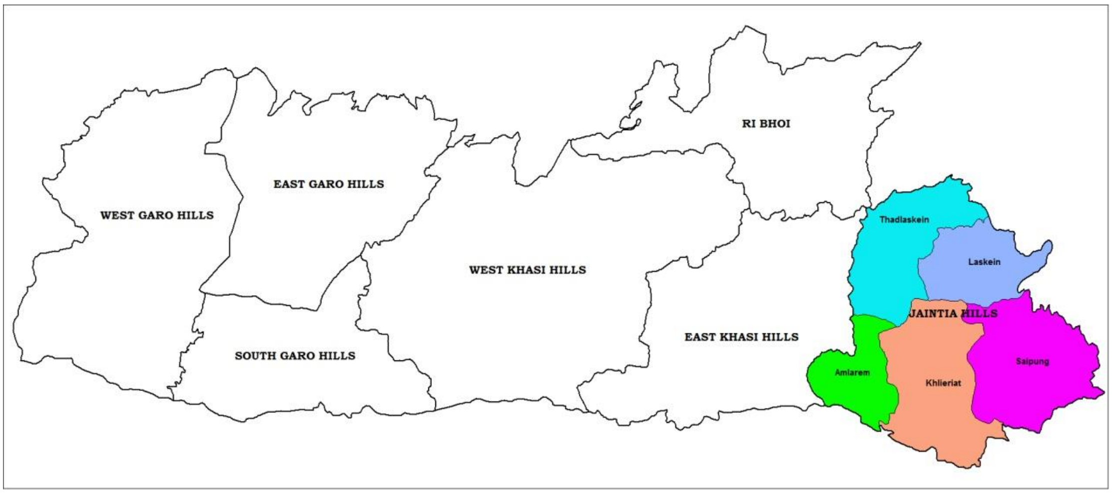
Technical Report Series: D

No: 49/2011-12

GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION BOOKLET JAINTIA HILLS DISTRICT, MEGHALAYA



North Eastern Region
Guwahati

September, 2013

GROUND WATER INFORMATION BOOKLET
JAINTIA HILLS DISTRICT, MEGHALAYA

DISTRICT AT A GLANCE

Sl No.	ITEMS	STATISTICS
1.	**GENERAL INFORMATION**	
	i) Geographical area (Sq km) ii) Administrative Divisions Number of Blocks Number of Villages	3819 5 a) Thadlaskein b) Laskein c) Amlarem d) khliehriat e) Saipung 537
	iii)Population ((Provisional) (2011 census) Total Population Rural Population Urban Population	 3,92,852 (Decadal Growth 2001-2011 31.34%) 3,64,369 (Decadal Growth 2001-2011 32.96%) 28,483 (Decadal Growth 2001-2011 13.67%)
	iv) Average Annual Rainfall (mm) Source: Dept. of Agriculture, Meghalaya Rain gauge station: Rymphum seed farm, Jowai	4173
2.	**GEOMORPHOLOGY**	
	Major physiographic units	Denudational High & Low Hills, dissected plateau with deep gorges.
	Major Drainages	Myngngot (Umngot), Myntdu, Wah Prang, Wah Lukha, Wah Simlieng and Kopili
3.	**LAND USE (Sq Km)**	**2010-11**
	a) Forest area	1540.59
	b) Net area sown	351.75
	c)Total Cropped area	355.35
4.	**MAJORS SOIL TYPES**	a) Red loamy b) Laterite c) Alluvial
5.	**AREA UNDER PRINICIPAL CROPS** (*as on 2010-11, in sq Km*) *Source: Directorate of Agriculture, Meghalaya.*	**Kharif**: Rice:123.24, Maize:30.68, Oilseeds:4.1 **Rabi** : Rice:0.50, Millets:1.62, Pulses:0.77, Oilseeds:0.89
6.	**IRRIGATION BY DIFFERENT SOURCES** a. Surface water (sq km) b. Ground water (sq km)	 45 Nil
7.	**NUMBERS OF GROUND WATER MONITORING WELLS of CGWB** No. of dug wells No. of Piezometers	(as on 31.3.2013) 2 Nil
8.	**PREDOMINANT GEOLOGICAL FORMATIONS**	a. Archaean Gneissic Complex - Granitic, Gneissic and schistose rocks. b. Shillong Group Quartzites and phyllites. c. Tertiary sedimentary rocks like sandstone and shale. d. Recent Alluvium (as valley fill deposits)

