS OF ARTIFICIAL RECHARGE AND RAINWATER HARVESTING i) Projects Completed by CGWB (No & amount spent) ii) Projects Under technical Guidance	NIL
15	GROUND WATER CONTROL AND REGULATION i) Number of OE Blocks ii) Number of Critical Blocks	NIL
16	MAJOR GROUND WATER PROBLEMS AND ISSUES	Pathogenic contamination and scarcity in Rural areas are there, it is still in

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1.0 Introduction

The Chandel district (formerly known as Tengnoupal district) came into existence on 13-5-1974. The district occupies the south-eastern part of the state of Manipur. It is the border district of the state. Its neighbours are Myanmar (erstwhile Burma) on the south, Ukhrul district on the east, Churachandpur district on the south and west, and Thoubal district on north. It is about 64 km away from Imphal. The National Highway No. 39 passes through this district.

The District is inhabited by several communities. It is sparsely inhabited by about 20 different tribes. They are scattered all over the district. Prominent tribes in the district are Anal, Lamkang, Kukis, Moyon, Monsang, Chothe, Thadou, Paite, and Maring etc. There are also other communities like Meiteis and Muslims in small numbers as compared to the tribes. Non-Manipuri like the Tamil, Bengali, Punjabi, and Bihari are also settled in this district.

The Moreh town, the international trade centre of the state falls in the southernmost part of the district. When the Trans-Asian Super Highway comes into existence, Chandel district will be one of the gateways to the Asian countries.

Table: 1. Administrative Sub-Divisions of Chandel district, Manipur

District	Block	Area in sq. km.	Sub-Division	Headquarters	No. Of Villages
Chandel	Machi Moreh Chandel	3,313	Machi	Machi	59
			Tengnoupal Chandel	Moreh Chandel	75 87
	Khengjoi & Chakpikarong T.D.B.		Chakpikarong	Chakpikarong	140
Total		**3,313**			**361**

Source: Directorate of Economics & Statistics, Govt. of Manipur

It is a hill district with an area of 3,313 sq. km. As per Census 2011, the population of the district is 1, 44,028 (Male 74,543 & Female 69,485) and scattered in 361 villages. The density of population per sq. km is 43 persons.

Even though considered as one of the backward districts, Chandel is not left behind when the safety of the nation comes. The names of Chara Nicholas Mayon, S. Gemithang, and NL Benaingvir Mayon were included in the list of Martyrs of India who sacrificed their lives during the Kargil War and they will always be remembered by one and all.

The district experienced sub-tropical to temperate climate. The temperature varies from 5^{o} C to 35 ^{o} C. The area experiences the influence of the South West Tropical monsoon. The maximum rainfall of monsoon period occurs between the month of May and August. The average annual rainfall in the district is 1,036 mm.

In Chandel district, terrace cultivation is practised in some pockets of the hills where 'jhumming' cultivation is widely adopted in most of the hills. In these hills, traditionally people cultivated land on high slopes and abandon the plots after a few years following the practice of 'Jhumming' or shifting cultivation. Arable land is by and large marginal and hence, agriculture is persistently on subsistence level

Agriculture being the main occupation of the people in the area, it has an important place in the economy of the district. Agriculture sector contributes a major share in domestic products of the district and provides employment to the working force of the district. In fact, the domestic production fluctuates depending on the performance of agricultural sector. Despite the crucial importance of this primary sector in the economy of the area, the irregular and erratic behaviour of monsoon accompanied by inadequate irrigation facilities have resulted in severe fluctuations in agricultural productions. Agriculture becomes points of employment and income; agriculture plays a very crucial role in the economy.

Manipur represents a peculiar physiographic situation in the eastern Himalayas. Chandel district of Manipur is endowed with an enormously diverse heritage of wetlands. In the eastern hilly slopes of the state, a number of small streams join the Chinwin River in Myanmar. The important river in the district is Akonglong River and its tributaries viz, Chamu and Chingai. The other important river is the Yu-River with its tributaries like Maklang, Tuyonbi, Taretlok, Lokchao, Lalimlok and Tuiyang. These rivers, flowing north to south and sub-parallel in the steep valley, finally culminate in the Chindwin in the Kabow valley of Myanmar. These rivers have a catchments area of 6,953 sq. km. constituting 31% of the geographical area of the state.

