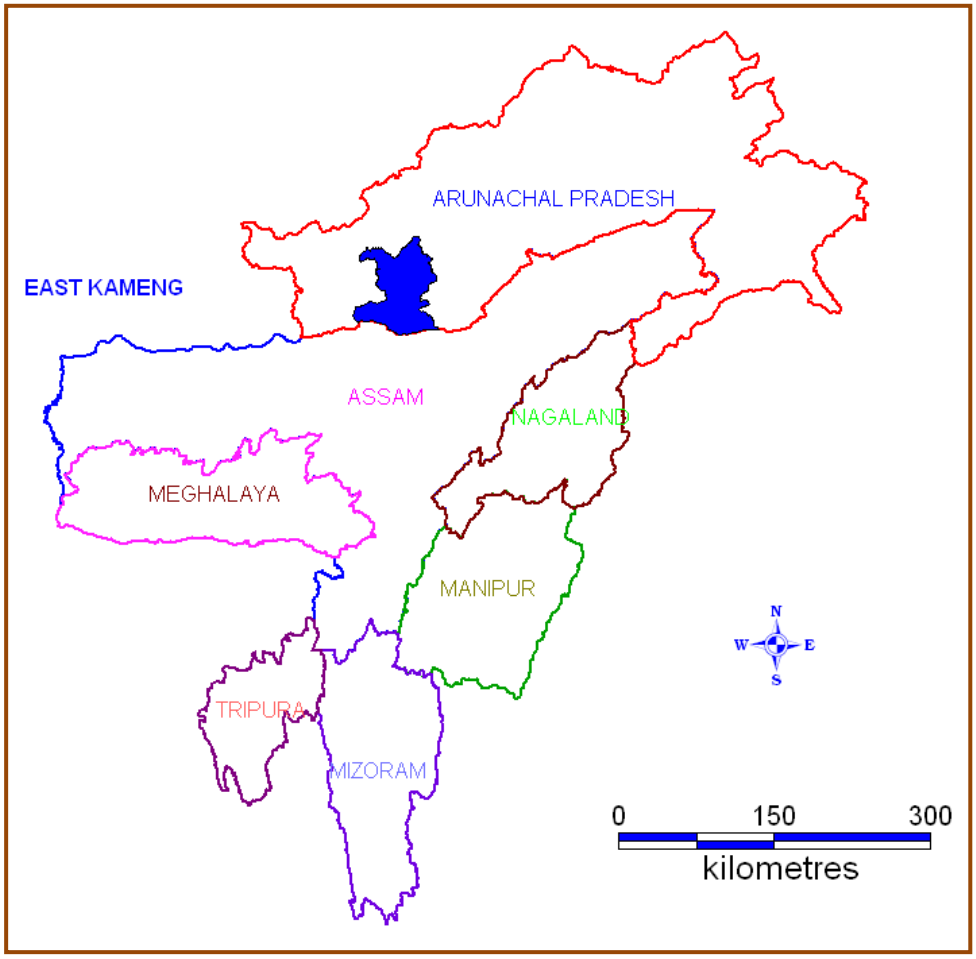
Technical Report Series: D

No: 32 /2009-10

Ground Water Information Booklet
East Kameng District, Arunachal Pradesh



Central Ground Water Board

North Eastern Region

Ministry of Water Resources

Guwahati

September 2013

GROUND WATER INFORMATION BOOKLET
EAST KAMENG DISTRICT, ARUNACHAL PRADESH

AT A GLANCE

Sl. No.	ITEMS	Statistics
1.	GENERAL INFORMATION	
	i) Geographical area (sq. km)	4134
	ii) Administrative Divisions (As on 31st March 2003) Number of Sub-divisions Number of Block Number of Circles Number of Villages	 02 07 12 310
	iii) Population (As on 2011 Census)	78413
	iv) Average Annual Rainfall (mm)	2,035 mm
2.	GEOMORPHOLOGY	
	Major physiographic units	High to moderate denude-structural hills, low to moderate structural hills, intermontane valleys and valleys in the foothills and plains in the fringe areas.
	Major Drainages	River Kameng and its tributaries
3.	**LAND USE (sq. km)**	
	a) Forest area	2,481.52
	b) Net area sown	63.66
4.	MAJOR SOIL TYPES	Soils in the high hills lack in organic matter, acidic and reddish in colour. Soils in the foothills and in the valleys are alluvial or loamy type with occasional pebbles and gravels. Soils in the district possess high amount of organic carbon.
5.	**AREA UNDER PRINCIPAL CROPS (as on 2011-12) sq.km**	83.98
6.	IRRIGATION BY DIFFERENT SOURCES (Areas and numbers of Structures)	
	Dug wells	Not Available
	Tube wells	Nil
	Tanks/ ponds	N. A
	Canals	47 Nos.
	Other sources	Nil
	Net irrigated area	920.34 ha
7.	**NUMBER OF GROUND WATER MONITORING WELLS OF CGWB**	