9.	**HYDROGEOLOGY**	
	Major water bearing formation	Ground water occurs under both unconfined & semi confined conditions in the hard rocks controlled mostly by topography & secondary porosities of weathered residuum and in joints & fractures.
	• depth to water level Pre-monsoon 2012 Post-monsoon, 2012 Long term water level trend in 10 years (1986 – 2005) in m/yr	 0.77 to 2.63 m bgl bgl 0.0379 rise in pre monsoon at Jowai 0.0016 fall in post monsoon at Jowai Annual rise of 0.0330 at Jowai
10.	**GROUND WATER EXPLORATION BY CGWB**	(as on 31.3.2013)
	No. of wells drilled (EW,OW,PZ, SH. Total)	7 EW and 1 OW Total: 08
	Depth Range (m)	80.18 to 159.52
	Discharge (m^3/hr)	0.30 to 6.3
11.	**GROUND WATER QUALITY**	
	Presence of chemical constituents more than permissible limits	Sporadic occurrence of high concentration of Fe in few pockets in deeper aquifer
	Type of water	Good for drinking & irrigation purposes
12.	**DYNAMIC GROUND WATER RESOURCES** (as on March 2009) ham	
	Annual Replenishable Ground Water Resources	37800
	Net Annual Ground water draft	Negligible
	Projected demand for domestic and industrial uses upto 2025	1319
	Stage of Ground Water Development	0.006 %
13.	**AWARENESS AND TRAINING ACTIVITY**	1 Mass awareness Programme and Water Management Training Programmes organized in Jowai and Thadlaskein
	Mass awareness Programmes Organized	
	Water Management Training Programmes	
14.	**ARTIFICIAL RECHARGE & RAINWATER HARVESTING**	
	Project Completed by CGWB	Nil
	Project under technical guidance of CGWB	Nil
15.	**GROUND WATER REGULATION**	
	Number of OE Block	
	Number of Critical Block	
	Number of Blocks notified	Nil
16	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	a. Higher concentration of Fe is observed in few pockets in deeper aquifer of the district (higher than permissible limit prescribed by BIS, WHO) b. Management and utilization of Groundwater. c. Coal mining, limestone quarries and cement factories affecting the water quality and the environment particularly the water bodies.

GROUND WATER INFORMATION BOOKLET
JAINTIA HILLS DISTRICT, MEGHALAYA

1.0 Introduction

The Jaintia Hills district is the easternmost district of Meghalaya and covers a total geographical area of 3819 sq. km. It lies between North latitude 24^{0}58' and 26^{0}03' and East longitude 91^{0}59' and 92^{0}51'and covers about 17 percent of the total area of Meghalaya. The population is 299108 as per 2001 census. It is hilly and tribal and is bounded by Karbi Anglong district (Assam) in northern, North Cachar Hills district (Assam) in eastern part, East Khasi hills district in the west and Cachar Hills district (Assam) and Bangladesh in the south.

As per provisional 2011 census, Jaintia Hills has a population of 3,92,852 of which male and female were 1,95,641 and 1,97,211 respectively (1008 females per 1000 males. There was change of 31.34 percent in the population compared to population as per 2001.

Jaintia Hills district is divided into five blocks. The area, population and number of villages of the administrative blocks are given below in Table 1.1. Continuing the old system of the Raja of Jaintiapur, the tribals follow the division of the district into twelve *elaka* (provinces), each under a *dolloi*,

Table 1.1: Area and number of villages of the administrative blocks

Blocks	No. of villages	Area (sq.km)
Thadlaskein	133	753
Laskein	100	553
Amlarem	98	398
Khliehriat	109	2115
Saipung	97	
Total	537	3819

1.1 Land Use

The land utilization of the district is presented in the **Table 1.1.**

Table 1.2: Land utilization statistics of of West Garo Hills District (2010-11)

Land Classification	Area (sq. km.)
Geographical area	3819
Forest area	1540.59
Non-Agricultural area	316.02
Cultivable Waste Land and groves	1326.76
Fallow Land	273.79
Net Area Sown	351.75
Area Sown more than once	3.60
Gross cropped area	355.35

Source: Directorate of Economics and Statistics, Meghalaya

The district has a forest area of 1540.6 sq. km., i.e. about 40% of the total geographical area. The net area sown is 351.75 sq. km. and the total cropped area is 355.35 sq. km. Fallow land covers about 4%, net area sown is about 9%, while the total cropped area is also about 9%.

The mainstay of the district is agriculture. However due to the abundance of limestone, plenty of cement factories have been set up in the district. Coal mining in Khliehriat block at sites like Ladrymbai, is also one of the major activities. Coal mined here is mostly exported to Bangladesh and Assam.

In the district there are no major or medium irrigation projects, hence the agricultural development in the area is dependent on minor irrigation schemes. The existing irrigation schemes are based only on surface water and the source is mainly through non-monsoon base flow. The total command area as on 31/03/2004 is 4545.29 ham in the district. Piped water supply schemes and spot source water schemes are the main source of water supply schemes and play a major role for the water requirement of the people especially in the rural areas. Piped water supply schemes are categorized into (i) Gravity Feed Schemes and (ii) River Pumping Schemes. Spot source water supply scheme are classified into (i) Hand pump, (ii) Spring tapped chamber and (iii) Well (dug, ring) maintained by Public Health Engineering Department, Meghalaya (PHED).

1.2 Rainfall & Climate

The climate of the district is directly controlled by the southwest monsoon originating from the Bay of Bengal and the Arabian Sea. The climate shows a variation from the warm, humid tropical in the plains in the eastern and southern part and temperate climate is experienced in the western part around the district headquarter Jowai. The climatic conditions vary substantially from place to place due to wide differences in altitude. Therefore, according to the prevailing weather condition over the years, the district can be grouped into four conspicuous seasons namely winter season, pre-monsoon season, monsoon season and retreating season.

The average annual rainfall in the district is 4173 mm recorded at Rymphum seed farm in Jowai. The district receives a fairly high rainfall throughout the year. Most of the precipitation occurs between April and October. The monthly maximum rainfall of 2655.80 mm was recorded in June 1995 at the same rain gauge station. The lowest annual rainfall was recorded in 2009 with 2623 mm and the highest annual rainfall was recorded in 1995 with 7695 mm..

