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भारत सरकार

GOVERNMENT OF INDIA

जल संसाधन मंत्रालय

MINISTRY OF WATER RESOURCES

केंद्रीय भूजल बोर्ड

CENTRAL GROUND WATER BOARD

केरल क्षेत्र

KERALA REGION

भूजल सूचना पुस्तिका, कन्नूर जिल्ला, केरल राज्य

GROUND WATER INFORMATION BOOKLET OF KANNUR DISTRICT, KERALA STATE

तिरुवनंतपुरम

Thiruvananthapuram

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GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

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द्वारा

By

एम् संताना सुब्रमणि
वैज्ञानिक ग

M. Santhana Subramani
Scientist C

KERALA REGION
KEDARAM, KESAVADASAPURAM
THIRUVANANTHAPURAM – 695 004
TEL: 0471-2442175
FAX: 0471-2442191

BHUJAL BHAVAN
NH-IV, FARIDABAD
HARYANA- 121 001
TEL: 0129-12419075
FAX: 0129-2142524

GROUND WATER INFORMATION BOOKLET OF KANNUR DISTRICT, KERALA STATE

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DISTRICT AT A GLANCE

Sl No.	ITEMS	STATISTICS
1.	**GENERAL INFORMATION**	
	i) Geographical area (Sq km)	2966
	ii) Administrative Divisions (As on 31-03-2011) Number of Tehsil/Block Number of Panchayat/Villages	 3 / 9 81 / 129
2.	**GEOMORPHOLOGY**	
	Major physiographic units	Lowland, Midland and Highland
	Major Drainages	Valapattanam, Kuppam, Anjarakandy and Mahe
3.	**LAND USE (ha) as in 2009**	
	a) Forest area	48734
	b) Net area sown	123516
4.	**MAJOR SOIL TYPES**	Laterite, Brown hydromorphic, Coastal and river alluvium and Forest loamy soil
5.	**AREA UNDER PRINCIPAL CROPS (ha) as in 2009**	Paddy - 7232 Coconut - 82223 Tapioca - 1831 Banana - 2181 Pepper - 12533 ArecAnut - 11262 Cashew - 19366
6.	**AREA IRRIGATED BY DIFFERENT SOURCES (ha) as in 2009**	
	Wells(Dug wells &Tube wells / Bore wells)	15180
	Tanks / Ponds	1912
	Canals	1710
	Other Sources	4510
	Net Irrigated area (ha)	23312
7.	**NUMBER OF GROUNDWATER MONITORING WELLS OF CGWB (AS ON 31-3-2011)** No. of Dug wells No. of Piezometers	 42 17
8	**PREDOMINANT GEOLOGICAL FORMATIONS**	Gneiss, Schist, Charnockite, Coastal Alluvium.

9.	**HYDROGEOLOGY** Major Water bearing formation Depth to water level (Pre-monsoon, 2011) Depth to water level (Post-monsoon, 2011) Long term water level trend in 10 years(2002- 2011) in m/yr Premonsoon- Postmonsoon-	Weathered, fractured crystalline formations, laterites and Recent alluvium. 1.75 to 20.48 m bgl 0.37 to 19.26 m bgl Rise – 0.0007 to 0.8277 Fall – 0.0033 to 0.5056 Rise – 0.0064 to 0.4912 Fall – 0.008 to 0.1936
10.	**GROUND WATER EXPLORATION BY CGWB (As on 31-03-2011)**	
	No. of wells drilled (EW, OW, PZ, SH, Total)	EW – 12, PZ –18, SH – Nil Total – 30
	Depth Range (m)	86 to 200
	Discharge (litres per second)	0.01 to 14
	Transmissivity (m^2/day)	1.44 to 81.27
11.	**GROUND WATER QUALITY**	
	Presence of chemical constituents more than permissible limits	Quality is good. Major chemical constituents lie within the permissible limit.
12.	**DYNAMIC GROUNDWATER RESOURCES (as in March 2009) – in MCM**	
	Annual Replenishable Ground Water Resources	479.11
	Net Annual Groundwater Draft	217.39
	Projected demand for Domestic and Industrial Uses as in 2025	119.32
	Stage of Ground Water Development	45.37%
13.	**AWARENESS AND TRAINING ACTIVITY** Mass Awareness Programmes organized Date Place No. of Participants	 One 25-01-2002 Kannur 300
	Water Management Training Programmes organized Date Place No. of Participants	One 2006 Kannur 150
14.	**EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING**	

	Projects completed by CGWB (No., Amount spent & Year)	2 Numbers. i) Mayyil S.C. Colony (Rs.1.53 lakhs, 2001) ii) Ezhimala Naval Academy(Rs.8.46 lakhs, 2001)
	Projects under technical guidance of CGWB (Numbers)	Nil
15.	**GROUND WATER CONTROL AND REGULATION**	
	Number of Over Exploited blocks	Nil
	Number of Critical blocks	Nil
	Number of Semi-Critical blocks	Two (2 Nos) 1.Kuthuparamba 2. Thalassery
	Number of blocks notified	Nil
16.	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	Decline in water level, Water scarcity, Seasonal salt water ingress near rivers & coastal estuaries

GROUND WATER INFORMATION BOOKLET OF KANNUR DISTRICT, KERALA STATE

1.0 INTRODUCTION

Kannur (Cannanore) district is one of the northern maritime districts of Kerala. It covers an area of 2966 sq km bounded by the North latitudes 11^0 40' and 12^0 48' and East longitudes 74^0 52' and 75^0 56'. It is bounded by Kasaragod district in the north, Kozhikode district in the south, Coorg district of Karnataka and Wayanad district in the east and the Lakshadweep Sea in the west. The Census data for the year 2011 reveals that the district has total population of 2525637 persons with 1184012 males and 1341625 female's population with a literacy rate of 95.41%.

1.1 Administration

Kannur district is divided into 3 taluks (Taliparambu, Kannur and Thalassery), 5 municipalities (Payyanur, Taliparambu, Kannur, Azhikode and Koothuparambu), 9 blocks (Payyanur, Kannur, Thalasserry, Taliparambu, Edakkad, Irikkur, Iritty, Peravur and Koothuparambu), 81 panchayats and 129 villages.

1.2 Drainage, Irrigation practices

Kannur district is mainly drained by the *Valapattanam* and *Anjarakandy* rivers. The other rivers are *Kuppam*, *Mahe*, *Thalasserry* etc. Dendritic is the common drainage pattern. The *Valapattanam* river, which is the longest in the district originates from Brahmagiri Reserve forest in Coorg district of Karnataka. The drainage area of the river in Kerala is 1321 sq.km. The *Anjarakandy* river originates from the Kannoth Reserve forest. The drainage area of the river is 412 sq.km.

Kannur district has 23,312 ha. area under irrigation, which accounts about 8.01% of the gross irrigated area of the state. Kannur district is provided with one major irrigation project along with some minor irrigation projects. The major irrigation scheme of the district is Pazhassi project. The command area fixed for Pazhassi project was 11525 ha of land. However only 8125 ha of land has been benefited through this project as on date. Ground water is also used for irrigation purposes. In addition to this, there are private tanks to facilitate the irrigation sector.

The index map showing location of blocks, drainage exploratory wells, piezometers and ground water monitoring wells are given in **Figure1**.

1.3 Works carried out by CGWB

Systematic hydrogeological survey in Taliparambu taluk of Kannur district was carried out by Sh. S.V.N.S. Rao. A report on the hydrogeological conditions in Kannur was compiled by V.C. Jacob and P. Lakshminarayanan in 1980. Ground water management studies in Kannur district was carried out by Anadigayan during 2001-2002. Reappraisal groundwater survey in Mahe Region of the west coast for augmentation of water supply to Mahe were carried out by P. Lakshminarayanan in 1984-85. Water supply investigations were carried out by P. Subramanian and K.M. Najeeb in Electronics component complex and Ezhimala area. Exploratory drilling was carried out by CGWB during 1988-89 and 1998-2000. Reappraisal Hydrogeological survey in Kannar district carried out by Dr.V.S.Joji during the year 2008-09.

