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जल संसाधन मंत्रालय

MINISTRY OF WATER RESOURCES

केंद्रीय भूजल बोर्ड

CENTRAL GROUND WATER BOARD

केरल क्षेत्र

KERALA REGION

भूजल सूचना पुस्तिका, पालक्काड जिल्ला, केरल राज्य
GROUND WATER INFORMATION BOOKLET OF PALAKKAD
DISTRICT, KERALA STATE



तिरुवनंतपुरम

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**GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
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**GROUND WATER INFORMATION BOOKLET
OF
PALAKKAD DISTRICT, KERALA**

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GROUND WATER INFORMATION BOOKLET OF PALGHAT DISTRICT, KERALA STATE

PALAKKAD DISTRICT AT A GLANCE

Sl.No.	ITEMS	STATISTICS
1.	GENERAL INFORMATION	
	Geographical area (Sq km)	4480
	Administrative Divisions (as in 31-03-2011) Number of Tehsil/Block Number of Panchayats/Villages	5/13 91/163
2.	GEOMORPHOLOGY	
	Major physiographic units	Midland and Highland
	Major Drainages	Bharathapuzha, Bhavanipuzha
3.	LAND USE (Hectares) as in 2009	
	Forest area	136257
	Net area sown	198043
	Area sown more than once	104305
	Cultivable area	22861
	Current Fallow	13940
	Non agricultural Area	2458
4.	MAJOR SOIL TYPES	Laterite Soil, Virgin forest soil, Black cotton soil, Alluvial soil.
5.	AREA UNDER PRINCIPAL CROPS (Hectares) as in 2009-10	
	Rice	224413
	Fruit crops	43813
	Vegetables	7408
	Pepper	2559
	Cashew nut	2702
	Tapioca	2838
	Coconut	60528.6
	Arecanut	9589
Rubber	52270	
6.	AREA IRRIGATED BY DIFFERENT SOURCES (Hectares) as in 2009-10	
	Wells (Dug wells & Tube wells / Bore wells)	22298
	Tanks / Ponds	6763
	Canals	42056
	Other Sources	18640
	Net Irrigated area	90304
7.	NUMBER OF GROUNDWATER MONITORING WELLS (as in 31-3-2011)	
	No. of Dug wells	66 (CGWB) + 31 (GWD)
	No. of Piezometers	36 (CGWB) + 36 (GWD)

8	PREDOMINANT GEOLOGICAL FORMATIONS	Recent Alluvium Sub-recent Laterites Archaean crystalline formations (Charnockite, Gneiss, Schists)
9.	HYDROGEOLOGY	
	Major Water bearing formations	Weathered & fractured crystalline formations, Laterites Recent alluvium
	Depth to water level (Pre-monsoon, April 2011)	1.55 to 11.23 mbgl
	Depth to water level (Post-monsoon, Nov. 2011)	0.73 to 8.67 mbgl
	Long term water level trend (2002-2011)	Rise - 0.02 to 2.24 Fall - 0.01 to 5.49
10.	GROUND WATER EXPLORATION BY CGWB (As on 31-03-2011)	
	No. of wells drilled (EW, OW, PZ, SH, Total)	EW -62, PZ – 55 Total - 117
	Depth Range (m)	65 - 300
	Discharge (lps)	0.01 to 36
	Transmissivity (m ² /day)	0.2-291
11.	GROUND WATER QUALITY (As on 2009)	
	Presence of chemical constituents more than permissible limits(e.g. EC, F, As, Fe)	Chemical constituent F reported beyond permissible limits from Attappadi and Chittur blocks.. Local occurrence of inland salinity reported from Chittur block.
12	DYNAMIC GROUNDWATER RESOURCES (2009) – in MCM	
	Annual Replenishable Ground Water Resources	795.25
	Net Annual Groundwater Draft	484.17
	Projected demand for Domestic and Industrial Uses up to 2025	141.79
	Stage of Ground Water Development, %	60.88
13.	AWARENESS AND TRAINING ACTIVITY	
	Mass Awareness Program organized Date/Place/No. of Participants	2003 Chittur 300 2005 Kollengod 300 2005 Palakkad 300 2009 Pattambi 300
14.	GROUND WATER CONTROL AND REGULATION	
	Number of Over Exploited blocks	1
	Number of Critical blocks	1
	Number of blocks notified	1
15.	MAJOR GROUND WATER PROBLEMS AND ISSUES	Occurrence of Fluoride localized Salinity Problems. Pollution of ground water from industrial waste

1.0 INTRODUCTION

Palakkad (Palghat) (**Figure 1**) is the land of Palmyrahs and Paddy fields. Palakkad is a major Paddy growing area of the State. It is often called as the “Gateway of Kerala”. There is considerable change in the land use and cropping pattern in the district for the last five years. Due to low income from paddy and coconut, farmers are changing the cropping pattern to cash crops like sugarcane, vegetables and flower cultivation. Over dependence on groundwater for domestic, irrigation and industrial purposes in the district has led to the lowering of water table and water scarcity especially along the eastern parts. In most of the areas especially in eastern part of the district decline of water levels necessitates deepening of existing dug wells and putting deep bore wells thereby increasing cost of pumping and quality deterioration. Local enquiry revealed that farmers have taken loan from the banks for putting bore wells and fitting pump sets for irrigation purposes. The district receives on an average **2362** mm of rainfall annually. During 1998 the district recorded a good rainfall of 2407 mm and subsequently the rainfall has been decreased considerably.

1.1 Work carried out by CGWB

The compilation on Hydrogeological condition in Palakkad district was done by John Kurian (1981) and subsequent reappraisal surveys by him during 1981 - 82. Reappraisal survey in parts of Palakkad district was carried out by K. Md. Najeeb, (1990 - 91). Exploration was carried out during first and second phases of SIDA project during 1973-78 and 1983-88 respectively. Drilling activities were carried out by CGWB during 2001-2003. The report on "Ground Water Resources and development potential of "Palakkad district" was published in 1997. E. Shaji, Scientist 'B' carried out Reappraisal hydrogeological survey during 2002 – 03 and 2005-06. Micro level study was carried out in Chittur block for identifying the fluoride in groundwater. Construction of piezometers were carried out in over exploited and industrial belts of the district during 2002-03, 2005-06., 2006-07 & 2007-08. Mass awareness and groundwater management trainings were organized at Palghat and Chittur blocks during 1999, 2002, 2005 and 2009. Pamphlets depicting groundwater scenario of the district were distributed to the public during each function.

1.2 Drainage and Irrigation

The district is drained mainly by two rivers, viz *Bharathapuzha* and *Bhavani* Rivers. Of these *Bhavani* is east flowing and form a tributary of the *Cauvery* River. *Bharathapuzha* basin can be divided into 50 watersheds and 290 mini watersheds. Soil erosion is more in the upstream parts of

the basin. Dendritic is the common drainage pattern. 75 % of the population is depending on surface water resources for their irrigation needs, mainly from Bharathapuzha, its tributaries and other water bodies. There are 12 reservoirs in the district associated with two major rivers and its tributaries viz - *Parambikulam, Peruvarepallam, Thoonakadavu, Chulliyar, Pothundi, Moolathara, Meenkara, Walayar, Malampuzha, Gayathri, Kanjirapuzha and Mankulam.*

There are number of irrigation projects major and minor, existing in the district. The major projects are Malampuzha, Chittoorpuzha, Kuriar Kutty, Karapara, Kanjirapuzha and Attappady Valley Irrigation Project.