Central Ground Water Board has carried out water supply investigations, Ground Water Exploration and District Ground Water Management Studies in the district. Of late, during Annual Action Plan 2004-05, District Ground Water Management Studies was carried out in the district. Further, Ground Water exploration has been carried out during the year 2005-06.

2.0 Geomorphology & Soil Type:

2.1 Geomorphology

Geomorphologically, the district is an undulatory one, comprising dissected plateau, denudational high and low hills with deep gorges. The district represents a remnant of ancient plateau of Indian Peninsular shield uplifted to its present height due to tectonic activities in the past and deeply dissected suggesting several geotectonic and structural deformities that the plateau has undergone. The southern parts form a platform on which Tertiaries were deposited in the post- cretaceous period. Topography varies from gently rolling type to highly undulating type. The highest point of 1627m above MSL is observed at *Maryngksin*, in eastern part and the lowest point is 76m above MSL at *Dawki*.

Broadly, the district can be differentiated into four major geomorphic units.

- Alluvial plain in the southern part of the district bordering Bangladesh.
- Area having denudo-structural hills and highly undulating topography.
- Area showing more or less flat topography with rolling mounds representing plateau
- Area containing denudational hills and less dissected topography.

2.2 Drainage

The drainage system of the district is controlled by topography. Broadly, there are mainly two watershed in the district, one river flowing in the northern direction toward the Brahmaputra and the other in the south, towards the Surma valley in Bangladesh. The important rivers flowing to the Brahmaputra are *Kopili, Myntang* and *Mynriang* and the main rivers flowing to the Surma valley are *Myngngot (Umngot), Myntdu, Wah Prang, Wah Lukha* and *Wah Simlieng.* The drainage pattern is sub parallel to parallel. It is being controlled by joints and faults as indicated by the straight courses of the rivers and streams with deep gorges.

2.3 Soil Type

The district shows different types of soils as the provenance differs widely. The loamy soil is the most prevalent one. They vary from sandy to clayey-loam *in Jowai* and *Nongbah*. Reddish lateritic soil is observed in the hill slope in *Sonapur* and alluvial soil occurs in the southern periphery of the district eg *Dawki, Muktapur, Lakroh* etc. The soil is acidic in nature, with low percentage of phosphorous and high organic carbons.

3.0 Geological Set-up

The district area falls mainly within the Shillong or Meghalaya Plateau which is constituted mainly of Precambrian rocks of gneissic composition in which granites, schists, amphibolits, calc-silicate rocks occur as inclusions of various dimensions.

The gneisses form the Basement Complex for the overlying Shillong Group of rocks and is separated from the later by an unconformity indicated at places by the occurrence of a conglomerate bed. The presence of primary structures like current bedding, ripple marks etc. indicated that quartzites of the Shillong Group are of sedimentary derivative later metamorphosed to quartzites. These occur mostly as thick layers. Grainite Plutons occur as isolated patches in the district , intruding the Basement Gneissic complex and Shillong Group of rocks.The Granites occur as intrusive body in the Basement Gneissic complex. Both Porphyritic and fine-grained pink granite occur in the area.

The Shella Formation of Jaintia Group consists of alteration of sandstone and limestone occurs in the south-central and south-western part of the district.

The shelf facies of Barail Group, consists of fairly coarse grained sandstone, shale, carbonaceous shale with streaks and minor seams of coal and occupy the south-eastern part of the District.

The Quaternary fluvial sediments occur as valley-fill deposits and in the extreme southern plain of the district bordering Bangladesh.

The Generalised geological succession of the area of Jaintia Hills District is given in Table. 3.1.

Table 3.1 General Geological Succession

Geological Age	Group	Formation	Rock Type
Quaternary			Undifferentiated fluvial sediments (occurring as valley fill deposits and in the southern plain)
Unconformity			
Eocene- Oligocene	Barail group	-------	Coarse sandstone, shale, minor coal lenses carbonaceous shale,
Unconformity			
Palaeo- Eocene	Jaintia Group	Shella (600m)	Alteration of sandstone and limestone.
Unconformity			
Neo-Proterozoic – Lower Palaeozoic		Granite Plutons	Porphyritic coarse granite, pegmatite, aplite/quartz vein etc.
Intrusive Contact			
Palaeo- Mesoproterozoic	Shillong Group	Upper Division Lower Division	Mainly Quartzites intercalated with phyllites. Mainly schists with Calc Silicate rocks, carbonaceous phyllite and thin quartzite layers.
Unconformity (Shared conglomerate)			
Archaean(?)- Proterozoic (Undiff)	Basement Gneissic Complex		Mainly quartzo-feldspathic gneiss with enclaves of granites, amphibolites, schists etc.

4.0 Ground Water Scenario:

4.1 Hydrogeology:

Hydrogeologically, the district can be divided into three units, namely consolidated, semi consolidated and unconsolidated formations.

4.1.1 Consolidated formation: These include the oldest rock formation occupying about 1300 km^2 in the northern and western parts. Peneplaned gneissic complex, quarzites etc constitute this unit. The depth of weathering varies from place to place and is 15 to 20m at places. The presence of substaintial-weathered mantle is confined to their secondary porosities, which form excellent repository of ground water in hard rocks area. The storage and movement of ground water in hard rock is controlled by physiography, zone of weathering and interconnected places of weakness. Ground water occurs under unconfined condition and in semi-confined condition in the interconnected secondary structural weakness/ features like joints, fractures etc of the underlying hard rocks. The depth to water level varied between 0.13 to 1.13 m bgl.