	(As on 31-3-2013) No of Dug Wells No of Piezometers	Nil Nil
8.	**PREDOMINENT GEOLOGICAL FORMATIONS**	Pre-Cambrian gneisses and schists, quartzite of Bomdila Group. Gondwana sedimentaries comprising quartzite, shale and sandstone, Siwalik Group comprising sandstone, siltstones etc and Recent alluvium.
9.	**HYDROGEOLOGY**	
	Major Water bearing formation	Weathered and fractured Pre-Cambrian gneisses and schists, sandstone, silt stone, quartzites, shale and Recent alluvial formations.
	Pre- monsoon depth to water level during 2009 Post- monsoon depth to water level during 2009	N. A. N. A. N. A.
10.	**GROUND WATER EXPLORATION BY CGWB (As on 31-03-2013)**	
	No of wells drilled (EW, OW, PZ, SH, Total)	1 EW
	Depth Range (m)	71.0
	Discharge (litres per second)	4.5
	Storativity (S)	-
	Transmissivity (m^2/day)	-
11.	GROUND WATER QUALITY	
	Presence of chemical constituents more than permissible limit	Iron slightly more than permissible limit at places
	Type of water	Fresh and suitable for all purposes
12.	**DYNAMIC GROUND WATER RESOURCES (2009) in mcm**	
	Annual Replenishable Ground Water Resources	169.04
	Net annual Ground Water Draft	0.15
	Projected Demand for Domestic and Industrial Uses up to 2025	0.45
	Stage of Ground Water Development	0.1%
13	**AWARENESS AND TRAINNING ACTIVITY**	Nil
	Mass Awareness Programme organized	
14.	**EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING**	Nil

	Projects completed by CGWB (No & Amount spent)	
	Projects under technical guidance of CGWB	
15.	GROUND WATER CONTROL & REGULATION	Not applicable
16.	MAJOR GROUND WATER PROBLEMS AND ISSUES	In spite of copious rainfall received, the district suffers from acute shortage of drinking water in lean period. Ground water development in the district is nil. Groundwater is required to be developed forthwith in the valleys. Artificial recharge and rainwater harvesting through various means is necessitated for sustainable management of water resources tapping ground water.

GROUND WATER INFORMATION BOOKLET
EAST KAMENG DISTRICT

1.0 INTRODUCTION

East Kameng district (Fig-1) is situated in the western part of Arunachal Pradesh lies between 92°30' and 93°24' East longitudes and 26°56' and 27°59' North latitudes covering an area of 4134 sq. km. The district is surrounded in the east by Lower Subansiri and Papumpare districts of Arunachal Pradesh, Sonitpur district of Assam on the south east, West Kameng district of Arunachal Pradesh on the west and Tibet as well as a part of Lower Subansiri district on the north. The district is divided into 2 sub-divisions *viz*. Seppa and Chayangtajo; 7 community development blocks and 12 circles comprising 310 villages, 125 Gaon Panchayat and one Mahakuma Parishad. The district headquarter, Seppa is situated at a distance of 620 km from the state capital Itanagar. The entire district is mountainous barring a small area on the southernmost tip bordering Assam. The name 'Kameng' has been derived from the Kameng River, originating in the glacial lakes below 'Gorichen' flow through the district, and joined to the mighty Brahmaputra River in the plains of Assam. Other important rivers like Pacha, Pachi, Pachok, Papu, Para, Pakke(I&II), Bishom and Dibru are tributaries of Kameng and not navigable. The district is situated on hilly tract ranging from 150 to 1960 m of elevation. The total reserved forest area of the district is 11529.45 ha comprising Khellong Forest Division, Bhalukpong; Pakhui Wild Life Sanctuary, Seijosa and Seppa Forest Division.

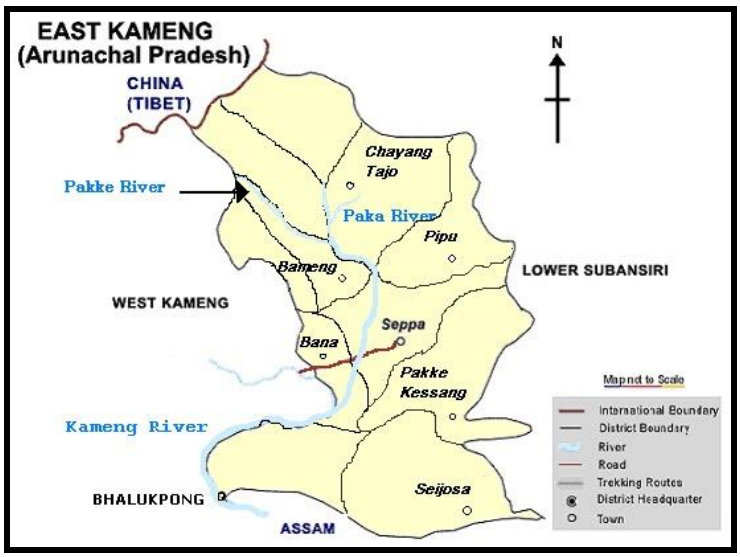


Fig-1 East Kameng District

The total population of the district according to 2001 census is 57,179 comprising 28,802 males and 28,377 females having a population density 14 persons per square km.