Manipur River is one of the main rivers in the district, which ultimately flows to the south towards Myanmar and joins the Chindwin River. The major tributaries of Manipur River basin flowing in Imphal valley are Imphal, Iril, Nambul, and Sekmai Rivers which originate from the surrounding hills. Sekamai River at Sekmaijin and that falls into the Chindwin River of Myanmar. The other rivers either fall directly into or indirectly join with the Imphal River through these lakes.

The district is occupied by mostly north-south parallel hill ranges made up of consolidated and semi-consolidated rocks ranging in age from Pre-Mesozoic to Miocene. The consolidated rocks are confined to the eastern part towards Myanmar border while the semi- consolidated formations cover almost the entire foothill valley area towards the Imphal valley comprising shale, siltstone, sandstone and conglomerate. These formations belong to Disang, Barail, Surma and Tipam Group of rocks. In the central part of the valley, unconsolidated alluvium of Quaternary Age occurs.

Ground water occurs in secondary porosity in joints, fissures, fractures and weathered residuum of consolidated and semi-consolidated rocks and inter-granular pore spaces of alluvial deposits.

No ground water exploration work has been carried out by CGWB in the district. Hydrogeological studies reveal that the ground water exploration may be undertaken. The construction of dug well, dug cum bore well and tube wells through DTH and direct rotary rigs or manually may be carried out.

Rainwater harvesting techniques should be adopted. Construction of check dams in suitable locales is also encouraged for artificial recharge to ground water in the district. Spring water is also one of the main sources of water supply in the district.

2.0 Rainfall and Climate

Chandel district experiences low to moderate climate of sub-tropical monsoon type. The summer months are hot and wet while the winter months are cold and dry in the district. The maximum rainfalls occur due to southwest monsoon during May to August. The sunshine hours are limited up to 5 hours during rainy season.

The temperature varies from 5^{o} C to 35^{o} C. The area experiences the average temperature in the summer months from 32 to 35^{o} C while in winter, the temperature is normally around 4 to 6^{o} C. January is the coldest month and April is the hottest. Fog & frost are common features during the mornings in winter months but snowfall is rare. The average annual rainfall in the district is 1,036 mm.

The types of seasons in the area are

(i) the cold season (December, January, February) (ii) the hot dry season (March, April)

(iii) the rainy season (May, June, July, August, September) (iv) the retreating monsoon season (October, November)

Humidity:

The relative humidity in the region is moderate to high throughout the year. The winter month is very less humid. Clear skies are common during the post-monsoon season. In the cold season, the morning sky often remains overcast due mainly to lifted fog, which gets cleared with the advancement of the day. In the pre-monsoon months, skies are generally clouded.

Wind Velocity:

Wind is generally light during the monsoon season. In the rest of the year, wind is generally moderate and becomes strong at times in association with thunderstorms. Strong wind down the valleys is experienced as local effects produced by the nature. The direction of wind is highly influenced by local conditions except over the plains where wind generally blows from the northwest throughout the year. Strong easterly wind usually occurs during the Occurrence of fog is frequent in the valleys during the winter. Fog also occurs during the monsoon months period from March to May & it persists till the onset of monsoon.

Potential Evapo-transpiration:

Evapo-transpiration is high in the area during the monsoon season. Thunderstorms mainly occur during May to September, maximum frequency being in May-June and minimum in December. During the pre-monsoon months, thunderstorms are often violent like the *norwesters*, and from December to April, these are occasionally accompanied by *hail*.

3.0 Geomorphology and Soil Types

3.1 Geomorphic Features and Landforms

The hills in the district form north-south parallel ranges in the border areas of Myanmar, while the altitudes range from 790 to 3,050 m above mean sea level (a msl). The heights of the hill ranges in the Eastern part of the state are generally more than the western part.

The foothill valley plains are intermontane valleys surrounded by hillocks about 1,500- 2,000 meters high towards Imphal valley. The western part of the valley is flanked by abruptly rising hills. The general valley slope is from north to south from an altitude of 880 to 770 m above msl in the adjacent low lying plains towards western side of the district.

3.2 Drainage and Morphometric Features

It is located near the international border between India and Myanmar. Chandel district of Manipur is endowed with an enormously diverse heritage of wetlands. In the eastern hilly slopes of the state, a number of small streams join the Chinwin River in Myanmar.

3.3 Soil

Two major types of soils are found in the district, i.e. residual and transported, which cover both the hill and plain. The residual soils are either laterised or non-laterised.