2.0 RAINFALL & CLIMATE

Kannur district receives a total annual rainfall of around 3438 mm. District experiences heavy rainfall during the South West monsoon season followed by North East monsoon. South West monsoon during June to September contributes 70 % of the total rainfall of the year. The northeast monsoon contributes only about 30%. The distribution of rainfall during year 2006 to 2011 is shown in **Table 1**. Rainfall is considerably less during the period from January to May.

Table 1: Monthly rainfall in Kannur district (Period 2006-2011)

Year	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
2006	0.0	0.0	16.0	5.0	617.0	735.0	674.0	491.0	570.0	267.0	97.5	2.0	3475.0
2007	0.1	0.2	0.0	45.4	213.4	949.8	1115.9	783.8	595.6	315.1	72.3	0.2	4091.8
2008	0.0	0.6	250.2	23.7	56.6	725.8	483.6	480.3	396.4	392.5	3.0	9.8	2822.5
2009	0.0	0.0	9.3	97.2	169.6	625.3	1456.2	299.5	320.5	200.3	306.8	48.7	3533.4
2010	19.1	0.0	9.4	65.3	137.0	843.9	959.6	511.0	269.3	342.3	338.1	2.3	3497.3
2011	0.0	0.0	0.0	90.3	44.3	1093.8	852.5	647.5	436.4	214.5	91.4	0.5	3471.2

The year to year variability of annual rainfall is around 28.2%. In general, the rainfall increases from the coast to the eastern hilly regions. Kannur district falls under wet type of climate based on Thornthwaite's climatic classification.

2.2 Meteorological Parameters

Apart from the rainfall, the meteorological parameters play an important role in groundwater balance estimation and other types of relevant studies.

Temperature

The temperature is more during the months of April to May and is less during December and January. The average mean monthly maximum temperature ranges from 28.4 to 36.9^0C and minimum temperature ranges from 19.7 to 23.9^0C.

Relative Humidity

Relative humidity is more during south west monsoon season (ie June to September). It is more during morning hours and is less during evening hours. Humidity ranges from 77 to 88 % in the district.

Evaporation

Evaporation is more during summer months of March to May and low during the months of June to November. The mean evaporation ranges from 2.6 to 5.7 mm/day.

Sunshine Hours

Generally good sunshine hours are recorded in the month of November to May. January to March records the maximum sunshine hours of more than 9.1 hours/day. The months of June to August records the minimum sunshine due to cloudy sky.

Wind

Wind speed ranges from 2.1 to 3.3 km per hour with mean speed of 2.6 km/hr. The wind speed is high during the period from March to June and low during the period from September to December.

Potential Evapotranspiration (PET)

The monthly PET ranges from 124.5 to 170.6 mm. PET values are lower than the monthly rainfall during the months of May to October indicating water surplus for possible recharge into groundwater regime during these months.

3.0 GEOMORPHOLOGY AND SOIL TYPES

3.1 Geomorphology

Kannur district can be divided physiographically into three distinct geomorphologic units viz the coastal plains and lowlands in the western part, the central undulatory terrain comprising the midland region and eastern highland region. The coastal plains occurs as a narrow belt of alluvial deposits running parallel to the coast with a maximum width of about 15 km. Midland region forms a plateau land at certain places covered by a thick cover of laterite. The hilly tract in the eastern part consists of highly rugged terrains. The Ezhimala peak (259.69m) with the characteristic N-S alignment is a distinct physiographic unit in the coastal plains. Minor cliffs of laterite generally rising to an elevation of 50 to 60 m above mean sea level are found at Mahe, Thalasserry and Bekal coast. The midland region presents a plateau land covered by a thick cover of laterite. This is immediately to the east of the coastal strip, rising from 40 to 100 m above msl. The valleys in the plateau are gorge like and V shaped cut by youthful streams. The hilly tract along the eastern part of the district constitutes the highland region and is highly rugged. Development of bad land topography along the margins of the valley is a common feature observed in the district.

3.2 Soil types

There are mainly four types of soil observed in the district.

(1) Lateritic soil

(2) Brown hydromorphic soil

(3) Coastal and river alluvium

(4) Forest Loamy soil

(1) Lateritic soil – The predominant soil in the district is lateritic soil, which is the weathered product derived under humid tropical conditions. It occurs mainly in the midland and hilly areas characterized by rugged topography. They range from sandy loam to red loam.

(2) Brown hydromorphic soil – These are confined to the valleys between undulating topography in the midlands and in the low lying areas of the coastal strip in the district. These soils are brown in colour and the surface texture varies from sandy loam to clay. They have been formed as a result of transportation and deposition of materials from adjoining hill slopes and also through deposition by rivers.

(3) Coastal and river alluvium – The coastal alluvium is seen in the western coastal tract of the district. The coastal plain is characterized by secondary soils, which are sandy and sterile with poor water holding capacity. The width of the zone is more in the central part i.e., in the Kannur area and it is almost narrow in both north and southern areas of the district. The marshy soil in the coastal plain supports mangrove vegetation and is found at the estuaries and backwater extending inland along their courses. The soil is composed of recent deposits predominantly marine with some fluvial sediments along the coastline. These soils are immature with high sand content. River alluvium is found along river valleys cutting across the extensive lateritic soils. The soil is very deep with surface texture ranging from sandy loam to clay. It is fertile, having water holding capacity and plant nutrients which are regularly replenished during floods.

(4) Forest Loamy soil – These soils are found in the eastern hilly areas of the district and are characterised by a surface layer rich in organic matter. They are generally acidic and are dark reddish brown to black in colour with loam to silty loam texture.

4.0 GROUND WATER SCENARIO

Groundwater occurs under phreatic conditions in weathered mantle of the crystalline rocks, laterites and unconsolidated coastal sediments. It occurs under semi confined to confined conditions in the deep-seated fractured aquifers of the crystalline rocks and Tertiary sediments.

4.1 Hydrogeology

Kannur district is underlain by charnockites, pyroxene granulites, garnetiferous gneisses, hornblende biotite gneisses and schistose rocks overlain by Tertiaries and coastal alluvium along the coast ranging in age from Archaean to Recent. These rocks have undergone weathering and lateritisation. The hydrogeological units encountered in the district are (i) consolidated formations (weathered and fractured crystallines) (ii) Semi consolidated sediments equivalent to Warkalies of Southern Kerala and Laterite formations and (iii) unconsolidated formations (Recent alluvium occurring along the coast).

Consolidated formations

The weathered and fractured rocks in the crystalline formations form potential phreatic shallow aquifers and is composed essentially of charnockites, hornblende gneisses, schists and other intrusives. In the phreatic crystalline formations the depth to water level varies from 2.14 to 19.95 m bgl during premonsoon and from 1.28 to 19.03 m bgl during post monsoon period. The wells located in charnockites vary in depth from 6 to 13 m bgl. The thickness of weathered zone in the district is in the range of 3 to 20 m. The degree of weathering is generally low in charnockite areas. The gneissic rocks are highly weathered and well jointed and form good water bearing zones. The yield of the wells ranges from 10 to 20 m^3 / day. They can sustain pumping only for an hour and recuperation rate is very poor.

The deeper fractured crystalline aquifers are under semi confined to confined conditions. They are tapped through bore wells for domestic, agriculture purposes. The potential fractures are encountered at depth varying from 10 to 120 mbgl. The Board has constructed 12 Exploratory Wells in the district. Depth of wells ranges from 86 to 200 m bgl and the discharge ranges from 0.62 to 840 lpm. The details of wells drilled in hard rock area of the district are given as **Annexure 1**.