Agriculture is the mainstay of people which is only rainfed. The deep gorges and narrow valleys frequently open into wide valleys which sustain permanent agriculture. The shifting cultivation is practiced largely in hilly areas. About 28396 ha of land is utilized by the Jhumia families in the district. Jhum cultivation has been to some extent reduced now a days with the adaptation of settled cultivation by the people. The settled cultivation has emerged as more productive and reliable.

Only a small patch of 90 ha of land in the entire district is brought under irrigation through minor surface irrigation projects (Table-1). However, the total irrigation from all sources is 1563 Ha. Irrigation potential from ground water is nil. Paddy is the main crop while maize, wheat, pulses, oil seeds and vegetables are also cultivated in the district. Various fruits like apple, orange, pear, pine apple are grown in the district. The land use pattern of the district is as under (Table-2).

Table-1: Irrigation potential of East Kameng district as on 31.3.06

Irrigation potential created(Ha)	No of canals	No of tube wells	No of lift irrigation	Other sources	Area irrigated More than Once(Ha)	Net area Irrigated (Ha)	Gross area Irrigated (Ha)
231	47	-	-	-	12	90	102

(Source: Dir. Econ and Stat., Govt. of A.P)

Table-2: Land use pattern of East Kameng district as per Agriculture Census 2000-01.

Operational		Net area sown (Ha)	Current fallow (Ha)	Uncultivated Land including fallow land(Ha)	Fallow land other than current fallow (Ha)	Cultivable Wasteland (Ha)	Land not available For cultivation(Ha)	Gross Cropped area (Ha)		Net irrigated area (Ha)
No	Area (Ha)							Irrigated	Un-irrigated	
5671	19081	10653	530	1117	5600	892	289	1563	9654	1563

(Source: Dir. Econ and Stat., Govt. of A.P)

2.0 RAINFALL AND CLIMATE

The district enjoys sub-tropical to alpine climate with extreme cold in the northern part of the district. The climate is wet and humid in the south. Rainfall received in the district is highly varied as evident from the following Table-3. In general the foothill areas receive higher rainfall than the areas having higher relief in the north. Maximum-minimum temperature recorded at the foothill at Seijosa varies from 25 - 14^0 C in the month of January to 36 - 25^0 C in June. The temperature

gradually falls towards the north. Relative humidity at Seppa varies from 18.7 to 84% while at Seijosa, it varies from 32 to 93%.

Table-3 Rainfall variation in East Kameng District

Sl No	Location/Circle	Rainfall (mm)
1.	Bameng	1788
2.	Chayangtajo	2926
3.	Khenewa	2913
4.	Seijosa	3742
5.	Seppa	2035

3.0 GEOMORPHOLOGY AND SOIL TYPES

The district is representing a hilly terrain extending from the north of Brahmaputra floodplain with altitude up to 1900 m above mean sea level. The general topography is highly undulating with a gradual slope towards Sijussa in the south (Table-4).

Table- 4: Altitude of various places in East Siang District

Location Name	Bameng	Chyangtajo	Khenewa	Lada	Pakke-Kessang	Pipu - Dipu	Seppa	Sijossa
Altitude (in m from M.S.L)	1358	1906	1060	1260	1100	1200	363	163

Geomorphologically the district can be subdivided into five units.

a. High denudo-structural hills: The unit covers the north western part of the district and constitutes 10% of the district area. The height of the hills ranges from 2000 to 4000 m above M.S.L. The rock types forming the denude-structural hills are under the process of denudation. However, all the structural features are preserved. The oldest Proterozoic rocks i.e. the Bomdila Group comprising the granite gneisses, quartzite and schst which are highly weathered and fractured. This unit behaves both as recharge zone and run-off zone. The rainwater recharged through the fractures, fissures and weathered mantle are oozed out as springs at higher as also lower topographic locales.

b. Moderate denudo-structural hills: These are the hills with moderate height ranging in elevation from 1600 to 2100 m above MSL and occur in the west of Chayangtajo. This unit occupies more than 50% of the area and is located in the central part of the district. It has Pre-Cambrian and Lower Paleozoic rocks of Bomdila and Tenga groups respectively.