4.1.2 Semi consolidated formation: These constitute the major part of the district covering *Amlarem* and *Khliehriat* blocks and covers two- thirds of the entire area. IT ranges in age from late Cretaceous to Plio- Pleistocence. The shella formation of the Jaintia group is the most conspicuous. Ground water in this formation occurs under unconfined to semi confined conditions due to primary porosities of the semi consolidated formations as well as in the secondary porosities like caverns, open fractures and joints. The formations shows both isolated hammocky topography to highly undulating topography with steeply rising hills and deep gorges. The karst topography is observed in areas of *Letein, Latyrk, Litang* etc. occupied by the cavernous limestone. The depth to water level lies between 0.30 and 1.13 m bgl.

4.1.3: Unconsolidated formation: The unconsolidated formation is mainly represented by recent alluvium occurs near the southern fringe of the district and is the continuation of the alluvial plain of Bangladesh. It constitute about 67 km^2 representing about 2% of the total area.

4.2 Ground Water Exploration:

The ground water development is yet to be picked up in the district. As part of ground water exploration programme of CGWB, the Board had drilled seven exploratory wells and one observatory well in the district. The depth of the exploratory well ranges from 80.18 m to 159.52 m below ground level. The depth to water level of the wells ranges from 5.15 to 14.18 m below ground level. The ground water discharge varies from 0.30 m^3/hr at *Tyrsang* E/W to 6.3 m^3/hr at *Thadlaskein*, Diet and the Transmissivity lies between 0.02 m^2/day to 3.65 m^2/day respectively. The summarised details of Ground Water Exploration carried out in the district are given in Table 4.1.

Table 4.1: Summarised Details of Ground Water Exploration

S. No	Location	Depth drilled (m)	Aquifer type	Aquifer zones tapped (m.below ground level)	SWL (m.bgl)	Discharge (m^3/hr)	DD (m)	T (m^2/day)
1	Litang	80.3	Limestone	10-12,20-25,30.4-31.4,37.6-38.6,44.7-46.7,51.8-53.8,78.2-79.2	9.36	17	8.1	287.4
2	Thadlaskein Diet	120.4	Quartzite	22.4-25,80.7-84.1	10.24	6.3	1.12	3.65
3	Thadlaskein	159.52	Quartzite	10.12-16.22,61.92-68.02,80.22-86.32, 104.62-110.72,116.82-122.92	6.9	5.56	12.75	2.68
4	Jowai	80.18	Quartzite	23.19-24.19,31.39-32.39,40.49-41.49, 47.59-49.69,55.79-56.79,76.89-77.34	14.8	1	33.11	0.2
5	Wahlajer	88	Sandstone, shale	21.45-22.45,30-30.5,39.75-40.75,52.95-53.95,64.65-65.15	5.51	0.5	30.3	0.92
6	Thadlaskein	85.7	Quartzite	32.62-34,36-37.5,43.5-44.5,64.5-66.5,75-76	4.95	0.4	27.84	0.205
7	Nongbah	74.2	Quartzite	27.4-29.4,31.5-35.5	4.95	0.4	27.84	0.02
8	Tyrsang	82.35	Sandstone, shale	22.35-23.35,27.45-28.45,31.55-32.55,59.95-60.95	6.14	0.3	39.55	2.28

4.3 Ground Water Resources

The dynamic ground water resources have been assessed based on Ground Water Resources Estimation methodology of 1997 (GEC 97). In this methodology two approaches are recommended water level fluctuation method and rainfall infiltration method. As the data on ground water level is insufficient, the rainfall infiltration method is used for calculating the resource estimation of the district. Moreover, hilly area having slope of more than 20% are not taken into consideration as they are not worthy of recharge. Hence, the remaining area is delineated into command and non command area and assessment is done for both monsoon and non-monsoon seasons. As per the Rainfall Infiltration Factor method, recharge from rainfall is given by the following formula:

$(R_f) = RIF * A * NMR$

Where RIF = rainfall infiltration factor

A = Area of computation for recharge.

NMR = Normal monsoon rainfall

Recharge from sources other than rainfall, ground water irrigation, recharge from ponds and tanks, check dams nalla bunds is taken as nil for the district and only surface water irrigation is taken into account. 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 (as on March 2009) in ham is as follows.

Table: 4.2 Net ground water availability (ham)

Annual Replenishable GW resources				Total annual ground water recharge	Natural discharge during non-monsoon season	Net ground water availability
Monsoon season		Non-monsoon season				
Rainfall recharge	Recharge from other source	Recharge from rainfall	Recharge from other source			
30750	Nil	7050	Nil	37800	3780	34020