The transported soils are of two types, i.e. alluvial and organic. The soils have general clayey texture and grey to pale brown colour. It contains a good proportion of potash and phosphate, a fair quantity of nitrogen and organic matter and is less acidic in nature. The organic soils cover the low lying areas of the valley. With dark grey colour and clayey loam texture, these peaty soils have high acidity, abundance of organic matter, a good amount of nitrogen and phosphorous but are poor in potash. The hill soils are more or less rich in organic carbon (1 to 3%) in the top soil, but poor in available phosphorus and potash. They are acidic in nature.

The oldest rocks found in the state are mainly confined in the district close to Indo- Myanmar border and the rocks are grouped as Cretaceous rocks consisting of chromite (Epilates), serpentine etc. It is observed that Inceptisols are the dominant soils followed by Utisols, Entisols and Alfisols and occupy 38.4%, 36.4%, and 23.1% of the total geographical area of Manipur respectively.

Main Soil classification in the district

is i) Older alluvial soil
ii) Red gravelly sandy and loamy soil iii) Peaty and saline soil

4.0 Ground Water Scenario

4.1 Hydrogeology

Ground water occurs in secondary porosity as joints, fissures, fractures and weathered residuum of consolidated and semi-consolidated rocks and inter-granular pore spaces of alluvial deposits.

The consolidated rocks are confined to the eastern part of the Chandel district along the Myanmar border. The semi-consolidated and consolidated rocks ranging in age from Pre- Mesozoic to Miocene forms the main hydrogeological units in the area. The semi- consolidated formation, which covers almost the entire foothills and valley area, comprises shale, siltstone, sand stone and conglomerate. These formations belong to Disang, Barail, Surma and Tipam Group of rocks. In the western part, unconsolidated alluvium of Quaternary age occurs in the valley and topographical lows.

Aquifer System and Ground Water Occurrences

The study of geology and hydrogeology in the district reveals the feasibility for the exploration of ground water though construction of dug well, dug cum bore wells and some tube wells. In fact, there is a great variation in both vertical and lateral lithology, even over small distances. Sand and gravel layers have indefinite and largely undefined boundaries.

In general, ground water occurs under water table conditions in the shallow dug well horizons. The depth to water level is about 20 m below ground level during pre-monsoon period and it is less than 20 m below ground level during post-monsoon period.

Ground water occurs in water table to confined conditions. The piezometric head is generally found to lie between 20 m bgl and ground level. The deeper piezometric head is found in the northeastern fringe of the district particularly in and around Yaingangpokpi of Imphal East district.

Ground Water Movement

Ground water movement is essentially towards the lower western fringes from the peripheral eastern higher elevation during pre-monsoon and post-monsoon period in the area. Since, there are variations in the lithology and texture of the underlying formations, there are great variations in the hydraulic gradient also in the study area especially in between Disang and Barail parts of the district.

Yield Potential of Aquifers

By the detailed studies of the local geology and hydrogeology in the district, the following types of structures for abstraction of ground water may be deciphered.

i. Tube wells up to a depth of more than 100 m with a discharge range from 50 to 100 litres per minutes are suitable in the north western fringes of Chandel district towards the borders of Thoubal district and Churachandpur districts.

ii. Dug wells of 15 to 20 m depth may be constructed in the western region of the district along Chandel, Sugnu, and Chakpikarong etc with an expected discharge of 6 to 8 litres per minute.

iii. Dug wells and dug-cum-bore well structures up to a depth of 20 to 100 m are suitable in the eastern fringes of the district directly bordering to Myanmar. The expected discharge range may be more than 8 litres per minute.

The fluvial depositional environment in the valley area has been of a complex nature. Depending upon the degree of differential weathering between hilltops and valley floors, depression was formed and sediments were deposited.

4.2 Ground Water Regime and Depth to Water Analysis

The following Ground Water Monitoring Stations (GWMS) in the district were monitored prior to 1991 by Central Ground Water Board, North Eastern Region, Guwahati under its quarterly monitoring programme throughout India. **But the monitoring programme could not be continued due to the prevailing law and order situations since the year 1990 in Manipur state.** Some investigations with special reference to army camps and artificial recharge studies have been carried out in specified area.