c. Moderate Structural Hills: The unit comprises moderate hill ranges with altitude varying from 1000 to 2000 m above MSL, covering about 30% of the area in the central part of the district. It has well developed lineaments trending NE to SW directions. The Siwalik boulders and pebbles found at foothills partly cover this unit. The drainage pattern is dendritic and the area represents a run-off zone partially.

d. Low Structural hill: It comprises the foothill region with low eroded hills occupied by Siwalik Group of rocks with medium to coarse grained massive sandstones of calcareous nature. The elevation ranges from 700 to 996 m above MSL. The lithology comprises semi-consolidated clays, silt stone, sand stone, pebbles, conglomerate beds with older alluvial terraces of Recent age. Drainage pattern is dendritic to sub-paralllel.These structural hills are forming the recharge zones of groundwater for the valleys in the foothills.

e. Valley Fills: These are located generally at the confluence of the rivers and streams emerging from the hill ranges. The valleys are available in more numbers in the southern part of the district and having a slope towards south. The grain size of sediments is decreasing towards south while the thickness is increasing in the same direction.

Nature of soil varies within the area. So far no detailed soil classification of the area has been carried out. However, the soils can be broadly subdivided in the area

i) Soils of the high hills are reddish in colour and acidic in nature. Soils found in the village are rich in organic matter and clayey alumina type.

ii) Soils found in the foothills and in the valleys are alluvial or loamy type with occasional pebbles and gravels. But on the whole, due to variation in composition and depth of weathering of the country rocks soil varies in nature and composition even at close intervals.

Soils in the district are acidic in nature and it possesses high amount organic carbon being more than 0.75%. Soils in the valleys are having good water retaining capacity and favourable for cultivation of *kharif* and *rabi* crops and vegetables like cabbage, cauliflower, potato etc. Soils of hilly areas are suitable for *jhum* or dry paddy cultivation as also for growing maize, orange, apple etc.

4.0 GROUND WATER SCENARIO

Groundwater is available in all geological formations in the district depending upon their primary or secondary porosities, geomorphologic and hydrogeological set up.

4.1Geology and Hydrogeology

The area covered by the district exhibits a complex geological framework ranging in age from Pre-Cambrian to Recent. The Pre-Cambrian Bomdila gneiss comprises streaky biotite and augen gneisses with subordinate schist. In eastern, western and northern parts of district, those formations have prominence of gneiss and schist. These Pre-Cambrian rocks cover nearly 70% of the district area falling within tract from the northern side of the main central thrust to the boundary of West Kameng district in the north encompassing the places like Pakke-Kessang, Seppa, Bana and Chyangtajo.

Paleozoic Gondwanas are represented by Miri Formation which comprises quartzite with phyllite, dark gray highly jointed, micaceous and carbonaceous shale and occurs around Banna. Gondwana rocks possess 5% of the district area. Gondwanas have faulted contact with Pre-Cambrian Bomdila Group and Tertiary Siwalik Formations in the north and south respectively.

The Siwaliks are semi-consolidated in nature and comprise alternating sandstone, silt stone, carbonaceous shale. The Siwaliks cover 15% of the district area.

The youngest alluvial formation and the older terraces are confined to the intermontane valley fills and in the valley areas in the foothills. The older alluvial areas are also called Bhabar or the Piedmont zone. These alluvial formations comprise sand, gravels and boulders with silt and clay deposits.

These geological formations are highly disturbed and underwent severe tectonism during the geologic past and have left several imprints which could be easily detected as lineaments.

Hydrogeology governs the occurrence and movement of ground water in the terrain. Hydrogeologically the area incorporated in the district can be broadly subdivided into two units 1. Consolidated and semi-consolidated formations and 2. Unconsolidated formations.

1. Consolidated and Semi-consolidated Formations: These formations are underlain in the areas covered by the hills and mountains and occupy about 90% of the total geographical area of the district. The hills comprise phyllite, gneisses, quartzite, Gondwana and Siwalik sedimentaries comprising shales, sandstones, quartzites siltstones etc. These rocks are highly jointed and fractured with high degree of weathering. Ground water occurs in weathered zone as also in the fractured zones which form the zones of secondary porosity in these formations. Since there is no ground water development structures tapping all these water yielding horizons in the form of dug wells, dug-cum-bore wells or bore wells, ground water is discharged in the topographic lows in the form of springs. Rainfall forms the main source of recharge which gets recharged through the weathered mantle and finally reaches the fractures and openings through percolation. Because of high and

steep slopes of the hill surfaces good amount of rainwater flows down as surface run-off while a meager portion of precipitation seeps inside to vitalize the shallow weathered and deeper fractured horizons in the consolidated formations.