The major irrigation schemes are irrigating about 90,000 hectare of land and minor schemes irrigating about 2000 hectares of land. The main crops grown under the irrigation scheme are paddy, coconut, aracanut, plantain, grams, vegetables etc.

The Shiruvani dam constructed across the river *Shiruvani*, a tributary of *Bhavani* is the source of drinking water for the Coimbatore urban population.

2.0 RAINFALL AND CLIMATE

Based on Thornthwaite's climatic classifications the district experiences humid type of climate. The district receives maximum rainfall during the south west monsoon followed by the north east monsoon. The other months receive considerably less rainfall. The temperature is pleasant from December to February. The annual rainfall varies from 1883 to 3267 mm based on long term normal .The district receives on an average 2362 mm of rainfall annually. Major rainfall is received during June to September in the southwest monsoon (71%). The northeast monsoon contributes about 18%. The western part of the district around Pattambi receives the maximum rainfall whereas in the rain shadow area of Chittur in the eastern part receives the minimum rainfall. The Average monthly rainfall distribution for Palakkad district (2007 to 2011) is given in

Table 1

Table 1: Average Monthly Rainfall Distribution for Palakkad District (2007-2011)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
2007	1	0	0	101	159	625	1033	478	507	310	32.6	19	3267
2008	0	26.6	154	28	41	446	359	214	242	364	9	0.1	1883
2009	0	0	81	58	139	282	985	262	250	176	248	15	2496
2010	1.9	0	10.8	131	110	545	508	267	180	401	279	24	2457
2011	1	61	17.4	126	69	717	399	422	336	248	205	9	2610

At Palakkad the maximum temperature ranges from 28.1 to 37.4⁰C whereas the minimum temperature ranges from 22.2 to 25.3⁰C. The average annual maximum temperature is 32.3⁰C and the average annual minimum temperature is 23.4⁰. The wind is predominantly from west and east during morning as well as in the evening hours. The wind speed is high during August (13.6 kmph). The humidity is higher during the monsoon period i.e. from June to September. It is around 90% during this period. All through the year, the humidity is high during the morning hours.

3.0 GEOMORPHOLOGY AND SOIL

Physiographically the district can be divided into two parts viz, the high land and mid land. Ottapalam taluk lies completely in the mid land region whereas all other taluks lie both in midland and high land regions. The district is not blessed with coastal tract and natural lakes. The elevation of the landforms varies from 20 to 2386 m amsl.

The most important physiographic feature of the district is the Palakkad Gap. The train and road link between Kerala and rest of the country mainly passes through the 32 - 40 km wide gap. The important peaks are Anginda (2386 m), Padagiri (1585 m) and Karimala Gopuram (1440 m). The Terrain units and their areal distribution in % is given in **Table 2**

Table 2: Terrain units in Palakkad District Area %

Low lying terrain including flood plain and terrace	27
Moderately undulating mid land terrain with flood plain	26
Highly undulating terrain	12
Hilly area including scrap slope	35

The highlands of Bhavani basin are occasionally devoid of thick forest unlike those of Ponnani basin, which is marked, by dense forest, the silent valley.

3.1 Soil types

There are four types of soil

- (1) Laterite soil
 - (2) Virgin forest soil
 - (3) Black cotton soil
 - (4) Alluvial soil
- (1) Laterite soil - Seen in major part of Ottappalam, Alathur, Chittur and Palakkad taluks. These are most predominant soil type in the midland and gap areas. Laterites on high grounds are more compact when compared to the low lying areas.
 - (2) Virgin Forest Soil - Seen in Mannarkad taluk and in forest areas. They are rich in humus and organic matter.

- (3) Black Cotton Soil - Seen in Chittur and Attapady Valley of the Mannarkad Taluk, which is used for the cultivation of cotton. They exhibit mud cracks and have high water retaining power.
- (4) Alluvial soils are found along the banks of *Bharathapuzha* and its tributaries. In the Valley portion Valley fill deposits composed of talus and scree material are observed.

4.0 GROUNDWATER SCENARIO

Palakkad district is underlain by rocks of Archaean metamorphic complex. They include the granulite group, the gneisses and the schists above which laterite and alluvium are observed. Intrusives of pegmatites and quartz veins are also common in the northeastern parts of the district. Groundwater occurs in all the geological formation from Archaean crystallines (hard rock) to Recent alluvium (soft rock). Groundwater occurs in phreatic condition in the laterite, alluvium and weathered crystallines. It is in semi confined to confined condition in the deep fractured rocks.

Hydrogeology

The entire district can be divided into three units based on hydrogeological information.

- 1) Valley fills/Alluvium 2) Laterite terrain and 3) Crystallines.

Valley fills are noticed along the valley portion and along the river terraces/banks (near Ottapalam, Pattambi area) and are shown in the hydrogeological map. These are mainly seen in Mannarghat, Ottapalam and Pattambi, Trithala blocks. The water level ranges from 2- 11 m bgl (premonsoon) and 1- 9 m bgl (post monsoon). The fluctuation is generally high up to 4 m. The yield of dug well ranges from 5 to 20 m³/ day.

The laterite province is limited in extent, noticed in Trithala, Ottapalam and Pattambi blocks. The water level ranges from 4 to 11.0 mbgl during pre monsoon and post monsoon water level ranges from 3 to 8 m bgl. The fluctuation between pre and post monsoon varies between 2 to 4 m. The yield ranges from 5 to 30 m³/ day. In these areas the extraction is less. The specific capacity ranges from 10- 125 l/min/mdd.

The hard rock province covers 80 % of the area. This province can be divided into further zones based on weathering characteristics. The blocks covered under crystallines are Chittur, Kollenkode, Nenmara, Palghat, Attapady, Sreekrishnapuram, Alathur, Kuzhalmannam, and Mannarghat.

Overall groundwater regime is shown in the hydrogeological map of the district. In the northern part of the area, the high land region (Attapady block), groundwater occurs in semi confined to unconfined condition in the crystalline rocks. The depth of the water level ranges from 5 to 10 m bgl. In these areas (Zone A) borewells are feasible along the fractures/lineaments (**Figure-6**). Exploratory studies of CGWB have revealed that the yield of bore wells ranges from 0.5 to 36 lps

(**Naduvattom PZ**). Restricted development through bore well is possible in this area. The depth of weathering is more in the area and ranges from 10 to 23 m bgl. Hence proper casing is required for bore wells. Dug wells are feasible along the valley portions and adjoining rivers/ river lets. The yield varies from 5 to 25 m³/ day. In this zone the fractures are encountered within 170m. Hence the depth of bore wells can be restricted to 200m (**Annexure 1**).

Along the middle portion (Zone B) of the district which includes the Palakkad gap (Malampuzha, Palghat, Kuzhalmannom blocks etc), the thickness of weathering is more than 10 m. The major hard rock aquifer is hornblende biotite gneiss. The yield ranges from 2 to 30 lps. The water level in bore wells of the region is going down considerably. For example the Bore well constructed at Velamthavalam during 1990 recorded a static water level of 3.89 m bgl and the water level in the bore well drilled close by during 2002 is 64.40 m bgl. The yield of bore well in this zone is site specific. Along the E-W and NW-SE fractures, the bore wells are better yielding. Scientific site location is required in the region before constructing bore wells. Common abstraction structures feasible in the area are dug well, dug cum bore well and bore well. The yielding fracture zones, in general, are encountered generally within 125m and in exceptional cases up to 175m. Now the farmers are constructing bore wells having a depth of more than 300m. In general high yielding fractures are rare beyond a depth of 200m. Hence farmers need not go beyond 200 m depth for their bore wells. The dug well yield ranges from 5 to 30 m³/ day. But most of the dug wells are getting dry during summer season.