Table.2 Details of National Hydrograph Stations in Chandel district, Manipur (prior to 1991)

Location	Well No	Well Type	Latitude	Longitude	M.P. (magl	R.L of G.L (mamsl)	Geology	Basin
Shairo	83H3D6	Dug Well	24°16'02"	93°52'41"	0.68	786.44	Alluvium	Imphal
Khongsim	83L3A1	Dug Well	24°29'49"	94°01'12"	0.70		Alluvium	Imphal
Moreh	83L3B1	Dug Well	24°15'30"	94°18'30"	0.87		Alluvium	Imphal

4.3 Ground Water Resources

The district is totally covered by hills with slopes more than 20%. So, the methodology of GEC'97 could not be adopted for the computation of dynamic ground water resources in the district. Since the poor quality ground water is only a localized phenomenon, the block-wise poor quality area has been taken as nil. The sub-unit demarcation into command and non-command has not been carried out since the data for the same are not available.

4.4 Ground Water Quality

The quality of water is a measure of its chemical, physical, microbiological and radiological properties with respect to its purposed use. The issues related to chemical quality of ground water in the valley region of Manipur have assumed greater significance than the parts of hill since 90 percent population of the state lives in this valley. Study undertaken by Central Ground Water Board reveals that in the majority of cases, pH, EC and all other parameters are well within permissible limits. Ground water in the area is dominated by calcium-magnesium-bicarbonate (Ca-Mg-HCO_3) type.

Water qualities as well as quantity are major concerns of the state mainly in the rural sector of the hill district. Biological contamination of drinking water supply combined with scanty quantity has been a major cause of most of the water borne diseases. Because of the shortage of safe drinking water, many people use the available surface water for drinking and domestic purposes from any nearby surface source. The people illegally break the water pipe and tap inviting another problem.

4.4.1 Water Quality of Shallow Aquifer

Ground water in the shallow aquifers of the study area ranges within the permissible limits of BIS and WHO for both domestic uses and agricultural practices.

4.4.2 Water Quality for Deeper Aquifers

Deeper aquifer data are few in the study area except some data of tube wells of IPD wing, PHED, Govt. of Manipur. Water quality is within the prescribed limits.

4.4.3 Comparison of Ground Water Quality w.r.t. Earlier Study

The chemical quality data of the Manipur valley is considered for the information for Chandel district. The chemical quality of ground water in the area for the last two decades showed normal for domestic and drinking proposes except the higher concentration of sodium (Na) and chloride (Cl) in some pockets of Thoubal district. In recent study during the DGWMS/Reappraisal studies in Manipur valley, high concentration of some harmful chemical elements has been found.

4.5 Status of Ground Water Development

4.5.1 Present Ground Water Development

Ground water augmented through springs and streams are used for drinking and irrigation purposes only in the district. As there is no sources of ground water supply in the district, ground water utilization for the same may be considered as negligible. The development of ground water in the district is negligible.

i) Urban and Rural Water Supply Schemes:

Rural Water Supply facilities are provided to the people in rural areas under centrally sponsored Minimum Need Programme (MNP) and Accelerated Rural Water Supply Programme (ARWSP). During the ninth plan, the target was to cover 593 habitations against which there is a shortfall of 43 inhabitants. By the end of 31st March 2001, 2,461 habitations were fully provided with drinking water facilities. The rural population of the district is covered under this scheme.

4.5.2 Ground Water for Irrigation

No Ground water irrigation is practiced in the district except the irrigation practices through surface water. The main activities that carried out by M.I. are construction of field elements, field drains, land levelling etc and conducting adaptive trials, training of farmers in irrigation, water management, enforcement warabandi for suitable distribution of irrigation water to the farmers field etc.

The district has irrigation potential of 1,476 ha out of which 885 ha are utilized for irrigation under the surface flow irrigation schemes of M.I.S.

5.0 Ground Water Management Strategy

5.1 Ground Water Development

Based on the study of hydrogeological conditions, prospects for ground water development in the area are mainly confined to the valley only where ring wells and shallow tube wells are the feasible abstraction structures.

Rainwater harvesting should be adopted for the augmentation and recharge to ground water in a scientific manner by constructing recharge structures in individual and community level. Construction of check dams is also suitable.

Ponds are the most prevalent traditional water harvesting structures in the district. A few decades ago, one pond was shared by two or three households. Community ponds are also commonly found in the settlements. These are generally larger in size and better maintained than private ponds. The water supply situation in the state in terms of coverage and adequacy continues to be pathetic in most settlements. A large majority of the population depends on ponds to meet their water requirements.