Table 4.3: Categorization of ground water resources

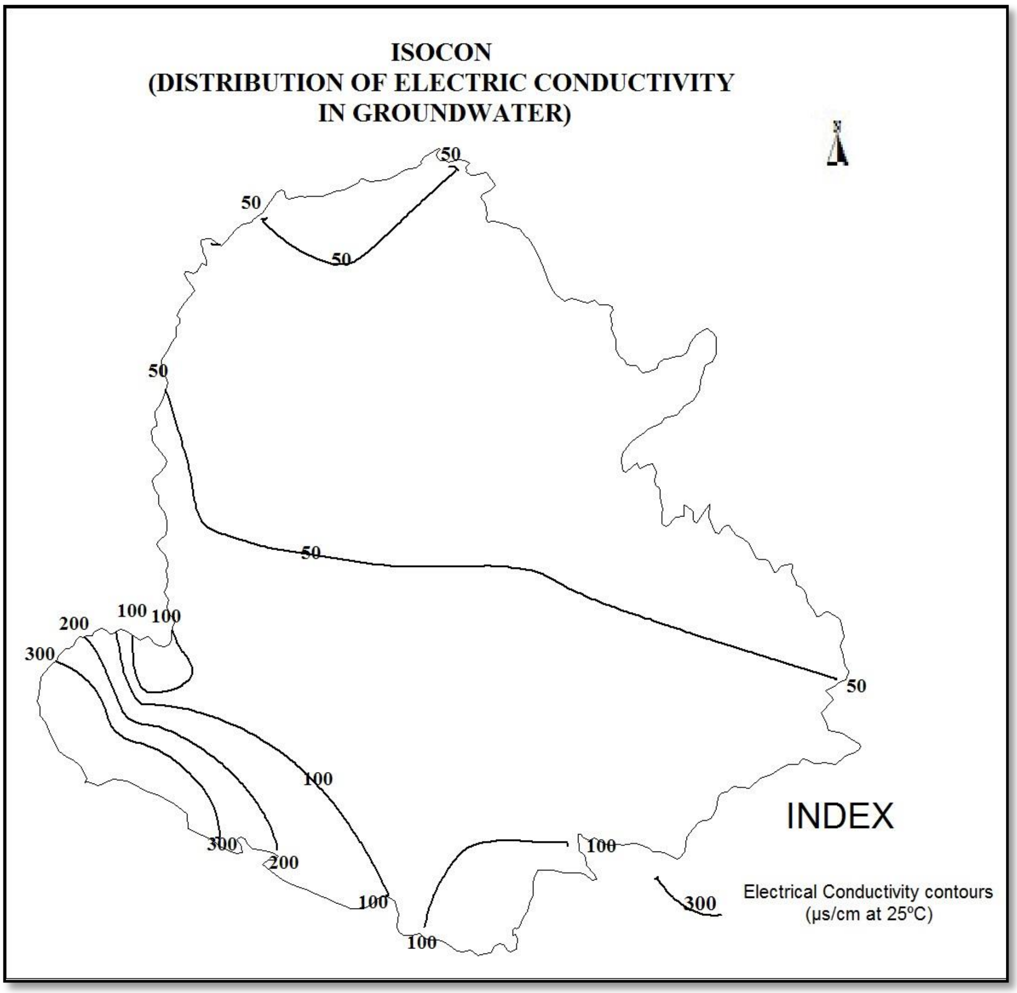
Net Ground water availability	Annual GW draft			Domestic and industrial uses upto 2025	Ground water availability for future irrigation	Stage of ground water development (%)	Categorization
	Irrigation	Domestic and industrial uses	Total				
34020	Nil	1.98	1.98	1319	32701	0.006	**Safe**

As per the ground water resource and the stage of development computed, it can be seen that, ground water development is yet to be picked up in the area. The stage of development during the last decade is negligible and the district can be developed further by utilizing the abundant ground water resources available in the district.

4.3 Ground Water Quality

In order to study the chemical quality of ground water representative water samples from select borewells, dug wells and springs were collected during the course of field work and the parameter analysed are pH, EC, TDS, CO_3, Cl, SO_4, F, Ca, Mg, TH and Fe.

It was observed that spring water is by and large slightly alkaline rather than acidic. Overall the chemical constituent present in the ground water is within permissible limit set by BIS and WHO except the concentration of Iron in few pockets in deeper aquifer, which is higher than permissible limit. Removal of the Iron is best effected by aeration process followed by sedimentation and filtration. Potassium permanganate or chlorine/chloride may be employed to oxidize the iron, which is then filtered from the waters. The process is applicable very much when bacteria is present in the water. Iron can also be removed by the addition of a mixture of sodium carbonate and sodium phosphate to precipitate iron as insoluble, followed by settling and filtration.



4.3.1 Water Quality affected by Coal Mining in Jaintia Hills District

The district is a major coal producing area of the state with an estimated coal reserve of about 40 million tonnes. The areas where coal mining is prominent are *Sutnga, Lakadong, Musiang-Lamare, Lumshnong, loksi, Ladrymbai, Bapung, Jarain, Shkentalang, Sakynphor Khilehriat and Rymbai.* The thickness of coal seams vary from 30 to 212 cm and is found to occur imbedded in sedimentary rocks (sandstones and shale) of the Eocene age *(*The main characteristics of the coal found in the district are its low ash content, high volatile matter, high calorific value and comparatively high sulphur content. The coal is mostly sub-bituminous in character. The physical properties characterize the coal as hard, lumpy bright and jointed except for the coal in Jarain which is both soft and hard in nature. Coal extraction is done by adopting obsolete and primitive surface mining method which is commonly known as 'rat-hole' mining. In this method the land is first cleared by cutting and removing the ground vegetation and then pits ranging from 5 to 100 m^2 are dug into the ground till the coal seam is reached. Thereafter, tunnels are made into the seam sideways to extract coal which is dumped on the ground surface nearby till carried away by trucks. Coal mining in the district undoubtedly has brought wealth and employment opportunities but leads to large scale denudation of forest cover, scarcity of water, pollution of air, water and soil and degradation of agricultural land.