Semi consolidated formations

Tertiaries, equivalent to Vaikom beds of Southern Kerala occur along the coastal region of the district from Dharmadam (8 kms south of Kannur) up to the district boundary in

the north. These are found to be lateritised on the top. Tertiaries are not potential aquifers in this district as they do not have potential fracture zones.

Laterite is considered to be the marker horizon to differentiate between Tertiary and Recent alluvial sediments. The thickness of laterite ranges from 10 to 20 m. Laterite constitutes a potential aquifer in the mid land regions of the district. Due to the porous nature of laterites, the dug well tapping laterite get recharged fast and also the recharge water escapes as sub surface flow and water level falls quite fast especially in wells located in topographic highs and steep slopes. The depth of dug wells in the laterite range from 8 to 23 m.bgl. Depth to water level varies from 4 to 20 m.bgl during pre-monsoon and 1.5 to 19 m.bgl during post monsoon period. The yield of the wells ranges from 15 to 30 m^3/day.

Dug wells tapping laterites in the coastal area do not exist in the district as laterites occur at considerable depth below the coastal alluvium.

Unconsolidated formations

The coastal alluvium comprising of sand, silt and clay forms potential phreatic aquifers in the district. It occurs all along the coast and in the valleys and is extensively developed by a large number of dug wells and filter point wells. As per the data of bore holes drilled by CGWB, thickness of alluvium is generally low in Kannur district except around Muzhappilangad where it is more than 20 m**.** The depth to water level in the dug wells during pre-monsoon ranges from 1.66 to 2.35 m.bgl and 0.76 to 2.0 m.bgl during post monsoon period. The details of wells drilled in sedimentary area of Kannur district is given as **Annexure 2.**

Water Level Fluctuation

The Decadal mean depth to water level in the pre monsoon and post monsoon periods are shown in **Figures 2 and 3** and the hydrogeology of Kannur district is shown in **Figure 4**.

The long term water level fluctuation (2002 – 2011) in the district have been analysed using the historical data of observation wells in the district. The trend analysis for the pre monsoon period indicates that the water levels are showing a rising trend in about 75 % of the wells analysed and it ranges from 0.0007 to 0.8277 m/yr. Declining trend of water levels ranging from 0.0033 to 0.5056 m/yr have been observed in about 25 % of wells in

the district. During post monsoon period, rising trend is observed in about 70 % of the wells analysed in the district. The rise is in the range of 0.0064 to 0.04912 m/yr. Declining trend of water levels ranging from 0.008 - 0.1936 m/yr have been observed in about 30 % of wells in the district.

4.2 Ground Water Resources

The ground water assessment was done block wise as per GEC-1997 methodology and is computed based on the data as on March 2009 and these figures are used in this report. The district has a net annual ground water availability of 479.11 MCM with a net availability of 250.35 MCM for the future use. The maximum stage of development is in Thalasserry block (80.39%) and the minimum development is in Irrikkur block (24.53%). Blockwise groundwater resources and categorisation of groundwater development of blocks as on 31st March 2009 are furnished in **Table 2**.

Table 2 Block- wise Groundwater Resources as on March 2009 (in MCM)

District		**KANNUR**						
Assessment Year		**2008-09**						
Sl. No.	**Assessment Unit/ District**	**Net Annual Ground Water Availability**	**Existing Gross Ground Water Draft for irrigation**	**Existing Gross Ground Water Draft for domestic and industrial water supply**	**Existing Gross Ground Water Draft for All uses (11+12)**	**Provision for domestic, and industrial requirement supply in 2025**	**Net Ground Water Availability for future irrigation development (10-11-14)**	**Stage of Ground Water Development {(13/10) * 100} (%)**
1	Edakkad	3889.87	1085.18	1218.12	2303.30	1349.06	1455.64	59.21
2	Irikkur	8900.88	1032.00	1151.34	2183.34	1275.10	6593.78	24.53
3	Iritty	5658.82	716.75	1147.42	1864.17	1270.76	3671.31	32.94
4	Kannur	1994.97	445.21	1024.03	1469.24	1122.88	426.88	73.65
5	Kuthuparamba	2748.38	928.17	1194.58	2122.75	1322.99	497.22	77.24
6	Payyannur	9744.51	2746.35	1854.82	4601.17	2054.20	4943.96	47.22
7	Peravoor	4023.72	1516.96	702.08	2219.03	777.54	1729.22	55.15
8	Taliparamba	8741.45	1736.70	1463.45	3200.15	1613.30	5391.45	36.61
9	Thalassery	2208.50	736.16	1039.29	1775.45	1146.36	325.98	80.39
TOTAL		**47911.10**	**10943.46**	**10795.13**	**21738.59**	**11932.20**	**25035.44**	**45.37**
TOTAL		**479.11**	**109.43**	**107.95**	**217.39**	**119.32**	**250.35**	**45.37**

Ground water withdrawal is taking place for irrigation, domestic and industrial purposes. The domestic and industrial requirements were computed as per the norms considering population of 2001 and also based on the projected population for the year 2025. The irrigation draft was calculated based on the number of ground water abstraction structure and the number of hours the well is in use per day and average number of day of irrigation in a year**.** **Figure 5** shows the categorisation of blocks in Kannur district as in March 2009. As per the categorisation of blocks based on 2004 data two blocks were under Critical category but as per the 2009 data computations, Thalasserry and Kuthuparamba blocks became 'Semi Critical' and the remaining six blocks under 'Safe' category.

4.3 Ground Water Quality

The chemical quality of groundwater has been evaluated by analysing 42 samples from Ground Water Monitoring Wells (GWMW) during pre-monsoon (May, 2009). The Electrical Conductivity of water from shallow aquifer ranges from 29 to 553 µs/cm at 25^0C. About 86% of shallow aquifer samples show EC less than 250 µs/cm at 25^0C. Deeper aquifer samples are characterized by high EC values ranging from 204 -802 µs/cm. The hardness of shallow aquifer samples varies from 6 to 120 ppm showing the soft nature of water. All the water samples shown fluoride within the permissible limit. The maximum value recorded was 0.44 ppm. The water from springs are also very fresh and is suitable for all purposes. In general the quality of water in phreatic and deep fracture zones are suitable for domestic, industrial and irrigation purposes. The data of chemical analysis of dug well samples are presented in **Annexure 3**.

4.4 Status of Ground Water Development

The shallow phreatic aquifers in alluvium are developed by a large number of dug wells and filter point wells. The yield of dug wells tested in the area ranges from 8 to 40 m^3/day.

The depth of dug wells in the laterite range from 8 to 23 m.bgl. The yield of the wells ranges from 15 to 30 m^3/day and can sustain pumping for a period of less than an hour to 3 hours. Generally large diameter wells are constructed in laterite terrain and the diameter

ranges from 2.0 to 4.0 m. Dug wells located in the topographic highs and ridges dry up in summer.

Dug wells in the weathered crystallines have yield in the order 10 to 20 m^3/day. The well tapping these aquifers range in diameter from 2 to 5 m and their depth varies from 5 to 20 m bgl.

In the fractured crystallines rocks, bore wells are constructed to the depth which ranges from 30 to around 110 m bgl. Potential zones are encountered between 25 and 80 m bgl. CGWB drilled only 12 bore wells of 200m depth under groundwater exploration programme in the district. The yield of bore well ranges from negligible discharge to 50,000 lph. The data from exploratory drilling carried out by CGWB revealed that the E-W lineaments, followed by N-S lineaments are found to be potential in the district.

The cost of construction of dug wells in alluvium and valley fills comes to Rs. 25,000 to 30,000 including the cost of pump set. In weathered crystalline it may go up to Rs. 40,000. The dug wells were deepened in laterites and the crystalline areas at places to about 1 to 4 m due to the fall in water level. Bore well culture is spreading fast in the district due to which the deeper fractured aquifers are more strengthened at places/ isolated pockets. .

The lifting devices of water are through centrifugal pumps, jet pumps for dug wells and submersible pumps and compressor for bore wells. Water is also being lifted by bucket and rope from dug wells for domestic purposes.