Groundwater investigations carried out in the district revealed that springs which form the main source of water supply for drinking water supply belongs to gravitational category. Mostly topographic and fracture springs are seen to occur in all hydrogeological units in the district. The discharge of the main water supplying springs varies from 10,290 to 34,600 lpd. The discharge of the springs reported to emanate through the weathered horizon has been observed to yield higher than those are seen to ooze through fractures. The yield of the springs is found to dwindle in the lean period. However, in the areas where spring discharge show significant decline and cause a shear crisis in the water supply in summer, needful measures of artificial recharge technique is to be adopted to augment the yield and sustainability of discharge.

2) Unconsolidated Formations: These formations comprise sand of various textures, silt, clay and pebbles with boulders occurring in the limited valley areas of Sijossa, Borgang, Namiri Papu and Pakke located in the southern and north eastern parts of the district. Approximately 6800 ha of land is available for cultivation in the former while 1200 ha are cultivable in valley areas. An average thickness of 8-10 m of alluvial/colluvial veneer could be seen in the Sijossa-Borgang-Namiri valleys while average thickness of alluvium/colluvium in Papu-Pakke valleys may range from 3 to 4 m. Weathering in the underlain consolidated formations may vary from 5-10 m as estimated during the studies carried out by CGWB. These valley areas could be fully developed through portable DTH-Percussion combined rig for augmentation of water supply and irrigation. The following table (Table-5) summarizes the hydrogeological outlines in the valley areas in East Kameng district.

Table-5 Summarized hydrogeology of the valley areas in East Kameng District

Formation	District	Name & type of valley	Area (sq.km)	Rock Types	Ground water Potential
Semi-consolidated	East Kameng	a. Seijosa b. Borgang c. Namiri and adjoin valley	20.0 10.0 38.0	Shale, Siltstone, Sandstone interbedded with coal seams and limestones	Low yield range upto 20 m^3/hr. Drawdown within 25m
Consolidated rock formations					
Fissured formation Metasediment	East Kameng	Intermontane valley a. Pappu b. Pakke	8.0 4.0	Phyllite,Schist,Slate,Quatzites Gneissic complex with acid and basic intrusives	Low yield upto 5-15 m^3/hr. Yield upto 5m^3/hr. In areas having lineament and structural weak planes, the yield may go upto 25-30m^3/hr.

4.2 Ground Water Resources

The dynamic ground water resources of the districts of Arunachal Pradesh were estimated by the Central Ground Water Board based upon the ground water resources estimation methodology of 1997 and it was published for the assessment year of 2009. In the report, the dynamic ground water resources potential of East Kameng has been calculated. Net groundwater availability in East Kameng district is 152.14MCM. Net annual groundwater availability for future irrigation is 151.54MCM. However, the domestic and industrial requirement of water for the district up to 2025 has been allocated as 0.45MCM. Stage of ground water development is 0.1%. There is absolutely no development of ground water in the district. However, there is a vast scope of ground water development in the valleys and the foothills through construction of dug well, dug-cum-bore wells and bore wells.

4.3 Ground Water Quality

The quality of ground water in the district is ascertained as per the chemical analysis done at the chemical laboratory of the water samples collected from various spring sources during the investigations carried out by CGWB.

It has been observed that the ground water in the district is slightly alkaline having pH value ranging from 7.15 to 7.51.Electrical conductivity values range within 70-150 micro-Siemens/cm. Carbonate content in ground water is nil. Concentration of bicarbonate ranges from 31-110 ppm. Concentration of Ca, Mg is ranging from 4-12 ppm and Negligible-4 ppm respectively. Total hardness values of ground water vary between 10-40 ppm .Sodium and potassium values range within 2-10 and 1-4 ppm respectively. Total dissolved solid which is a measure of quality of ground water ranges between negligible-80 ppm. Concentrations of other constituents like Chloride range from 7 to 11 ppm, nitrate and fluoride vary between neligible-0.50 and negligible-0.07 ppm respectively. Range of concentration of iron fluctuates between 0.25-0.60 ppm.

Therefore, based on the above chemical analysis data, ground water in the district can be designated as fresh, potable and it is suitable for domestic, irrigation and any future industrial uses.

To adjudge the chemical quality of drinking water, PHED of Govt. of Arunachal Pradesh has established one chemical laboratory at Seppa. The chemical analysis done by PHED has also not so far reported occurrence of any toxic constituents or higher concentration of chemical constituents beyond permissible limit.

4.4 Status of Ground Water Development

It is mentioned that ground water is not developed in the district, even not in the limited suitable tracts representing valley areas of Sijossa, Borgang, Namiri, Pappu and Pakke in the district through ground water structures. CGWB had taken up one ground water exploration at Sijossa valley in East Kameng district during the year 2000. Depth of drilling was 71m. Numbers of aquifers were encountered at the depth range of 38-41 m, 47-50 m and 59-65 m below ground level (bgl) tapping the shallow alluvium and Tertiary formations. Depth to water level was recorded as 5.8 m bgl while the discharge was 4.5 lps and drawdown was 26 m. After that no exploration or groundwater development activities were carried out by any agency or

department in the valleys of the district. Hence, till date the status of ground water development in the district is nil. Whatever ground waters uses are in practice is through tapping the sources of gravitational springs which are freely flowing at the topographic lows. The following Table 6 gives an account of status of drinking water supply in the district mostly through tapping spring sources.