The chemical quality of surface water is worst affected as a result of coal mining in the district. Most of the rivers and streams in the mining areas are polluted. The main source of this pollution in the mining area is “Acid Mines Drainage” originating from mines and spoils, leaching of metals from soil and rocks, organic enrichment, silting etc. The waters of the mining areas have been found containing sulphate concentration between 16 to 161 mg/L. The high concentration of sulphates is mainly due to presence of iron sulphide in coal and rocks and its reaction with water and oxygen. On the other hand, water of the non mining areas very low concentration of sulphates. Water pollution is exhibited by the colour of the water in mining areas which varies from brownish to reddish colour. Other parameters which characterized the degradation of water quality are low pH, high conductivity, high concentration iron and toxic metals, low dissolved oxygen and high BOD.

5.0 Ground Water Management Strategy

5.1 Ground Water Development

Development of ground water in the district is practically negligible. As the district is characterized by undulatory terrain, the scope for development of ground water lies in low lying depression, and valley fills which hold good prospects for ground water development. More over, in the district all the minor irrigation scheme are executed by the surface water only and as per Ground water resources estimation, the stage of ground water development is only 0.006% which leaves a greater scope for ground water development.

Ground water development is being done through dugwell and borewell in the intermontane valley and linear ridges. The development of spring is seen mainly along the foothills. The ground water is mainly used for domestic purposes such as washing and drinking. Therefore, there is ample scope for future development of ground water in the area.

The peneplanied surfaces, buried pediments and the valley fills are the most favorable localitions for the development of ground water. The fractured and lineament too hold prospect for the development of ground water. Structures like ring wells, shallow as well as deep tube wells are the feasible ground water structures. The fractured, fissured rocks and the intersection of faults /lineaments hold good prospects for ground water. As ground water is poorly developed/ exploited, dugwells are the preferred structures as of now in low-lying areas and valleys. The shallow water level conditions gives scope to maintain sufficient water column in the dug wells.

Ground water manifests itself at the surface as springs. This can plays an important role in rural water supply scheme in the district and a proper and scientific approach is required to augment the existing water supply scenario in the district.

6.0: Ground Water Related Issues and Problems

In few pockets of the district higher concentration of Iron in deeper aquifer is found which is beyond permissible limit set by BIS and WHO. In area where iron content is beyond permissible limit, iron removal plant or other suitable devices should be installed.

The district is well known for large production of coal with *Khliehriat* sub division as its main coal belt area. It can be seen that unscientific method of coal mining coupled with limestone quarry undertaken by cement factories has affected the environment particularly the water bodies in various part of the district. Hence scientific mining is suggested as a preventive measures. Government of Meghalaya can take up right steps in this direction.

7.0: Recommendations

Springs play a major role of water requirement for the people in rural areas. It is found that the location of the spring is mainly restricted to foothills and intermontane valleys. The spring water is of excellent quality and is suitable for drinking purposes as per BIS standard. As the people in rural areas are totally dependent on spring, there is an urgent need for scientific approach for proper development and management of this precious resource. 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.

As development of ground water is still in nascent stage, there is ample scope for future development of ground water in the district. It is being done through dug wells and bore wells in the intermontane valleys and linear ridges. In the foothills where most of the precipitation get wasted as surface runoff, rain water harvesting should be promoted by constructing structures such as gully plugs, check weirs and check dams and also roof-top rain water harvesting structures. In doing so, the water level on the upstream can be raised to a considerable extent. For roof-top rain water harvesting, rainwater can be collected from the PVC/GI or concrete rooftops through bamboo, GI or PVC gutters and pipes. This water can be used for domestic uses including drinking purposes after treatment. The rainwater harvesting structures are simple, economical and eco-friendly multi-purpose measures, mutually complementary and conducive to soil and water conservation, afforestation and increased agricultural productivity. The structures commonly suited to hilly areas are bench terracing, contour bunds / trenches, gully plugs, *nalah* bunds / Gabion structures, check dams and percolation ponds as also roof-top rain water harvesting for buildings.