To meet the ever increasing demand for water in the district, Kerala Water Authority and Grama Panchayats are empowered with the supply of water for domestic purpose. Public tube wells, dug wells, tanks/ponds and taps/hand pumps are employed for urban and rural water supply. The Kerala Water Authority has 679 bore wells, and 150 dug wells for water supply in the district. Spring is used to mitigate drinking and irrigation water supply. In addition to this, most of the houses have their own wells to meet the domestic requirements.

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1 Ground water development

Groundwater in the district is mostly developed through dug wells, dug cum bore wells, bore wells and filter point wells for domestic and irrigation purposes. Most of the households have their own wells to meet the domestic requirements. Recently in most of the areas groundwater is developed through bore wells for domestic and irrigation purposes.

Groundwater development and management should be coupled with rainwater harvesting. Conjunctive use of surface and groundwater shall be practiced effectively. Artificial recharge schemes should be practiced in large scale along with rain water harvesting. The springs seen in the eastern part of the district can be developed. 34 springs are located in mid upland, highland and partially in coastal areas of the district (CWRDM). It has been found that spring discharge varies from 1 to 480 lpm. These are the perennial source for drinking water schemes that can be effectively utilised to mitigate drinking and irrigation water scarcity in those areas.

More stress should be given for water shed management. There should be proper water budgeting in the district. Mass awareness and training programmes shall be carried out in panchayat level to make people aware about the importance of conservation and protection of groundwater.

5.2 Water Conservation and Artificial Recharge

Watershed management practices should be given utmost importance which in turn will help to conserve the groundwater and supplement the recharge. Roof-top rain water harvesting can be practised in areas like Chamberi, Poyilur and Thalasserry where all the dug wells go dry during summer. Bore wells can be recharged using rain water especially in critical blocks like Thalasserry and Kuthuparambu. In coastal areas of the district like Azhikode, Azhikkal, Edakkad, Dharmadam, Muzhapilangad, Kannapuram, Mahe and Cherukunnu, rainwater harvesting schemes can be practiced to avoid more stress on the shallow aquifer. Contour bunding, trenching, nalla bunding, check dams, percolation tanks and subsurface practices like recharge shaft, dug well recharge and water conservation structures like sub-surface dyke are suitable for midland areas of Kannur

district. The artificial recharge schemes recommended in different blocks are presented in **Figure 6.**

CGWB has implemented artificial recharge and rain water harvesting schemes in Kannur district as detailed below.

Sl.No.	Location	Type of Structure	Year
1	Mayyil S.C. Colony	Roof top rain water harvesting	2001
2	Ezhimala Naval Academy	Roof top rain water harvesting**,** Check dams, Recharge pit.	2001

Physiographically, the Mayyil S.C. Colony is located on a small hillock comprising about 25 families. Due to rainfall runoff and base flow discharge, the water level is very deep in summer. The only available dug well get dried up early in March. Further the inhabitants have to go to foot hills for bringing drinking water. To facilitate additional recharge, a scheme for roof top rain water harvesting was suggested. Roof top rain water from 10 houses were collected and delivered to a pit near to the existing dug well through PVC pipes. Project was completed on August, 2001 at the cost of Rs.1.53 lakhs. After the completion of the scheme, water level in the dug well of the colony have risen during post-monsoon. During summer, the well could provide drinking water to the colony population throughout the month of March and up to mid-April.

Ezhimala Naval Academy is situated on a hillock near the coast underlined by crystalline rocks. Due to the undulating nature of the terrain, heavy runoff occurs during rainy season and natural recharge is quite low. Hence to facilitate recharge, artificial recharge schemes were implemented with the construction of roof top rain water harvesting and recharge pit, gully plugging cum drainage line treatment/check weir etc. Construction completed in three phases and the total cost of the project comes around 8.46 lakhs.

Since 1964, Soil Conservation Department constructed several soil and water conservation structures like check dams, gully plugs, percolation ponds, husk burial, centripetal terrace, retaining walls for stream bank protection etc. and covered approximately more than 45 watersheds in the Kannur district under different schemes like Rural Infrastructure Development Fund (RIDF) aided by NABARD; NWDPRA under Central Govt. Schemes, Western Ghat Development Project (WGDP), People's Participation Scheme (PPS) and Tribal Support Programme (TSP) under Kerala State

Govt. Water conservation society (WCS), Kannur. Also carried out artificial recharge studies in the premises of Kannur Central Jail, Defence Security Corps (DSC), Kannur and Kunnathuparambu panchayats.

6.0 GROUND WATER RELATED ISSUES AND PROBLEMS

Decline in water level, water scarcity and pollution due to saline water intrusion are some of the major problems noticed in the district. Thalasserry and Kuthuparambu blocks having a stage of ground water development of 80.39 % and 77.24% respectively can be demarcated as vulnerable area on consideration of depletion of ground water level. Water scarcity is a severe problem faced by villagers living in hilly terrains due to the drying up of wells in summer season. Dug wells in the midland region also get dried due to the delay of monsoon rains or to the absence of summer showers. Based on mean decadal water level of 2002 to 2011 the following areas were identified as water scarce and these areas need special attention as below.

Sl. No	Location	Mean Depth to water level April (2002-11) (mbgl)	Mean Depth to water level, Nov, 2002-11 (mbgl)	Mean Fluctuation (m)
1	Chakkarakkale	11.83	7.09	4.74
2	Cheleri	13.75	10.47	3.28
3	Irikkur	6.83	4.24	2.59
4	Kelakkam	11.37	8.79	2.58
5	Padiriyad	8.86	6.25	2.61
6	Panoor	5.1	2.21	2.89
7	Peringome	10.67	7.6	3.07
8	Pukkundu	13.14	7.83	5.31
9	Ramantalai	10.24	7.39	2.85
10	Taliparamba	13.54	9.37	4.17

In coastal areas of the district like Azhikode, Azhikkal, Edakkad, Dharmadam, Muzhapilangad, Kamapuram, Mahe and Cherukunnu, brackish to saline water has been identified in aquifers due to intrusion of saline water from nearby backwater shallow channels.

The problems encountered in drilling in hard rock areas of the district are thick overburden, boulder/large weathered formation below overburden and backpressure. Mud

loss and caving are the main problems encountered in drilling and construction of tube wells in coastal sedimentary terrain of the district.

7.0 AWARENESS AND TRAINING ACTIVITY

Mass Awareness Programme (MAP) and Water Management Training Programme (WMTP) by CGWB

One Mass Awareness Programme (MAP) on conservation and protection of groundwater was conducted at Kannur in 2002. In this programme, the hydrogeological conditions of Kannur district, the measures for water conservation and protection were discussed. The programme witnessed a gathering of more than 300 people.

One Water Management Training programme (WMTP) was conducted at Kannur in the year 2006. More than 150 participants attended the training. In the programme, the participants are trained on various methods adopted for rainwater harvesting, artificial recharge to groundwater and the structures suitable for water conservation in different areas of the district. The general hydrogeological conditions of the district were also discussed.

8.0 AREAS NOTIFIED BY CGWA/SGWA

No area/block is identified for notification either by CGWA or State Groundwater Department in Kannur district.

9.0 RECOMMENDATIONS

The stage of groundwater development in Kannur district as on 2009 is 45.37 % leaving wide scope for future development. Of the nine blocks seven are under safe category and two are Semi critical category. In 2004 two blocks were under Critical category.

The groundwater development in Thalasserry and Kuthuparambu blocks are found to be more as compared with other blocks. Caution has to be exercised in the development of Edakkad block due to the falling trend in water level in both pre and post-monsoon seasons. Hence, future development may be restricted in these blocks.