Table: 6 Status of drinking water supply by PHED in East Kameng District as on 31.3.2006

No of towns Covered under drinking water Supply in the district	No of habitations covered under drinking water supply scheme	Percentage of Net covered under water supply to total villages	Population benefited (in thousand)	
			Urban	Rural
1	349+16	100%	15.002	42.177

(Source : Dir. Econ and Stat.,Govt. of A.P)

5.0 GROUND WATER MANAGEMENT STRATEGY

Since the ground water development is yet to be initiated in the district, the question of its management is redundant. However, in view of extreme necessity of sustainable water management for drinking and irrigation, the scope of development of ground water in the district should be examined forthwith with the deployment of portable percussion-DTH combined rig as also through application of needful artificial recharge and conservation measures.

6.0 WATER CONSERVATION AND ARTIFICIAL RECHARGE

Although considerable rain to the tune of 2035 mm per annum is received at Seppa (the rainfall in the foothill regions in the district is much higher), many villages and the district town regularly experience scarcity of drinking water supply as also of irrigation water during lean period which extends from November to April.

Due to the terrain condition, a lot of rainfall is wasted through surface run-off. Furthermore, due to climatic change as also due to the deleterious effect of global warming and recession of glacier, there will be direct impact on the water availability scenario in entire India especially along the Trans Himalayan Region including Arunachal Pradesh as envisaged by the scientific community. Hence, endeavour should be made to study on various methods of sustainability and conservation of water resource practices especially through artificial recharge as also rainwater harvesting and to find out its success in Arunachal Pradesh in general and East Kameng district in particular. In many places in Arunachal Pradesh lot of water scarcity is noticed both in Irrigation and drinking water sector in lean months what could be achieved through application of various scientific measures for sustainable water availability. Rainwater harvesting and artificial recharge are the prime important methods in achieving such sustainability. For doing artificial recharge, a

potential source of water is also needed. The rainfall in higher tune in the district could be a good source of recharge. Now, for easy availability of rain water for its recharge to the ground water and its utilization through conservation for various domestic purposes, the roof top rainwater, preferably from larger rooftops could be the best option. However, there are many other means of artificial recharge and rain water harvesting what could be applied in the district. The needful studies to find out the specific sites and methods are to be taken up through the collaborative studies by CGWB, Water Resources Department (WRD), Govt. of Arunachal Pradesh and other water user Departments of Govt. of Arunachal Pradesh like PHED etc. As a beginning, currently a DPR encompassing eight districts of Arunachal Pradesh barring East Kameng district has been prepared envisaging rooftop rain water harvesting and artificial recharge and is submitted to CGWB for allocation of funds for execution by Water Resources Department. If these schemes to be taken up are proved worth then the same type of rainwater harvesting structure could be taken up in East Kameng district also.

7.0 GROUND WATER RELATED ISSUES AND PROBLEMS

In spite of copious rainfall to the tune of 3240 mm per annum, the district suffers from acute shortage of drinking and irrigation water where groundwater may form a dependable source of supply. The springs form the main base of water supply; its yield often dwindles during the lean period which is required to be solved. Groundwater is not developed enough in the district which is to be explored forthwith especially in the valleys and along the stream courses which signify the geological weak zones having good ground water potential.