In the eastern parts of the district, ie Chittur and Kollenkode blocks, the weathered thickness is less than 10 m (Zone C), and the topsoil thickness is also less. The exploration of CGWB has revealed that the bore wells can yield up to 24 lps. The well drilled at Nellipallam yielded 24 lps and the fracture encountered at 108 m bgl. The major fracture in the E-W direction is highly yielding. The high yielding fractures are getting recharged from a distant source. The piezometers constructed in Chittur block yielded more than 16 lps and the fractures were encountered at depth of 80 to 100 m. In general high yielding fractures are encountered between 80 and 130 m bgl. The yield varies from place to place. Hence detailed geophysical investigation is required in this area for site selection of bore wells. Here also farmers are drilling deep bore wells having depth of more than 200m. The maximum recommended depth of bore well is 200m. The main feature noticed in the area is overdraft of groundwater. This area is a rain shadow region compared to the rest of the region due to which groundwater recharge is comparatively less. This is a potential zone for bore wells. The industrial draft and irrigation draft through borewells is more. Most of the borewells are in the private sector.

In this zone the quality of the groundwater is also poor in some pockets. Areas like Nedupeni, Kuduvayoor and Kozhinjampara, Gopalapuram inland salinity is observed within the phreatic zone. Fluoride content is more in groundwater samples of both bore wells and dug wells in Chittoor and Attapadi blocks. The highest fluoride content up to 5.74 ppm is reported from Kopanur area. The other places affected are Kozhinjampara, Eruthenpathi, Chinnammolathara, RVP Pudur and Chittur town. Taking into account of all these factors, further groundwater development is not recommended in the zone.

The pre to post monsoon (April – Nov 2011) fluctuation in the district varies from place to place. The fluctuation varies from 2 to 4 m bgl and the maximum fluctuation is noticed in the eastern part of the district. In the central and western part the fluctuation ranges from 2- 3 m. Long term trend of premonsoon and post monsoon water level, between 2002 and 2011 is analysed. In the eastern side of the district around Chittur area (Chittur block), the water levels for the Premonsoon Period is showing a significant declining trend. Rest of the areas, the water level decline is less. The depth to water level maps (pre and post monsoons) are shown in **Figures 2, 3** respectively.

Groundwater Resources

The groundwater assessment was done block wise using GEC-1997 methodology and is computed based on the data as on March 2009 (**Table 3**).

Table 3: Categorisation for groundwater development as on 31st March, 2009

Sl. No	Block	Net Ground Water Availability (Ham)	Ground Water Draft for all Uses (Ham)	Stage of GW Development	Is there a significant decline of premonsoon water Table	Is there a significant decline of post monsoon water Table	Categorization for future GW development
1	Alathur	13216.14	8402.69	63.58	No	No	Safe
2	Attappadi	5554.94	1081.01	19.46	No	No	Safe
3	Chittur	8429.91	8620.46	102.26	Yes	No	OE
4	Kollengode	7096.84	3005.06	42.34	No	No	Safe
5	Kuzhalmannam	8037.43	3186.36	39.64	No	No	Safe
6	Malampuzha	6372.36	5771.99	90.58	No	No	Critical
7	Mannarkkad	5431.62	2507.48	46.16	No	No	Safe
8	Nenmara	3633.69	2355.77	64.83	No	No	Safe
9	Ottappalam	3336.56	1729.30	53.43	No	No	Safe
10	Palakkad	6363.07	2872.92	45.15	No	No	Safe
11	Pattambi	5362.37	4470.41	83.37	No	No	Semi Critical
12	Sreekrishnapuram	4228.56	2578.42	60.98	No	No	Safe
13	Thrithala	2561.29	1835.43	71.66	No	No	Semi critical
Total		79524.78	48417.31	60.88			

Groundwater Quality

Based on the chemical analyses it is inferred that the quality of the groundwater in shallow aquifer is in general good (**Annexure 2**). However certain pockets are showing some quality deterioration especially eastern part of Palghat district where fluoride content is slightly high.

The dug wells are showing fluoride in the range of 1 - 5.75 ppm. The higher values recorded from Koppanur (5.75 ppm). The bore wells are showing high concentration of fluoride, ranges from 0.3 to 3.12 ppm. The highest concentration is reported from Chinnamoolathara (EW of CGWB).

The water supply bore well of Eruthanpathy is also showing 1.76 ppm of fluoride. The fluoride content can be brought down to permissible limits by mixing with KWA pipe water supply. Inland salinity is noticed from Kadumthuruthi (Yakkara) and Koduvayoor area. Based on the Reappraisal Survey carried out during 2002-03 the following observations were made. About 1 sq km area is affected in both the areas. The dug wells in the Kadumthuruthi colony (about 40 numbers) area showing high EC (Electrical Conductivity) values in the range of 2000 - 6700 microseimens/cm at 25^oC. In the Koduvayoor area about 25 dug wells are showing high EC values of 756 - 7200 micro seimens/cm at 25^oC. Based on Wilcox classification the 40 samples were categorized for irrigation suitability. The data is presented in the following **Table 4**.

Table 4: Categorisation for Irrigation Suitability

Classification of Irrigation waters	EC range in $\mu\text{s}/\text{cm}$ at 25 ^o C	Number of samples	%
Excellent	< 250	11	27
Good	250 - 750	12	30
Permissible	750 - 2000	15	38
Doubtful	2000 - 3000	0	0
Unsuitable	> 3000	2	5

It was found that almost all samples are suitable for irrigation except two samples (The places are Koduvayoor and Kadumthuruthi). The quality deterioration is due to inland salinity in these areas. These findings are based on the Reappraisal survey carried out by CGWB during 2002-03.

The GWMW samples collected during 2009 were analysed and it was observed that high EC Values were recorded in areas from the Eastern part of the district viz. Chullimedu, Athikod, Kollengod, Koppanur, Kozhinjampara, Nadupuni, Puthunagaram, Chunnambukalthode,

Vandithavalam and Nellinmedu. The highest EC of 1942 micro seimens/cm at 25⁰ C was recorded at Nellimedu.

5.0 STATUS OF GROUNDWATER DEVELOPMENT AND MANAGEMENT

The stage of groundwater development in the district during 2009 is 60.88 % leaving scope for future development. But there is a spurt in the development over the last 5 years (ie the development was 43.67 % during 2004). The groundwater development in the Chittur block is found to be more and the ground water levels are showing a significant decline.

During 2002-2004 this block was declared as drought affected. Hence future development may be restricted in this block. Groundwater based multinational companies are operating in this district compared to other districts of the State. Proper care should be taken before sanctioning any schemes in the district as a whole and especially in Chittur and Thrithala blocks large scale development shall be restricted. Since number of abstraction structures including private bore wells is on the increasing trend without any proper record, proper census of the abstraction structures is necessary for recommending new structures for future development.

There are about four urban water supply schemes and 154 rural water supply schemes available in the district. In addition about 1250 bore wells are operating which were drilled under Technology Mission. Majority of the water supply schemes are maintained by Kerala Water Authority and local bodies. About 52% of the population is getting water from these water supply schemes. But water supply schemes are not equally distributed on all parts of district and all are not need based. Most of the rural water supply schemes use groundwater as the source whereas the urban schemes depend on surface water or both. Rest of the population (48%) is depending on groundwater by their own dug wells and bore wells. In this district 10971 public taps and 37276 domestic connections are supplying water to people as per the 1998 statistics.