As the number of abstraction structures including private bore wells is on the increasing trend in the district, proper census of abstraction structures is necessary for

recommending new ones for future development. Groundwater development should be limited with conjunctive use of rainwater and surface water as the district is drained by very large number of rivers. More stress should be given for watershed development and management. The existing water resources viz. dug wells, ponds & tanks should be protected and conserved. In the district, there are 34 numbers of springs identified, which are not been developed so far effectively. Hence, attention may be given for the proper development of springs as they form perennial sources for drinking water.

There should be proper water budgeting in the district. In addition to the major irrigation project Pazhassi, there are plenty of minor irrigation and water supply schemes in the district, which require proper maintenance and attention. Emphasis should be given to micro level water supply projects. Block wise micro level study is recommended especially in critical blocks like Thalasserry and Kuthuparambu to get more realistic picture of groundwater development and to study the scope for future development. If necessary, regulatory measures are to be taken in such areas to control over exploitation of groundwater resources, promoting artificial recharge and preventing groundwater pollution.

Mass awareness and training programmes may be organised in Panchayath level to create awareness among people about the importance of conservation and protection of groundwater. A technical database has to be created at CGWB Regional Office, incorporating data from GWD and other agencies. This may be disseminated to the public through local bodies and NGOs.

Figure 1: Index map of Kannur District, Kerala

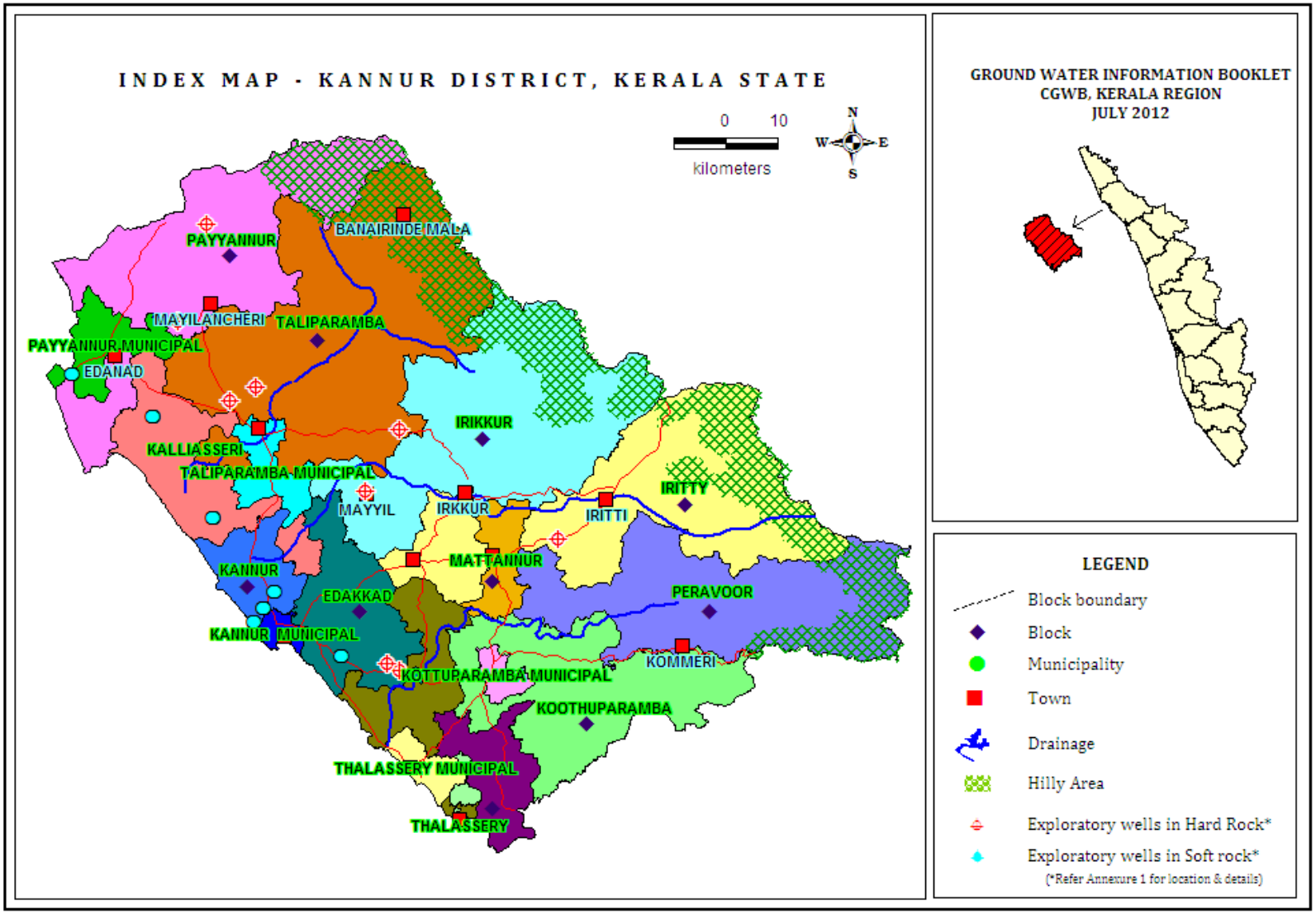


Figure 2: Depth to Decadal Average Water level - Premonsoon (April 2002-11)

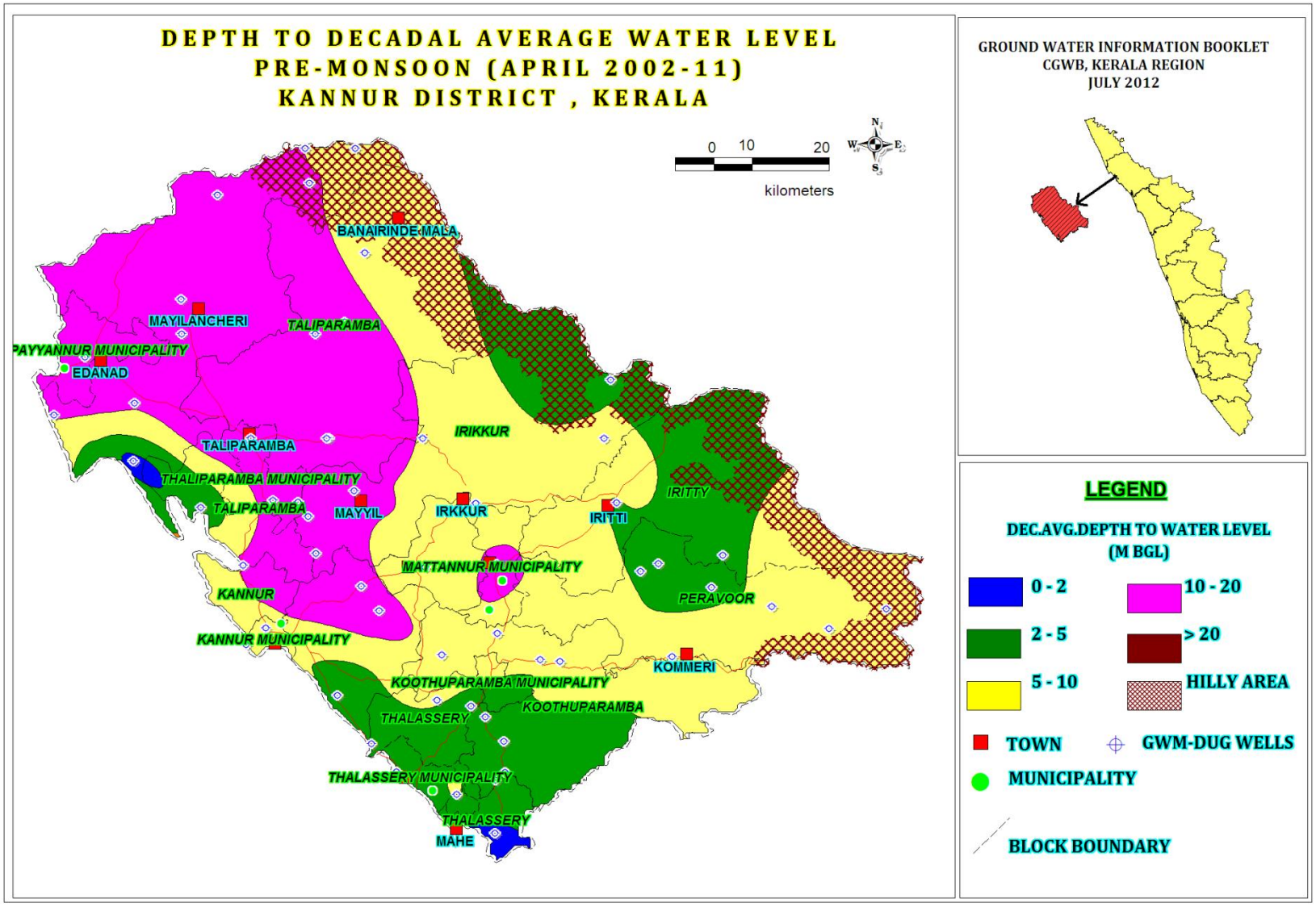


Figure 3: Depth to Decadal Average Water Level, Post monsoon- (Nov-2002-2011)