8.0 AWARENESS AND TRAINING ACTIVITY

Nil

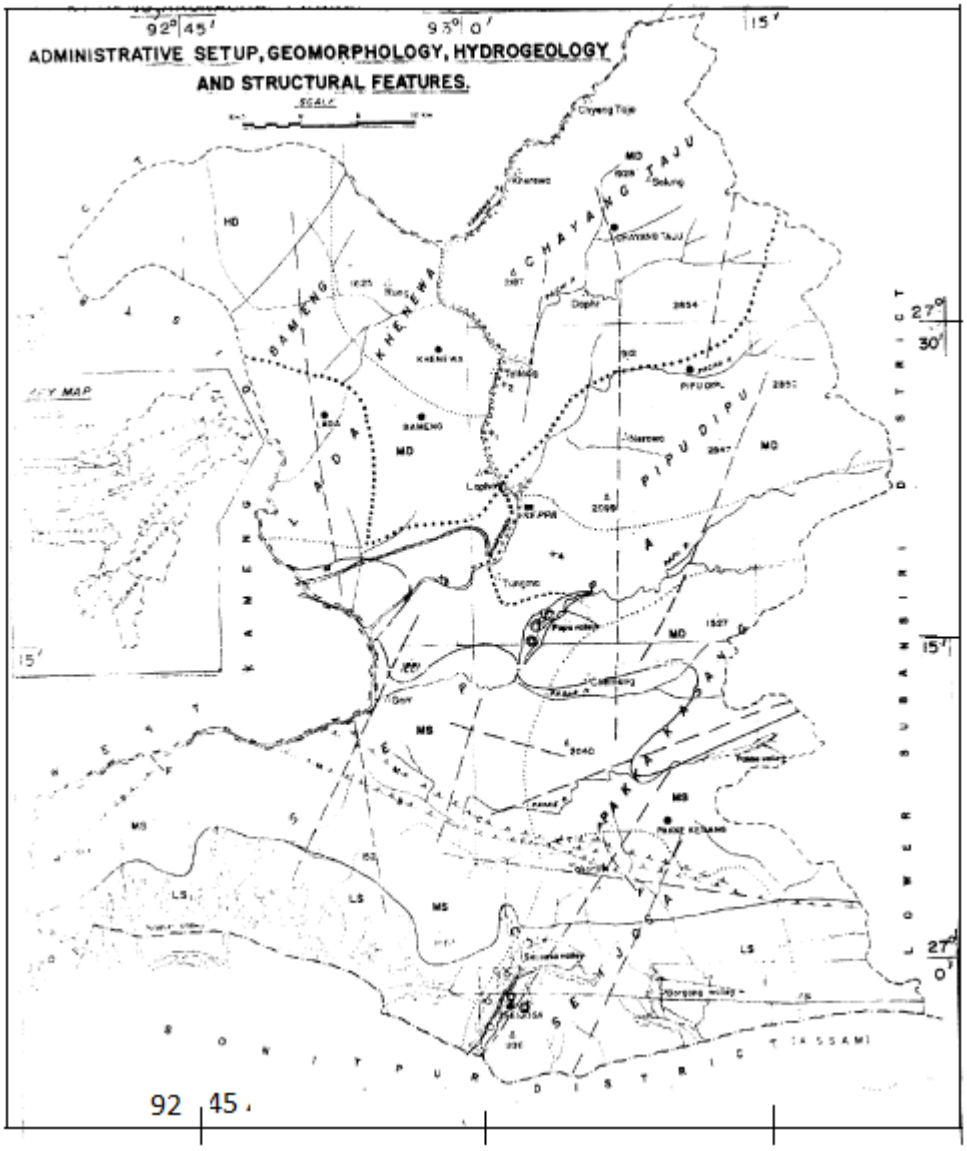
9.0 AREAS NOTIFIED BY CGWA / SGWA

Nil

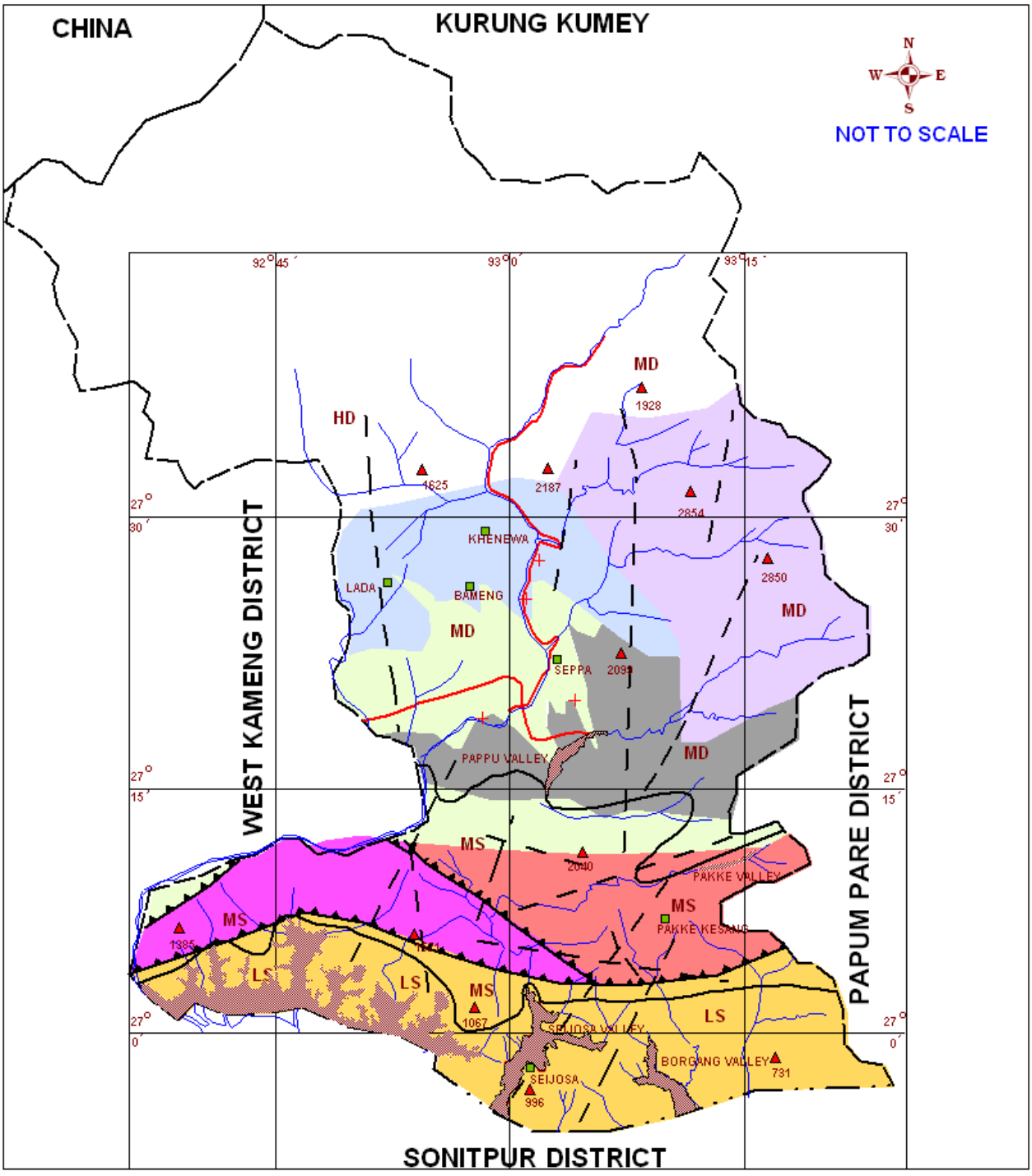
10.0 RECOMMENDATIONS

In view of low economic status and agrarian condition of the district, water resources particularly rain water and ground water is to be developed in a sustainable manner. Keeping in view of the copious rainfall received in the district, rainwater harvesting through various means should be popularized in the district. In needful areas, artificial recharge may also be adopted to augment the precious natural resources. Springs are the main source of water to supply through gravity in this mountainous terrain. In the restricted valley areas as also along the structurally weak zones, ground water development activities should be initiated through ground water exploration deploying portable percussion-DTH combination rigs. To enhance artificial recharge and rainwater harvesting along landscapes, terrace cultivation should be popularized abandoning the age old *Jhum* cultivation which is degrading the environment, soil and water resources. Similarly, the indigenous method of fish-cum- paddy culture should be popularized which will not only upgrade the economy of the district, it will help enhance return circulation of impounded rainwater for accelerated groundwater recharge. Ponds are to be constructed in large number in valleys for harvesting a lot of rain water as also for tapping ground water for