Groundwater is used for irrigation through dug wells, dug-cum bore wells and bore wells. The dug wells located along the valleys of midland and hilly area and the bore wells located along the fractures and lineaments are yielding more water during summer months. Coconut, banana, sugarcane and vegetables are being irrigated using groundwater during summer months. About 40 companies are operating in Kanjikode and Chittur area, which are extracting groundwater heavily for industrial needs. Hence this district records highest industrial and irrigation draft in the State.

Recently there is a tendency for the farmers to go in for bore wells in place of dug wells. Due to this the thickness of the unsaturated zone has increased.

Based on the studies the following areas are identified as water scarce areas and these areas need special attention.

Table 5: Water Scarce Areas

No	Block	Areas/Villages
1	Palakkad	Mundoor, Keralasseri, Kongad panchayaths
2	Mannarkkad	Alanallur (part) Thachampara (part) Chellathur in Thachanattukara,
3	Attapady	Agali, Puthoor, Sholayar
4	Alathur	Kannambra Part of Alathur
5	Thrithala	Kappur, Anakara, Thithala
6	Pattambi	Koppam, Vallappuzha
7	Ottapalam	Chathuvatta, Lakkidi part , Vaniyamkulam (Part)
8	Kollengode	Vadavannur , Elavncheri
9	Chittur	Vadakarapathi, Eruthenpathi, Perumatti and Moolathara
10	Sreekrishnapuram	Pookottukavu, Sreerkrishnapuram
11	Nenmara	Ayilur (part)
12	Kuzhalmannam	Kunnathur, Thenkurisi (part)

Groundwater in the district is mostly developed through dug wells and bore wells for domestic, agricultural and for industrial needs. A good percentage of the households in the district have their own drinking water wells. Recently the bore well culture has picked up and gained momentum in the district. In the crystalline terrain the groundwater is developed through dug wells, dug cum bore wells and bore wells. Along the valley fills and laterite terrain groundwater is developed through dug wells.

Groundwater development and management should be coupled with rainwater and surface water. More stress should be given for watershed management which will help in conserving the groundwater and supplementing the recharge.

The existing water resources and dug wells, ponds, streams, should be cleaned, protected and conserved. Rainwater harvesting and artificial recharge schemes should be practiced in the district. Conjunctive use of surface and groundwater shall be practiced effectively.

In Thachampara panchayath there are plenty of springs (locally known as cholas) especially at Vakottu mala and Irumbumutty mala areas. These have not been developed so far effectively. These are the perennial source for drinking water schemes. Attention may be given to these cholas. Meenvallam and Alta waterfalls can also be used effectively for the drinking water supply

schemes. This will reduce the stress on groundwater in the district directly. In situ collection of rainwater coupled with artificial recharge to groundwater can be practiced in the mid land regions.

There should be proper water budgeting in the district. There are plenty of minor irrigation and water supply schemes in the district, which require maintenance and attention. Priority should be given to small-scale water supply projects.

Mass awareness programmes should be organised in Panchayath level to make awareness among people about the importance of conservation of this precious resource, especially in Pattambi, Attapady, Palakkad, Thrithala and Kollenkode blocks. Stress should be given for integrated water shed management and conjunctive use in the district. A comprehensive artificial recharge report has to be prepared for this district for a better water management.

Groundwater Development

The number of groundwater abstraction structures that can be constructed for 70% development of the resource is expected to be around 26,700 and for 90% development about 34300 structures can be constructed. However, no abstraction structures are recommended in the district without a feasibility study, as most of the blocks are water scarce areas. The census figures presently available about the abstraction structures are not matching with the ground reality. In Chittur block the wells are getting dry during summer season. Any sort of abstraction structures should be constructed with proper site selection and technical support from CGWB and GWD or reputed agencies.

Indiscriminate construction of bore wells in private sector is common in the district especially in the Chittur block both for industrial and irrigation purposes. Hence 100% well census data is a must for computation of the actual draft. Since there is spurt in the groundwater development in the district over the last 5 years the recommendation for groundwater abstraction shall be restricted or controlled.

Water conservation and Artificial Recharge

Groundwater development should be coupled with management of rainwater harvesting and surface water. More stress should be given for watershed development through which better groundwater management can be achieved. The existing water resources and dug wells, ponds, streams, should be cleaned, protected and conserved. Rainwater harvesting and artificial recharge schemes should be practiced in the district.

It has also been observed that the existing surface water structures like ponds, tanks and cultivable land, irrigated canal are being encroached for settlement purposes which reduce natural recharge.

CGWB has implemented a number of artificial recharge and rainwater harvesting schemes in the district. They are

S.No.	Location	Year	Structure
	Anangadi	1979	Sub-surface Dam
	Bavaji Nagar	1998	Sub-surface Dam
	Allanallur	1998	Sub-surface Dam
	Komauttichella	2003	Sub-surface Dam
	Chunnambukalthodu	2003	Check Dam
	Chittur	2009	Recharge pit and Storage Tank

These schemes are successful and are very much useful for the district. The farmers are being benefited by the schemes. The subsurface dyke constructed at Bavaji Nagar received wide appreciation. The agricultural production on the upstream side has increased. The dug well near by the structure maintained higher water level during summer season and yielded more water.

There is abundant water Resource in the district, to meet the requirement of the farmers. But the resources have to use judiciously and sustainably. Most of the panchayat wells in the district are having sufficient water. But these wells are not in use but for waste dumping. 1000 wells can be desilted and cleaned and protected as a first stage in Chittur and Kollengode blocks. These wells can be fitted with pump sets and used for community level. There are plenty of ponds/tanks having sufficient water, but most of them are silted and with collapsed side walls. These tanks have to be renovated and can be used for irrigation purpose. These tanks can be effectively used for water storage from canals intermittently. In Thachampara panchayat of Mannarkad block there are plenty of springs locally known as cholas, especially at Vakott Mala and Irumbumutti mala area. These springs have not been developed so far. Meenavallam and Alta water falls can be used for major schemes. This will reduce stress on ground water development in the district.

A comprehensive plan for suitable abstraction structures and AR schemes are very much essential in the district. Since the yield of the bore well is site specific, the farmers have to take technical support from CGWB/GWD or reputed NGO's before putting bore wells for irrigation purposes. However domestic wells can be constructed without much technical guidance. A data bank has to be maintained in CGWB which has to be disseminated to the farmers through GWD/NGOs or panchayats.

There are about 13 blocks and 91 panchayats in the districts. All these panchayats need a separate plan for AR schemes. Chittur, Kollamkode, Palghat (Malampuzha), Trithala, Attapady block are to be considered for the AR schemes implementation. In Chittur block 6 panchayats needs, 8 sub surface dykes and 12 bore well recharge schemes (using Bore well only) . 2 ponds from each

panchayat have to desilted and cleaned. And also roof top rain water harvesting is to be implemented wherever fluoride is higher than the permissible limit in two panchayats.

In Kollenkode block, 5 panchayats need AR schemes separately. 5 sub surface dykes and 10 ponds from each panchayats have to be cleaned and 6 roof top harvesting with recharge facilities are suggested. 4 Bore well recharge scheme is required.

In Palghat and Malampuzha block, gully plugging is required, and 50 rain pits/trenches are required in the area since the weathered thickness is more.