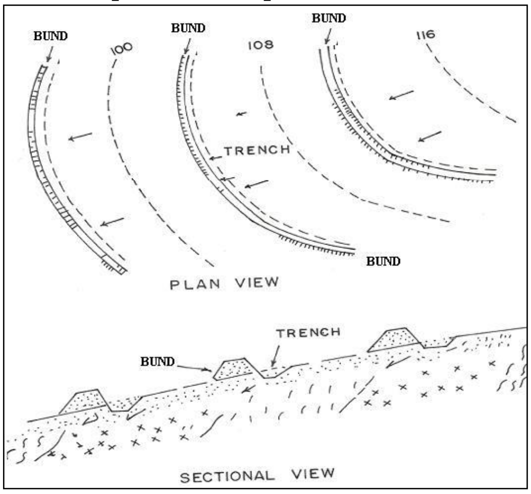


Fig. 1. Schematic Diagram of Contour Bund/Trenches

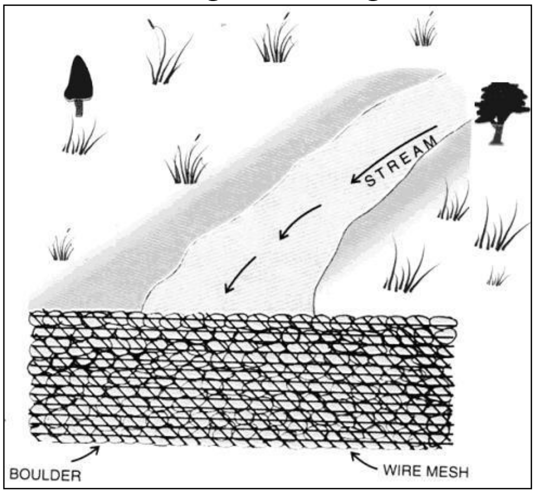


Fig. 2. Schematic Diagram of a Gabion Bund

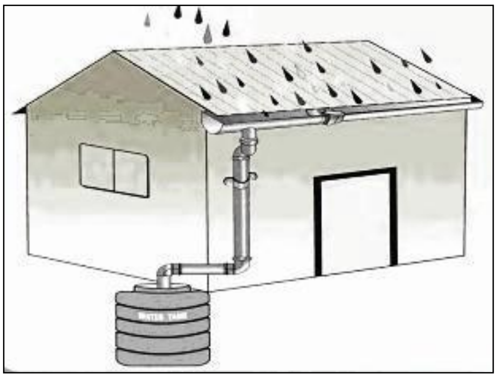


Fig. 3. Schematic Diagram of Roof Top Rainwater Harvesting

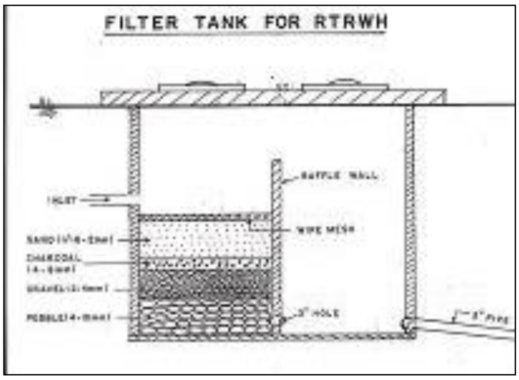


Fig. 4. Schematic Diagram of Filter

The intermontane valleys are the most favourable places for ground water development. Structures like ring/dug well, shallow and deep bore well are feasible ground water abstraction structures. Hydrogeological studies have indicated that lineaments, joints, fractures and faults are the main controlling factors for the occurrence and distribution of ground water. These structures can be targeted for ground water development. Thus, the potential fractured zones must be confirmed by Geophysical Survey and lineaments studies by Remote Sensing Studies.

The chemical quality of ground water indicates that groundwater in the area is good for domestic, irrigation and industrial use. However Iron content in deeper aquifer in some bore/tube wells are beyond permissible limit, which warrant proper treatment before use. Moreover, mining system should be done scientifically and preventive measures have to be taken by the State Government in this regard so as to keep the water bodies free from pollution. As regards high iron concentration in water, removal of the Iron is best effected by aeration process followed by sedimentation and filtration. Potassium permanganate or chlorine/chloride may be employed to oxidize the iron, which is then filtered from the waters. The process is applicable very much when bacteria is present in the water. Iron can also be removed by the addition of a mixture of sodium carbonate and sodium phosphate to precipitate iron as insoluble, followed by settling and filtration.