successful watershed development, while in sloping terrain; rainwater may be harvested in the ponds coated with impervious polythene sheets etc. for utilizing the water for irrigation during the stress period as also for pisciculture.


92° 45'
93° 0'
15'
ADMINISTRATIVE SETUP, GEOMORPHOLOGY, HYDROGEOLOGY
AND STRUCTURAL FEATURES.
SCALE
KEY MAP
BAMENG KHENEWA
CHAYANG TAJU
PIPU DIPU
LOWER SUBANSIRI DISTRICT
ARUNACHAL PRADESH
ASSAM
27° 30'
27° 0'
15'
92 45

HYDROGEOLOGICAL MAP OF EAST KAMENG DISTRICT



LEGEND

MAP UNIT	GEO MORPHIC UNIT	FORMATION	AGE	LITHOLOGY	GROUND WATER STRUCTURES FEASIBILITY
	LS	Older Alluvium & River Terraces	Pleistocene	Unconsolidated Clay, Silt, Sand with Pebbles	Dug well 6 to 8 m deep with 2 to 3 m diameter. Expected yield: 20 m^3/day in Seijossa valley. 10 m deep dug well feasible in Borgang, Namiri and adjacent valleys.
	MS	Siwaliks	Miocene Pleistocene	Semi-consolidated sediments comprising Sandstone, Shale, Boulders etc.	Being hilly and in accessible, much information is not available.
	MS	Undifferentiated Mesozoic – Tertiary	Mesozoic Palaeozoic Formation		
	MD	Lower Gondwana Formation	Permian - Carboniferous	Consolidated Sandstone, Shale, Carbonaceous Shale etc. Highly fractured	
	MD	Miri Formation, Abor Volcanics	Middle Palaeozoic		
	MD	Tenga Formation, Tiding Group,Ophiolite	Lower Palaeozoic	Gneiss, Schist, and Quartzite, Phyllite, Conglomerate etc.	Development of existing springs with discharge varies from 17 to 26 m^3/hr.
	MD	Bomdila Group	Upper Proterozoic		

LS : Low Structural hills, MS: Moderate Structural hills , MD: Moderate Denudostructural hills, HD: High