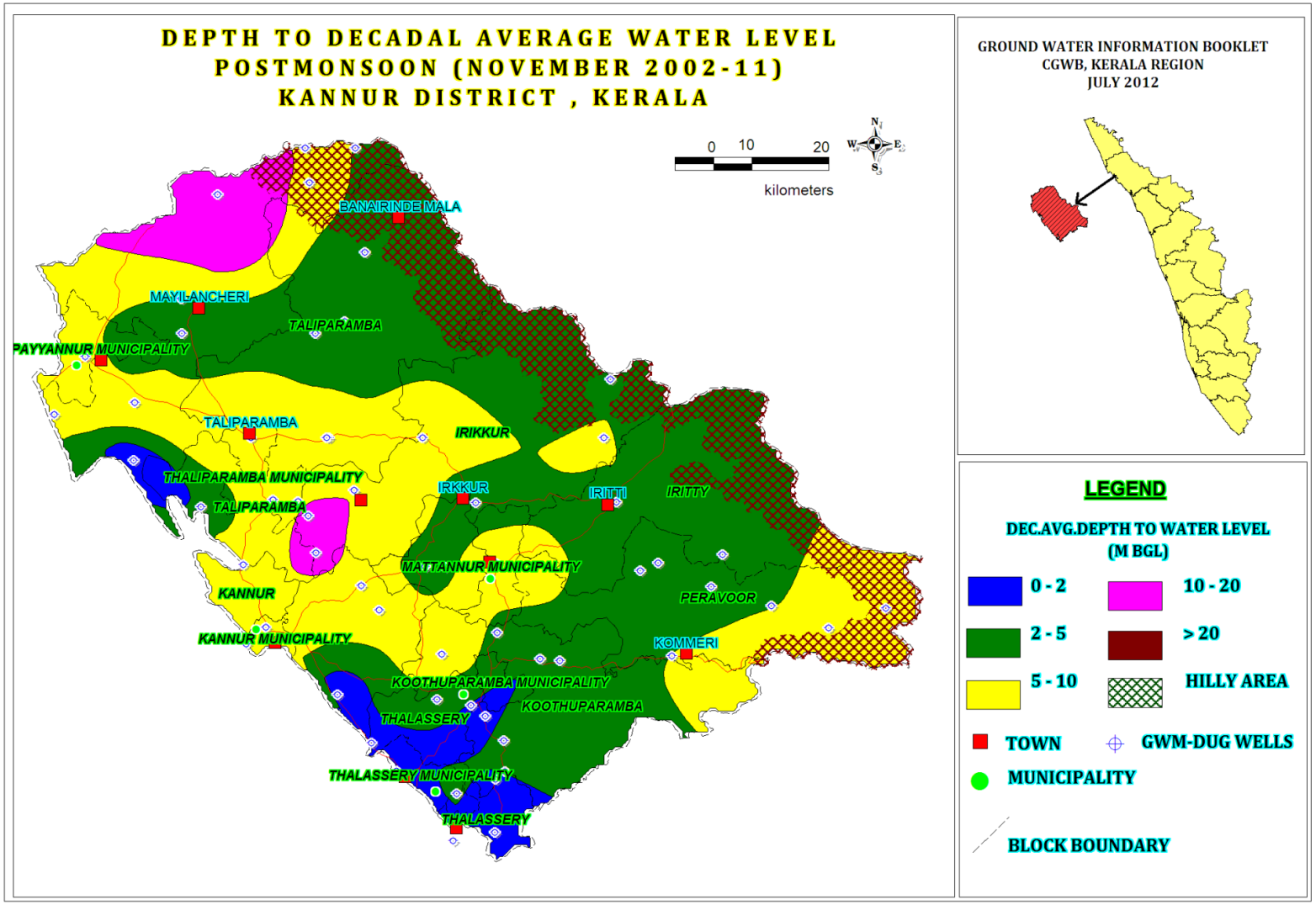


Figure 4: Hydrogeology of Kannur District, Kerala State

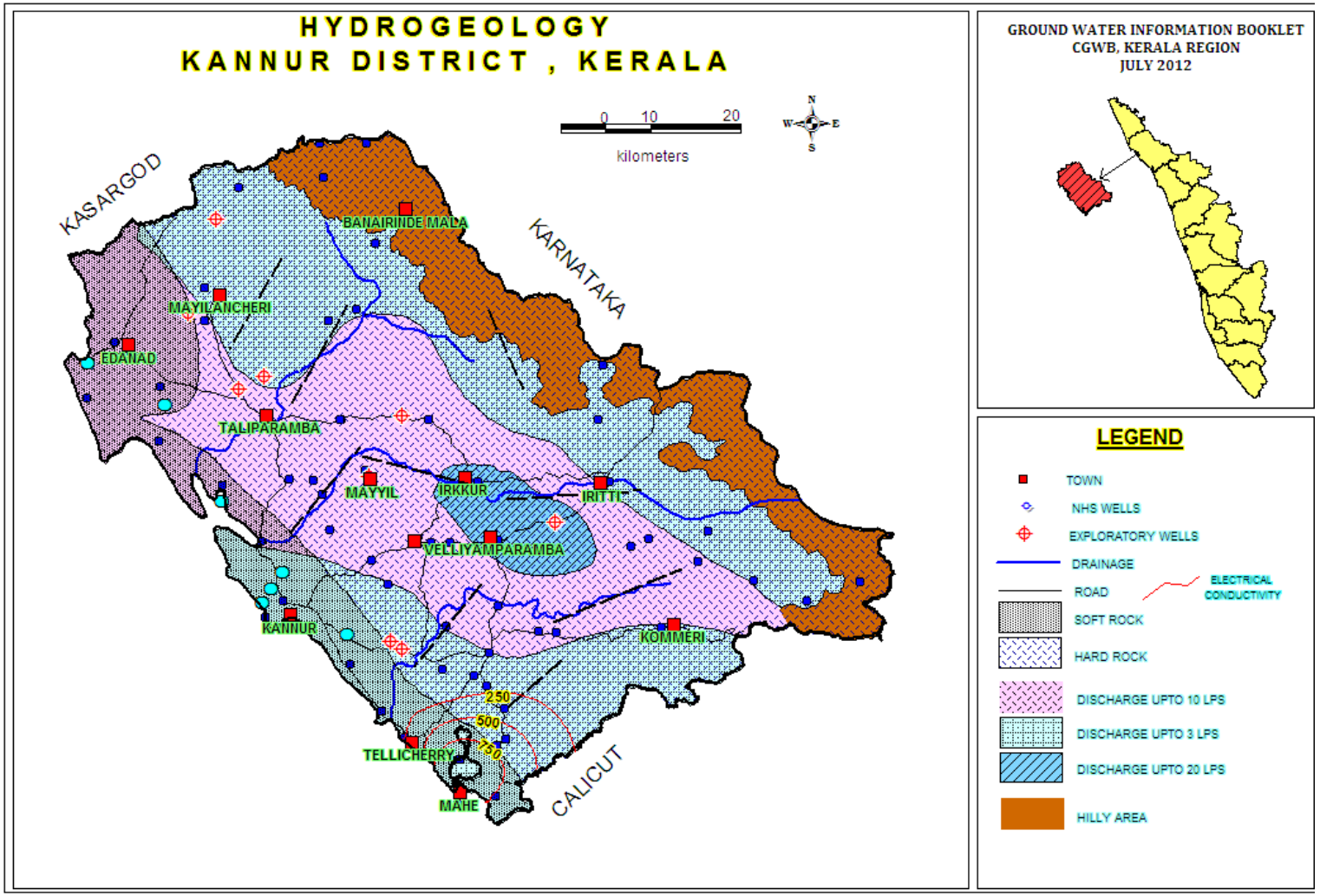