Private ponds are drying in the townships and heavy settlement areas where the rate of premium land is high. However, fortunately, the community ponds still exist in these areas. Infact, the heritage of the community pond seems to have been strengthened in the absence of a satisfactory or reliable water supply system. Paradoxically, the extension of piped water supply system worsened the water situation in some settlements as the residents began neglecting the ponds in their area. As the ponds went in disuse and dried up, water supply services became unavailable or very poor in many of these places. A substantial amount of the vegetables produced in the state are grown in private kitchen gardens, which use water from ponds.

It was quite common to have a small pond at the lower end of the plot in paddy fields. It was useful during the dry spells between the rains. However, most of these ponds are now filled up and reclaimed for cultivation. Rainwater harvesting is suitable for meeting the domestic water requirements of the state. This is due to

i. Heavy and widespread nature of precipitation
ii. Many houses already have GI sheet-covered slopping roofs,
iii. Most of the residential houses are small, owner-occupied houses
iv. People are familiar with this concepts, and
v. The relatively pollution free atmosphere

However, the available storage structures are small in capacity. This is an area that NGOs are best suited to address.

5.2 Water Conservation and Artificial Recharge

Individual and community pond with the practice of roof top rain water harvesting *(old age method)* are also very common in the area for water conservation. Following design criteria is recommended.

5.2.1 Shallow Domestic Wells

Open wells and filter point wells are feasible in the area. In unconsolidated sediments, ring well may be constructed by excavating down to the saturated horizon. Cement or earthen rings placed one above another with weep holes in the bottom rings are likely to hold sufficient quantity of water. Depth ranges from 10 to 20 m depending upon the topographic elevation. Expected discharge will be 0.5 to 3.0 cubic meters per day.

Bamboo as pipe and screen are very much within the reach of small and marginal farmers, as bamboo is locally available in the district. This type of well will be low cost and long lasting. Expected discharge may be 3 to 5 cubic meters per day.

5.2.2 Tube Well for Irrigation Purpose

Deep tube wells are feasible in most of the valley parts of the district. These tube wells are expected to tap the granular zones occurring beyond 30 m bgl. Diameter of casing pipe, when used as housing pipe, need to be decided based on the anticipated discharge. Housing pipe should be large enough to accommodate the pump. For avoiding corrosion and clogging of well

screen, the entrance velocity should be less than 2 cm/sec.

6.0 Ground Water Related Issues and Problems

Safe drinking water supply and human health and work efficiency in Manipur for rural sector have remained as primitive as ever. The development of ground water for water supply is highly recommended with strong attention to be paid to the water availability, quality and artificial recharge to ground water in the area.

7.0 Awareness and Training activity

7.1 Mass Awareness Programme and Water Management Training Programme by CGWB.

No such programme has been conducted in the district.

7.2 Participation in Exhibition, Mela, Fair etc.

No such Exhibition, Mela, Fair etc are organized/participated by CGWB in the district.

7.3 Presentation and Lecture Delivered in Public Forum/Radio/T.V/Institution of Repute/Grassroots Associations/NGO/Academic Institutions etc.

CGWB is not involved in such programme in the district.

8.0 Area Notified by CGWA/SGWA

Nil.

9.0 Recommendations

Ground water is important in the rural areas for irrigation and domestic supply. Ground water is available from varying depths i.e. from a shallow (less than 25 m) aquifers or a deeper aquifer (30 - 120 m). With rapid urbanization, population and industrial growth, problems related to ground water pollution needs immediate attention. Bye laws are to be constituted for regulations of optimum withdrawal of ground water etc.

Existing hydrogeological set up indicates that there are a few scopes available for the development of ground water by way of constructing ground water abstraction structures in a planned way for economic ground water development in the district.

i) Tube wells up to a depth of more than 100 m with a discharge range from 50 to 100 litres per minutes are suitable in the north western fringes of Chandel district towards the borders of Thoubal district and Churachandpur districts.

ii) Dug wells of 15 to 20 m depth may be constructed in the total western region of the district along Chandel, Sugnu, and Chakpikarong etc with an

expected discharge of 6 to 8 litres per minute.

iii) Dug wells and dug-cum-bore well structures up to a depth of 20 to 100 m are suitable in the eastern fringes of the district bordering Myanmar. The discharge may be more than
8 litres per minute.

Proper maintenance of these sick wells in the entire area is to be carried out so as to mitigate water scarcity as reported from different villages.