In Attappady block 6 numbers of gully plug and 3 sub surface dykes are required. In Trithala Block, two sub surface dyke and 4 rain water harvesting schemes required. Sand mining and water level decline has to be checked. Roof top Rain water harvesting with recharges facility is required in all blocks. No additional structures are recommended in the district. Though majority of the block are safe, a declining trend in water level trend is noticed. Most of the ground water is going as base flow.

Block wise artificial Recharge Schemes proposed for the district for immediate implementation are given below

Table 6: Artificial Recharge Scheme Proposal (Figure 6)

S.No.	Block	Panchayat	Artificial Recharge Schemes				
			SSD	GP	BWR	Ponds/Tank	RWH
1	Chittur	Eruthenpathy	2		2	2	2
		Kozhinjampara	1		2	2	2
		Nellipally	1		2	2	
		Pattenchery	1		2	2	
		Perumatty	1		2	2	
		Vadekakapathy	2		2	2	
2	Kollenkode	Kollenkode	1		2	2	2
		Koduvayoor	1			2	2
		Muthalamada	1		2	2	2
		Padunagaran	1			2	
		Vadevannur	1			2	
3	Attappady	Agali	1	2			1
		Pudoor	1	2			1
		Shalayar	1	2			1
4	Trithala	Trithala	1			2	2
		Chalusseri	1			2	2
5	Palghat (including Malampuzha)	Kudumba				2	2
		Mondur				2	2
		Malampuzha				2	
		Puthussery				2	2
		Elapully				2	2
		Akathethara				2	2

SSD - Sub surface dyke
 GP - Gulley Plugging
 BWR -Bore well recharge
 Ponds/Tank- Desilting and renovation of tanks and ponds
 RWH - Roof Top Rainwater Harvesting with Recharge

In Chittur and eastern blocks, farmers can practice bore well recharge and rainwater harvesting, for which incentives can be given to farmers. Bore well recharging has to be practiced in the Chittur block and Kollenkodu blocks since the aquifer can take water even during rainy season. The canal water may be diverted to the near by ponds and tanks for groundwater recharge. The roof water also can be diverted to the existing bore wells. There are plenty of dry bore wells in the Chittur block, which can be used for recharging.

6.0 GROUNDWATER RELATED ISSUES AND PROBLEMS

Certain pockets in the eastern parts are showing some quality deterioration especially eastern part of Palghat district where fluoride content is slightly high .The dug wells are showing fluoride in the range of 1 - 5.75 ppm. The higher values are recorded from Kopanur (5 .75 ppm). The bore wells are showing high concentration of fluoride, ranging from 0.3 to 3.12 ppm. The highest concentration is reported from Chinnamoolathara (EW of CGWB). The water supply bore well of Eruthanpathy is also showing 1.76 ppm of fluoride. The fluoride content can be brought down to permissible limits by mixing with KWA pipe water supply. Inland salinity is noticed from Kadumthuruthi (Yakkara) and Kuduvayoor area. About 1 sq km area is affected in both the areas. The dug wells in the Kadumthuruthi colony (about 40 numbers) area showing high EC (Electrical Conductivity) values in the range of 2000 - 6700 microseimens/cm at 25⁰C. In the Kuduvayoor area about 25 dug wells are showing high EC values of 756 - 7200 micro seimens/cm at 25⁰C.

The Coco Cola factory which is extracting groundwater for its products was operating in the Chittur Block and has invited agitation in a big way. The company is presently non operational. Pepsi ltd Company is operating in the industrial belt of Malampuzha block which is also extracting groundwater for its product.

7.0 AWARENESS & TRAINING ACTIVITY

In addition to the normal activities of CGWB, more thrust was given to Mass Awareness to educate people about the need to conserve and protect the precious groundwater resources. Such programmes were being conducted from 1996 onwards. In addition to this, CGWB started imparting training on Rain Water Harvesting and artificial recharge to groundwater resources for the public. Mass awareness progarmmes were conducted during 2000, 2003, 2005 and 2009. During the period April 2006 – March 2007 one training programme and one mass awareness

programme (MAP) were conducted in Palaghat district. To impart training on rainwater harvesting, especially the water scarce and problematic areas have been selected. The training programmes have been found very useful by the participants as was evident by the number of queries and discussions that followed the lectures. These Mass Awareness and Training Programmes were very helpful in making the public conscious of the importance of the groundwater – to keep it safe from pollution, to conserve it and recharge and not to waste it. A lot of people are approaching the office for follow up action. Wide media coverage has been witnessed for the various training programmes.

8.0 NOTIFICATIONS BY CGWA/SGWA

Chittur block of Palghat district notified by CGWA and SGWA for registration of abstraction structures and further restriction since the block is categorized as over exploited.

9.0 RECOMMENDATIONS

1. The stage of groundwater development in the district during 2009 is 60.88 % leaving scope for future development. But care should be taken since there is a spurt in the development over the last 5 years ie the development was 43.67 % during 2004 presently increased to 60.88 %.
2. The groundwater development in the Chittur and Trithala blocks is found to be more. During 2002-2004 this block was declared as drought affected. The water level in Chittur block is showing a falling trend. Hence future development may be restricted in these blocks. Groundwater based industries are operating in this district. Care should be taken before sanctioning any schemes in the district as a whole and Chittur and Thrithala blocks in particular.
3. As number of abstraction structures including private bore wells is on the increasing trend without proper dissemination, proper census of the abstraction structures is necessary for recommending new structures for future development.
4. Groundwater development should be limited with conjunctive use of rainwater and surface water. More stress should be given for watershed development for better water management. The existing water resources, dug wells, ponds, tanks and streams, should be cleaned, protected and conserved.
5. In order to assess the groundwater of the district in realistic manner, block wise micro level study is recommended. Micro level study should cover 100% well inventory and collection of relevant data regarding draft.

6. In the inland salinity area of Koduvayoor and Kadumthuruthi, bore wells can be constructed with proper casing by blocking the top zone. Rainwater harvesting schemes can also be implemented.
7. In Thachampara panchayath, there are plenty of springs (locally known as Cholas) especially at Vakottu mala and Irumbumutty mala area. These have not been developed so far effectively. These are the perennial sources for drinking water schemes. Attention may be given to these cholas. Meenvallam and Alta waterfalls can also be used effectively for the drinking water supply schemes.
8. The depth to bore wells may be restricted to 200m only.
9. In the fluoride affected area dilution method can be practiced to reduce the fluoride level in the drinking water.
10. There should be proper water budgeting in the district. There are plenty of minor irrigation and water supply schemes in the district, which require maintenance and attention. Priority should be given to micro level water supply projects.
11. Mass awareness programmes should be organised in Panchayath level to create awareness among people about the importance of conservation of this precious resource. Stress should be given for integrated water shed management and conjunctive use in the district.
12. A comprehensive artificial recharge and groundwater conservation report has to be prepared for this district for a better water management. Rainwater harvesting and artificial recharge schemes should be practiced in the district. In situ rainwater collection and artificial recharge to groundwater can be practiced in the mid land regions.
13. A technical data base center 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.
14. Bore well recharge is recommended in Chittur Block and other eastern blocks of the district.
15. The groundwater conservative measures, method of drilling and site selection etc are given in the text part which may be practiced