Figure 5: Categorisation of Blocks in Kannur District

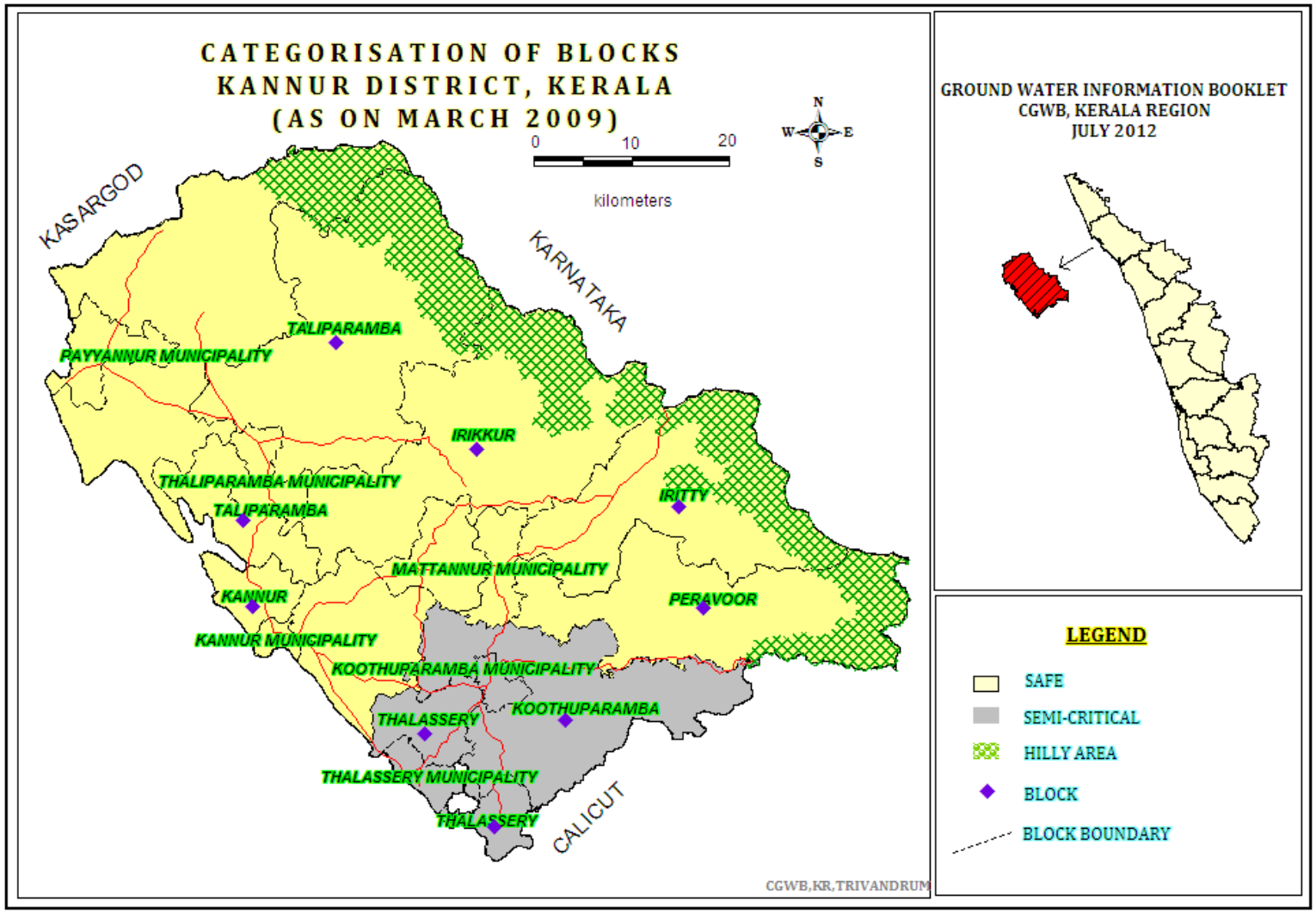
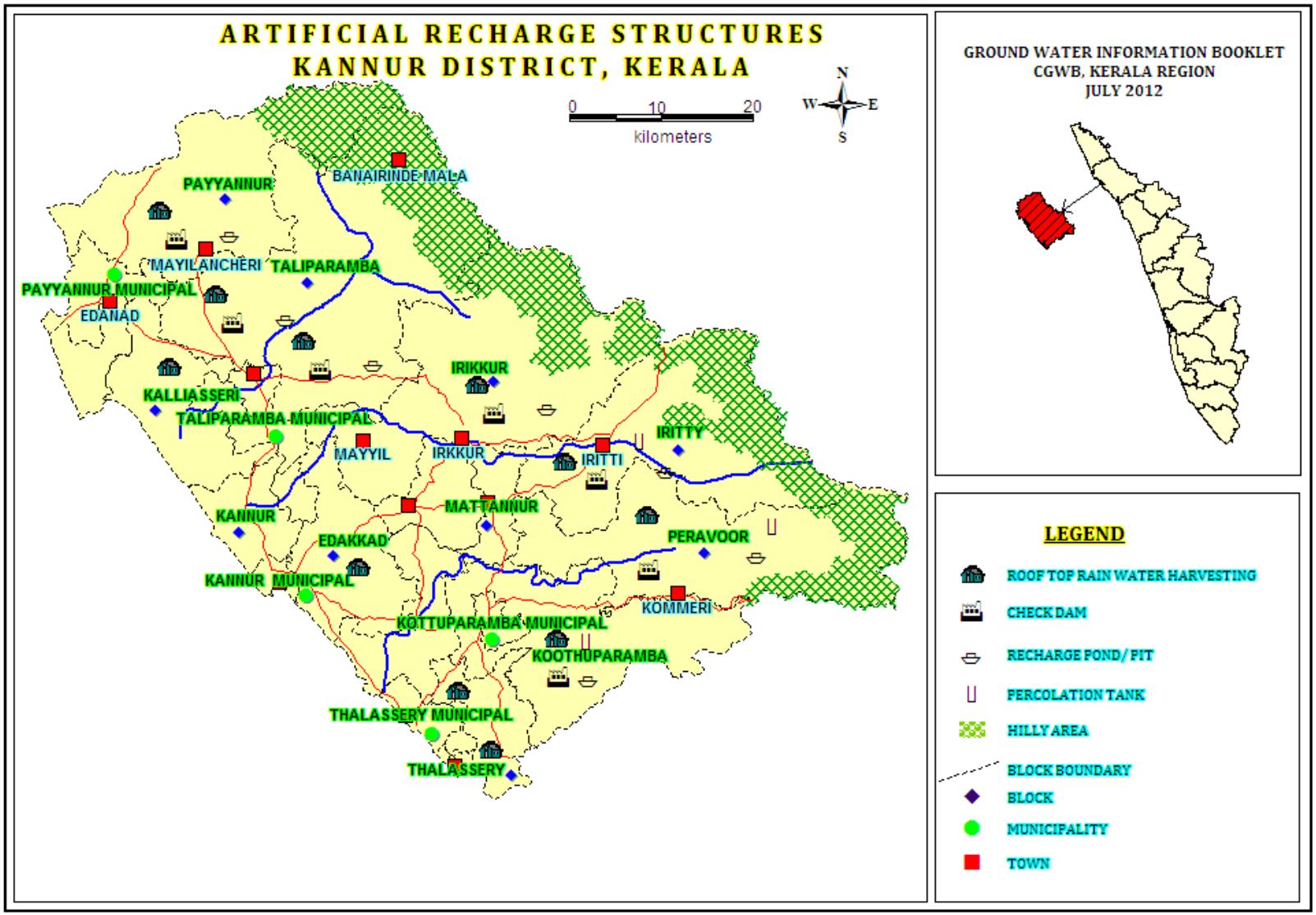