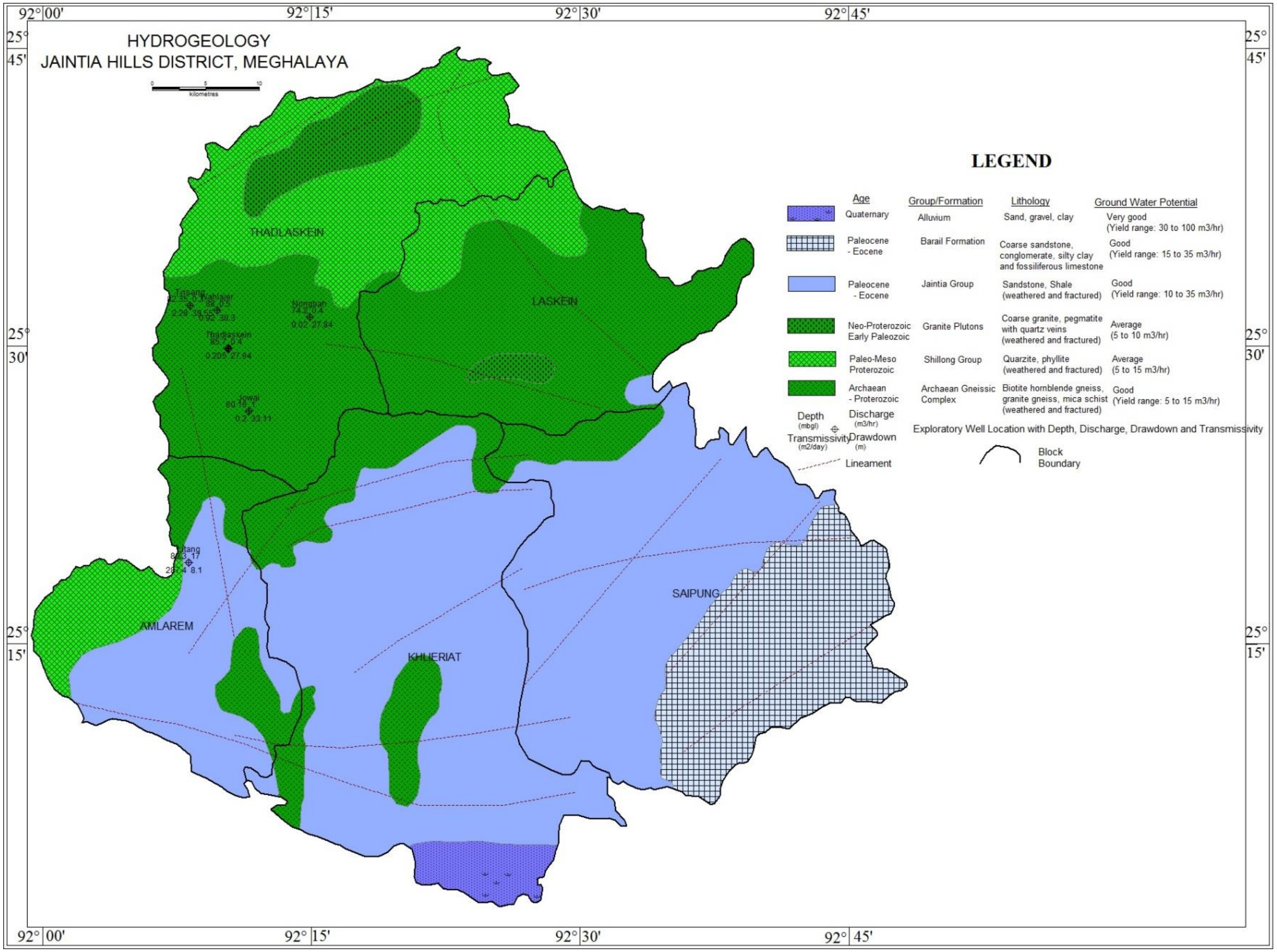
Although the district receives heavy rainfall, in the hilly portion people face acute scarcity of water. In these areas, roof top rainwater harvesting may be adopted effectively to meet the demand of the people residing on hilltops. Rainwater can be collected from the rooftops made of PVC or concrete or through bamboo. Filters can be used at the time of collection for filtration of impurities. This water can be used for domestic uses and drinking purposes after treating with bleaching powder to remove bacteriological contamination.

In the foothills 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 counter bunding will be effective means of augmentation of ground water.

As already mentioned above, the stage of ground water development for Jaintia district is only 0.006%. Hence, there is sufficient scope for development of ground water resources in the district. A special thrust to ground water development for irrigation and future utilization is recommended. Creating public awareness for effective use of water resources is essential for proper management of ground water resources. Hence, the co-operation of public is as important as the technical or administrative considerations.

Depletion of forest cover, pollution of air, water and soil, degradation of agricultural fields, and scarcity of water and other natural resources are some major environmental issues of the coal mining areas. The rivers in the district are the greatest victims of the coal mining. Hence there is urgent need for initiating activities for ecorestoration of the affected areas. Following measures can be taken up to mitigate the environmental problem and improvement of water quality.

- Preservation of non polluted water sources: Most of the water bodies in the mining areas barring a few springs have been polluted. Hence these springs should be preserve against pollution.
- Scientific method of coal mining and disposal of mine water as well as spoils.
- Filling of mine pits, channelling of seepage water for checking “Acid Mines Drainage” contamination of water bodies.
- Extensive afforestation and vegetation on coal mines areas is an important step of ecorestoration.
- Conservation of top soil is essential for plant growth and agricultural productivity.
- The villager needs to educated about the damage that coal mining activities causes to the adjoining areas


HYDROGEOLOGY
JAINTIA HILLS DISTRICT, MEGHALAYA
kilometres
92° 00'
92° 15'
92° 30'
92° 45'
25° 45'
25° 30'
25° 15'
THADLASKEIN
LASKEIN
AMLAREM
KHLIERIAT
SAIPUNG
LEGEND
Age
Group/Formation
Lithology
Ground Water Potential
Quaternary
Alluvium
Sand, gravel, clay
Very good
(Yield range: 30 to 100 m3/hr)
Paleocene - Eocene
Barail Formation
Coarse sandstone, conglomerate, silty clay and fossiliferous limestone
Good
(Yield range: 15 to 35 m3/hr)
Paleocene - Eocene
Jaintia Group
Sandstone, Shale (weathered and fractured)
Good
(Yield range: 10 to 35 m3/hr)
Neo-Proterozoic Early Paleozoic
Granite Plutons
Coarse granite, pegmatite with quartz veins (weathered and fractured)
Average
(5 to 10 m3/hr)
Paleo-Meso Proterozoic
Shillong Group
Quarzite, phyllite (weathered and fractured)
Average
(5 to 15 m3/hr)
Archaean - Proterozoic
Archaean Gneissic Complex
Biotite hornblende gneiss, granite gneiss, mica schist (weathered and fractured)
Good
(Yield range: 5 to 15 m3/hr)
Depth (mbgl)
Discharge (m3/hr)
Transmissivity (m2/day)
Drawdown (m)
Exploratory Well Location with Depth, Discharge, Drawdown and Transmissivity
Lineament
Block Boundary