Figure 1: Index map of Palakkad District, Kerala

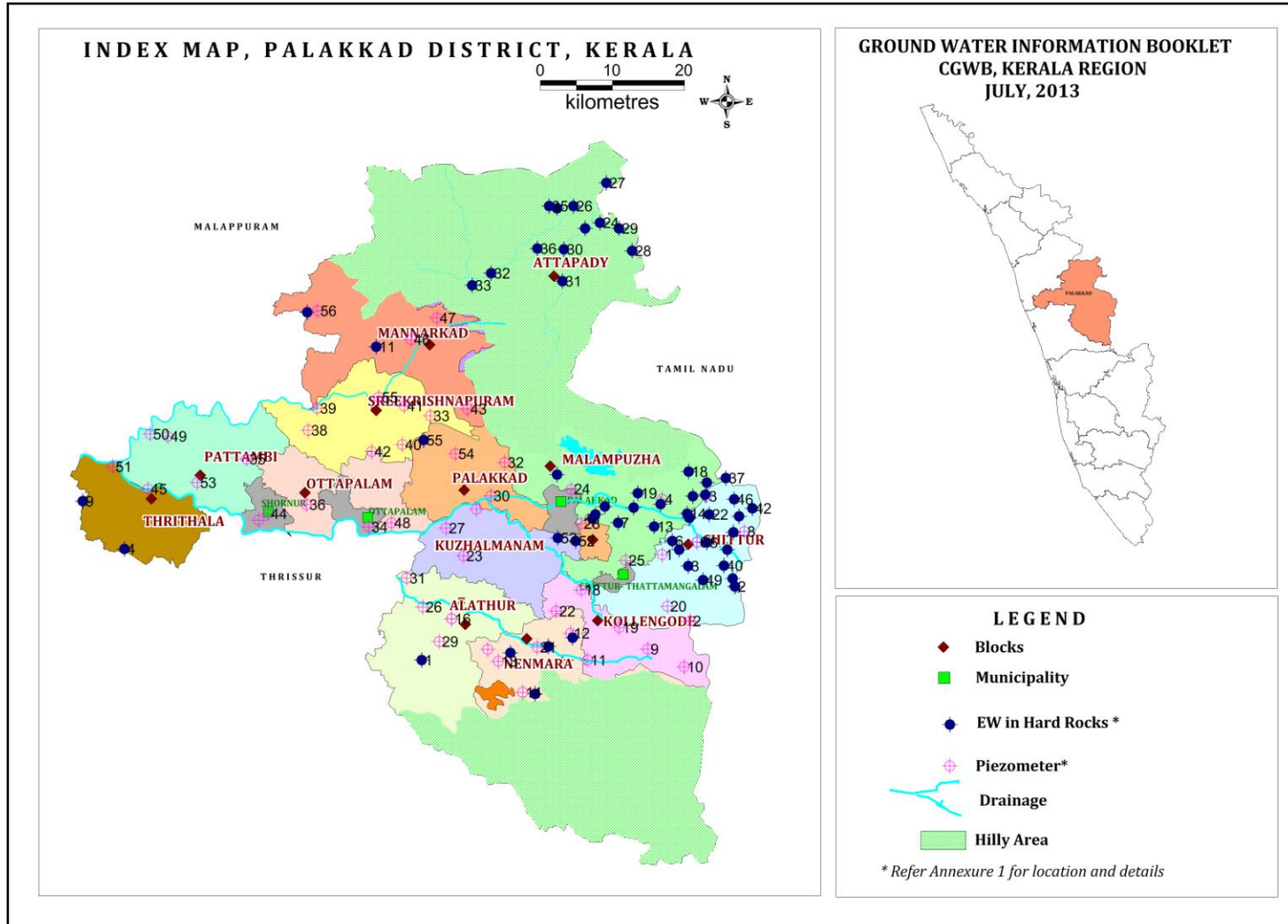


Figure 2: Depth to Decadal Average Water Level (Premonsoon April 2002-11)