Figure 6: Artificial Recharge Structures proposed in Kannur District



Annexure 1: Details of wells drilled in hard rock areas of Kannur district

Sl. No.	Location	Year of construction	Lineament Direction	Depth drilled	Depth of casing mbgl	Fracture zones	Discharge lpm during drilling	Rock type
1	Mangatuprambu	1998-99	NW-SE	200.00	13.70	15.0-17.0 50.5-54.0 103.0-106.0	240	Charnockite
2	Chavasseri	1999-00	E-W	86.80	11.90	-	840	Syenite
3	Chengala	1999-00	E-W	157.00	34.20	-	480	Garnet gneiss
4	Iringal	1999-00	N-S	175.00	33.00	-	180	Garnet gneiss
5	Mayyil	1999-00	E-W	92.90	22.80	-	504	Charnockite
6	Perul	1999-00	N-S	200.00	22.20	26.0-28.0 71.0-80.0	240	Hornblende Biotite Gneiss
7	Peringome	1999-00	NE-SW	200.00	-	16.5-18.5	12	Granite Gneiss
8	Vellora	1999-00	N-S	200.00	17.80	-	107.4	Charnockite Gneiss
9	Cheruthazham	1999-00	N-S	187.30	36.60	-	261.6	Hornblende Biotite Gneiss
10	Kannur CWRDM	1999-00	N-S	200.00	31.50	-	0.6	Biotite Gneiss
11	Chala	1999-00	E-W	200.00	21.70	40-43	60	Biotite Gneiss
12	Peralassery	1999-00	N-S	200.00	35.00	78.0-79.0 99.0-100.0 148.0-150.0	162	Quartz Mica Schist

Annexure 2: Details of wells drilled in Sedimentary area, Kannur district

Sl. No.	Location	Co-ordinates & Totposheet No.	Year of Construction	RL m amsl	Depth drilled (mbgl)	Depth constructed mbgl	Zones tapped	Discharge (lps)	Remarks
1	Muzhappilangad	12°50'20" 76°28'25" 58 M/5	1996	1.43	22	20.75	16.75-20.75 (Recent)	1.5	SWL – 2.09 m bgl
2	Kannur	11°52'30" 75°21'15" 49 M/15	1996	11.13	38.75	38.75	18-20	0.4	SWL – 13.00 mbgl
3	Eranvu	11°58'00" 75°19'00" 48 M/15	-	NA	28.95	NA	NA	NA	Slim hole
4	Payyanur	12°05'30" 75°11'30" 48 P/4	-	NA	35.52	NA	NA	NA	Slim hole

Annexure 3: Chemical Analysis Data of GWMW in Kannur district (2009)

Sl.No	Location	Date of collection	pH	Ec	TH as CaCo3	Ca	Mg	Cl	F	NO_3
				in µs/cm 25° C	<---------- mg/lit---------->					
1	Alacode	9/5/2009	7.23	97	26	7.2	1.9	13	0.37	7
2	Chakkarakkale	10/5/2009	6.65	236	30	4.8	4.4	52	0.12	88
3	Cheleri	9/5/2009	7.17	29	8	2.4	0.49	5.7	0	2.2
4	Chepparappadam	9/5/2009	7.23	57	16	3.2	1.9	9.9	0	3.6
5	Cheruthazham	9/5/2009	7.03	47	8	2.4	0.49	8.5	0.11	5.6
6	Chural	8/5/2009	7.46	74	30	9.6	1.5	5.7	0.18	2.9
7	Dharmadam	5/5/2009	7.53	105	28	10	0.49	16	0.07	2.4
8	Edakkad	9/5/2009	7.45	193	40	14	0.97	36	0.38	1.4
9	Edayannur	9/5/2009	7.41	41	8	3.2	0	7.1	0	0.53
10	Irikkur	9/5/2009	8.05	180	76	16	8.8	13	0.12	0.53
11	Iritty	5/5/2009	7.25	45	8	3.2	0	7.1	0.04	4.6
12	Kannapuram	10/5/2009	7.94	260	88	27	4.9	24	0	10
13	Kannavam	10/5/2009	7.62	67	18	4	1.9	8.5	0.06	5.1
14	Kommeri	10/5/2009	7.39	41	14	3.2	1.5	4.3	0.25	0.63
15	Kottiyur	5/5/2009	7.81	84	28	8	1.9	7.1	0.13	0.43
16	Mahe	10/5/2009	8.14	553	110	20	15	96	0.13	12
17	Manattana	9/5/2009	7.79	131	34	10	1.9	16	0.16	9.3
18	Mathamangalam	9/5/2009	7.43	100	18	4	1.9	14	0.24	15
19	Mattanur	8/5/2009	6.81	153	30	6.4	3.4	30	0.31	33
20	Mayyil	10/5/2009	7.05	133	22	6.4	1.5	24	0.16	5.8
21	Mulakunnu	10/5/2009	8.31	105	24	5.6	2.4	13	0.39	0
22	Padiriyad	10/5/2009	6.79	52	12	4	0.49	9.9	0	0
23	Pattiyam	5/5/2009	6.8	103	10	4	0	21	0.12	1.1
24	Payangadi	8/5/2009	7.73	181	70	22	3.4	13	0.1	0
25	Peringome	9/5/2009	7.49	183	42	12	2.9	30	0.12	8.8
26	Pukkundu	8/5/2009	7.63	99	30	8	2.4	8.5	0.4	2.7
27	Pulingome	9/5/2009	6.65	93	28	8	1.9	8.5	0.22	3.8
28	Payyannur	9/5/2009	7.21	150	30	10	0.97	24	0.26	7.7
29	Ramantalai	9/5/2009	7.33	40	6	2.4	0	9.9	0.09	0
30	Sreekantapuram	9/5/2009	7.49	173	40	7.2	5.4	28	0.16	6.7
31	Taliparamba	9/5/2009	8.39	277	64	18	4.4	34	0.02	12
32	Ullikkal	9/5/2009	7.87	98	12	4	0.49	21	0	3.8
33	Valappattanam	9/5/2009	7.35	157	26	8.8	0.97	24	0.04	7.7
34	Koothuparamba	8/5/2009	7.9	438	120	38	6.3	44	0.33	4.4
35	Mokeri	8/5/2009	7.75	175	16	4	1.5	31	0.09	7.7
36	Meruvambayi	9/5/2009	7.46	104	22	5.6	1.9	11	0.06	3.8
37	Manatheri	10/5/2009	7.96	165	58	10	7.8	7.1	0.25	0
38	Melepukkom (Peringalam)	10/5/2009	7.55	74	10	3.2	0.49	13	0.11	1.5
39	Pallikunni	10/5/2009	7.47	50	10	3.2	0.49	8.5	0.44	0
40	Panunda	8/5/2009	6.93	60	8	2.4	0.49	11	0.13	1.5
41	Thalassery	5/5/2009	8.31	361	64	17	5.4	41	0.19	18
42	Palloor(Mahe)	5/5/2009	7.85	361	60	14	5.8	61	0.1	36