The catchment area of Chakpi River is 660 sq. km. with an average annual yield of 0.790 Mham in the district. Some recommendations for the treatment of the catchments areas in the district are given below.

i. Construction of check dams at suitable places throughout the catchment and ridge area.
ii. Development of suitable plantations over the denuded and barren hill slopes at the maximum possible scale and speed.
iii. Encouraging terrace cultivation in the hill slopes and proper guidance of jhum cultivation. Construction of contour canals, subsurface dykes, gully plugging, terracing etc should be taken up.

The above steps will help in regulating the inflow of water besides checking siltation and sedimentation in the beds of rivers, streams, and lakes in the area. Local irrigation practices should be encouraged so that the plentiful water resources can be harnessed. Lifting water by pumping along river levees for irrigation purposes should also be encouraged.

FIG.1 MAP SHOWING ADMINISTRATIVE SETUP OF CHANDEL DISTRICT, MANIPUR

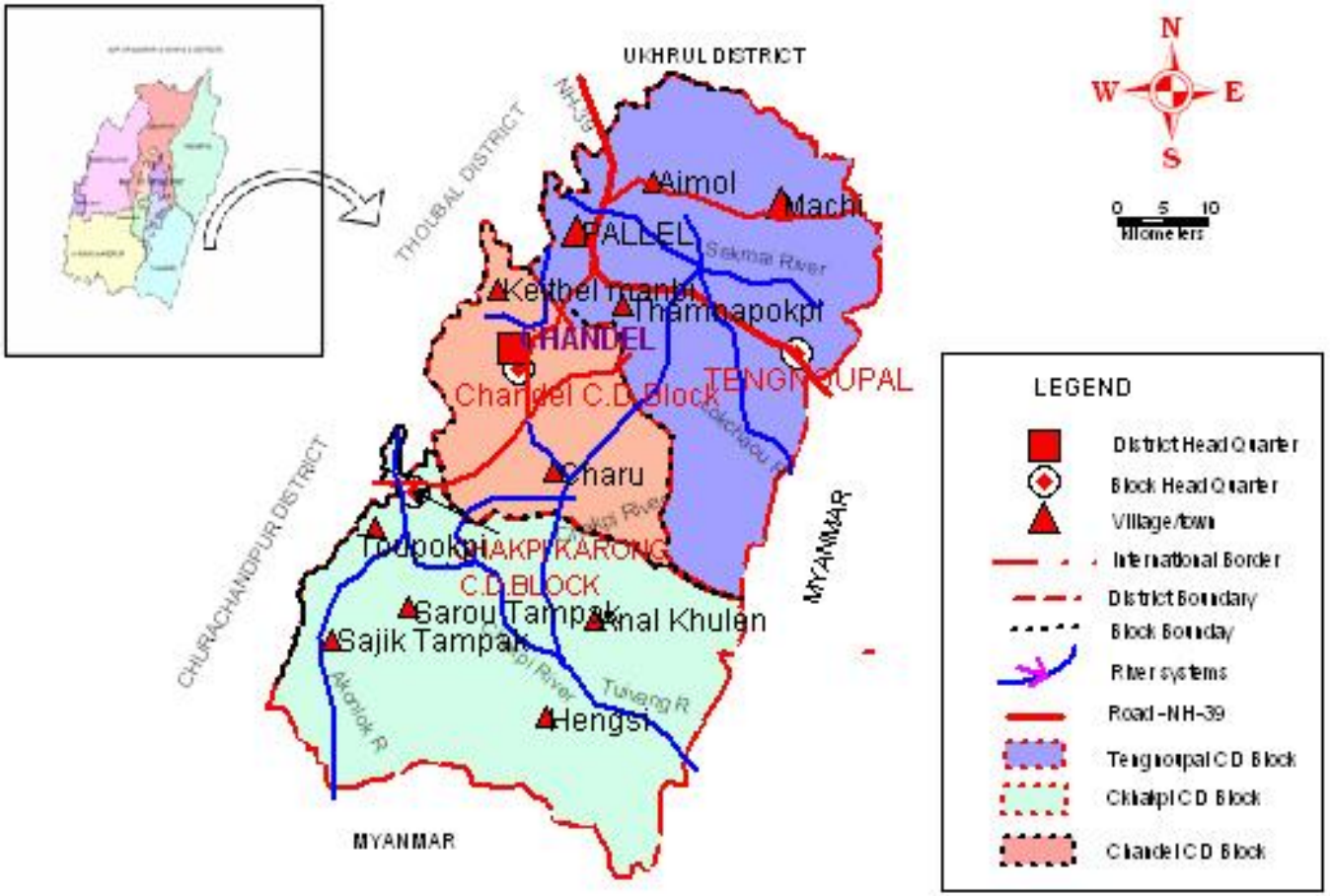

FIG.2. MAP SHOWING HYDRO-GEOMORPHOLOGICAL SETUP OF CHANDEL DISTRICT, MANIPUR

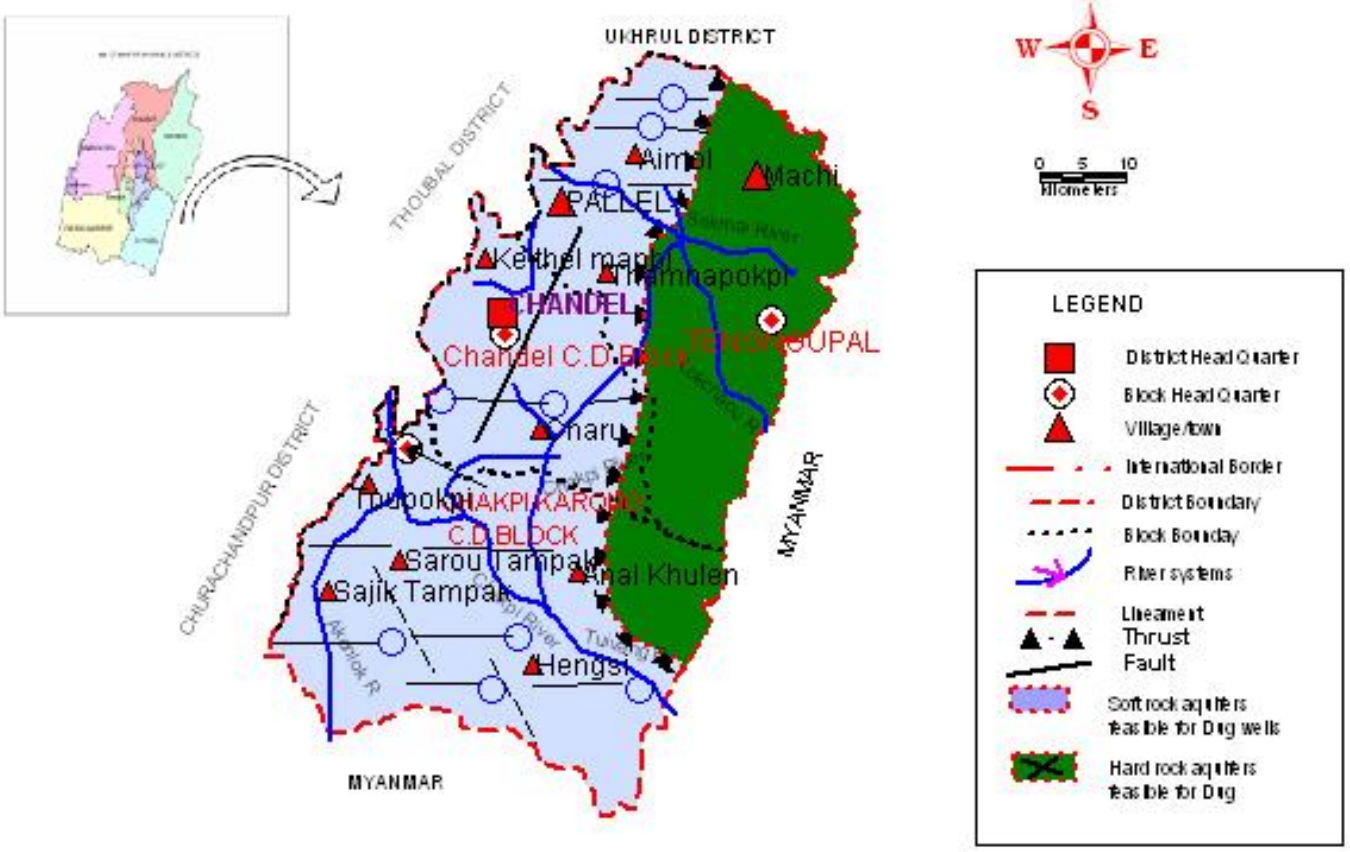

FIG.3 HYDROGEOLOGY OF CHANDEL DISTRICT