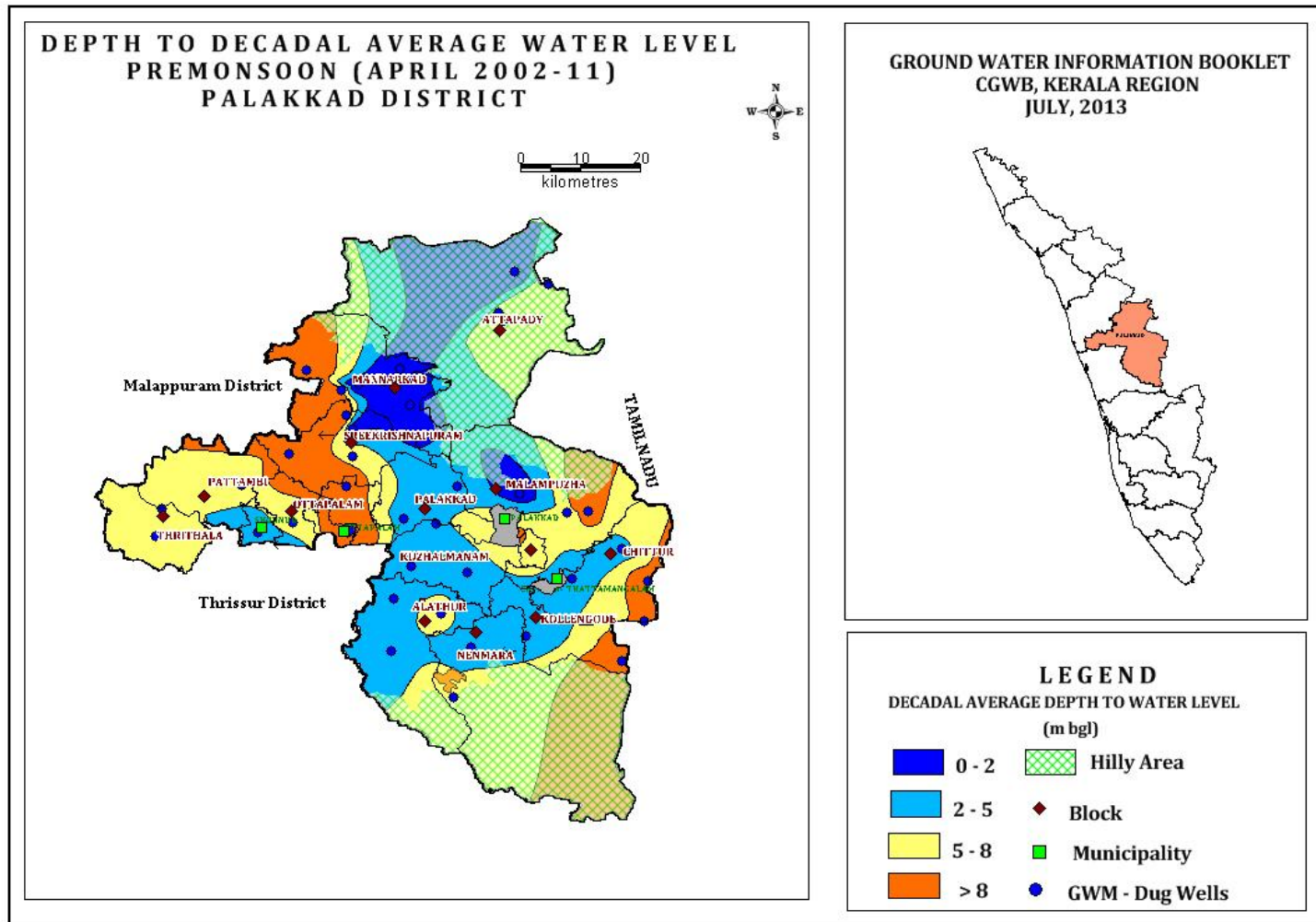


Figure 4 : Hydrogeology of Palakkad District, Kerala State

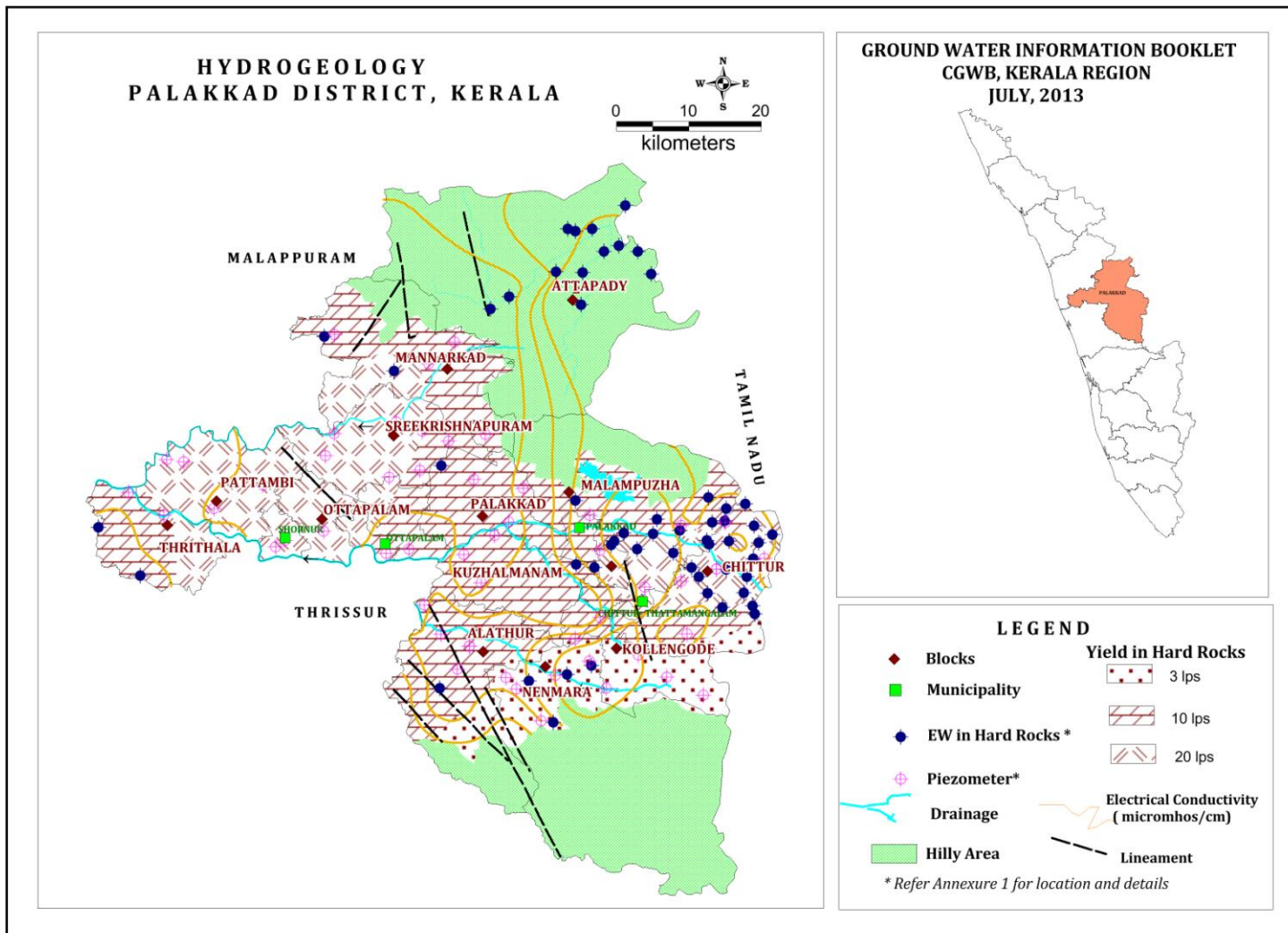


Figure 5: Categorisation of Blocks in Palakkad District

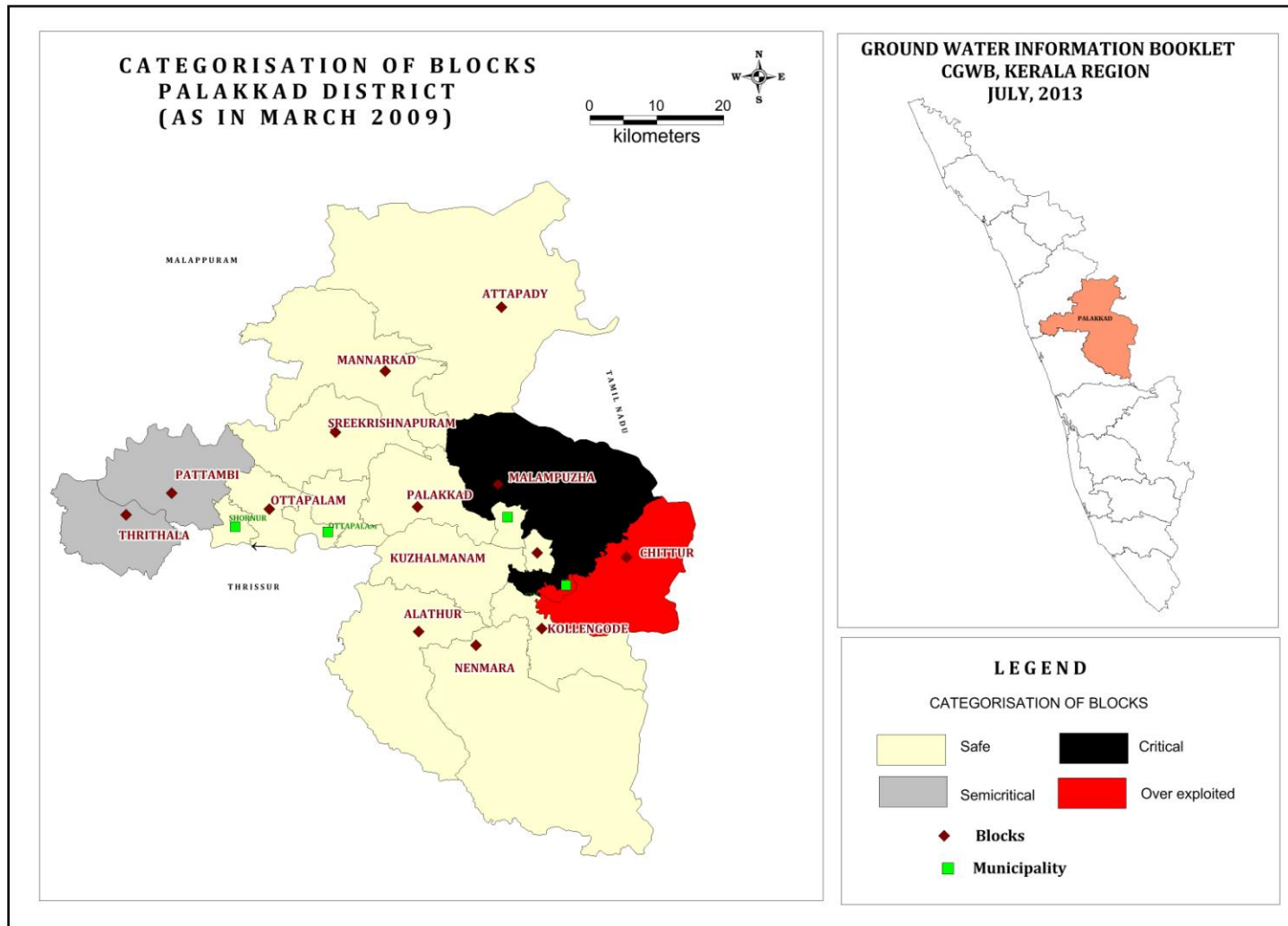
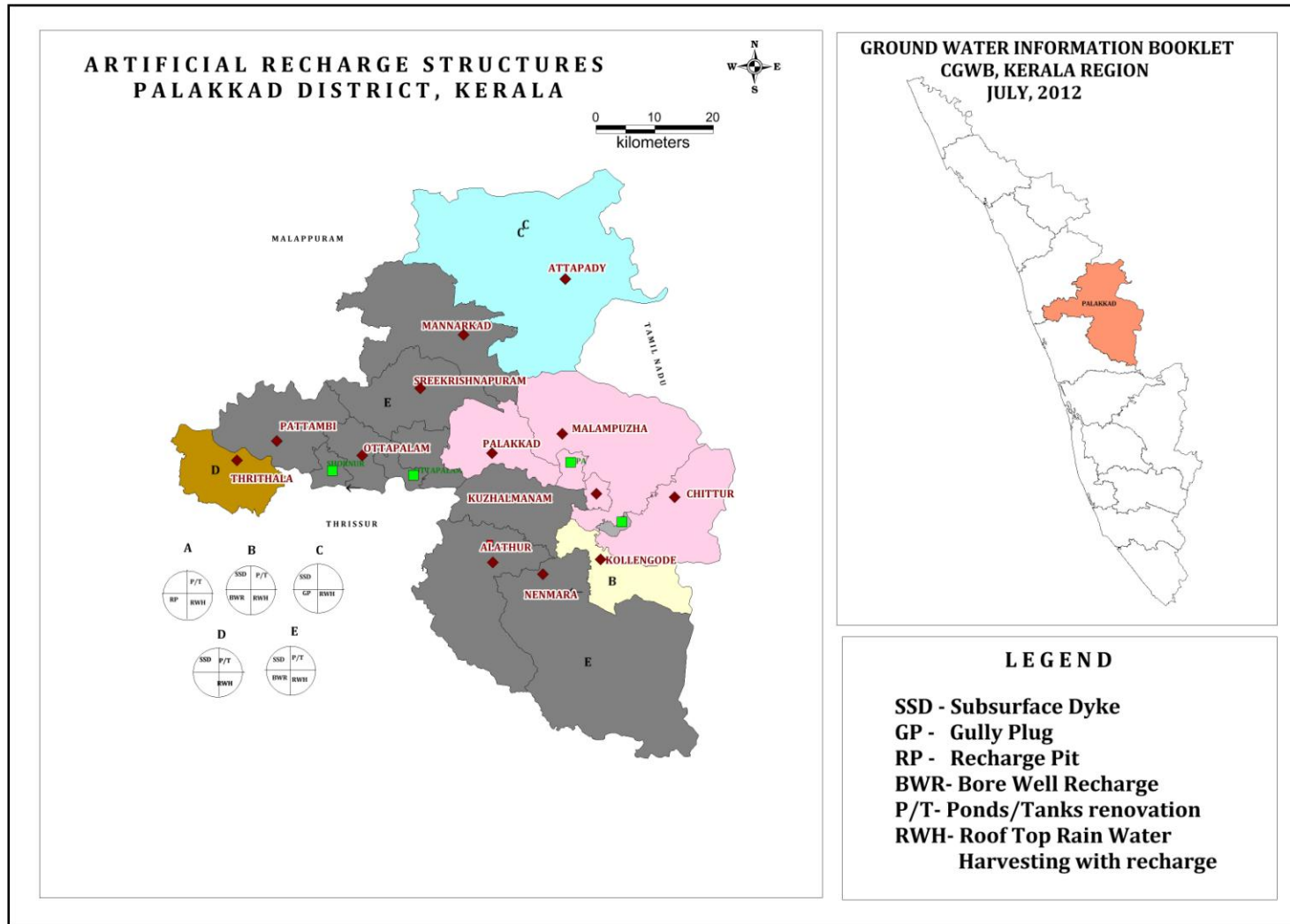


Figure 6: Artificial Recharge Structures proposed in Palakkad District



Details of Exploratory wells drilled by CGWB in Palakkad district

Sl. No	Location	Lat	Long	Year	Depth (m.bgl)	Aquifer*	Casing Depth (m.bgl)	Discharge (lps)	Draw-down (m)	T	S	EC	CI
1	Vadakkancheri	10.589	76.475	1978-79	137.46	HbGn	7.62	10.83		51.73	3.52x10 ⁻³	215	12.4
2	Velanthavalam	10.681	76.874	1978-79	101.21	HbGn	3.04	38.33		43.15		987	76
3	Vannamada	10.703	76.014	1978-79	128.62	HbGn	1.52	6.87		1.59	2.96x10 ⁻³	970	49
4	Chalisseri	10.728	76.096	1984-85	170.05	HbGn	8.7	10.00	17.16	43		270	18
5	Kozhinjampara	10.736	76.838	1978-79	152.4	HbGn	1.52	2.20		2.59	1.02x10 ⁻³	1175	188
6	Nallepalli	10.738	76.794	1979-80	89.92	HbGn	7.62	25.00		39.7		690	22
7	Pallatheri	10.761	76.725	1978-79	182.88	HbGn	3.04	2.95		4.19	4.28x10 ⁻⁵	931	34
8	Maruda Road	10.771	76.696	1978-79	300	HbGn	1.52	dry		NA		NA	NA
9	Kumaranallur	10.788	76.043	1984-85	300.81	Chrn	7.2	2.50	17.52	21.7		450	22
10	Kolippara	10.796	76.836	1978-79	107.9	HbGn	1.52	8.83		11.66	7.32x10 ⁻⁴	790	34
11	Kumarambattur	10.981	76.417	1985-86	137.5	HbGn	5.6	17.70	6.7	270		270	13
12	Palakkazhi	11.024	76.329	1985-86	300.81	Chrn	13.82	1.30	26.46	0.53		150	7.1
13	Para	10.756	76.771	1999-00	193.4	HbGn	5.5	0.20				1200	178
14	Menonpara	10.772	76.813	1999-00	175.2	HbGn	12.8	8.50		84.5		1470	306
15	Pudussery	10.781	76.708	1999-00	59	HbGn	7.5	12.00		118		700	104
16	S.N.Pallam	10.784	76.779	2000-01	89.7	HbGn	12.5	16.00		40		527	30
17	Akkathethara	10.821	76.647	2000-01	200	HbGn	4.3	0.50				284	13
18	Vattapara	10.825	76.815	2000-01	200	HbGn	16.5	3.00		9.44		662	121
19	Kanjikode	10.798	76.750	2000-01	138.5	HbGn	16.5	14.00				624	50
20	Maniyeripallam	10.780	76.745	2000-01	200	HbGn	22	0.40				1520	117
21	Kirampara	10.769	76.879	2000-01	200	HbGn	5.5	0.10				2120	128
22	Nallaveettuchella	10.771	76.841	2000-01	200	HbGn	13.5	2.00					
23	Palakkad	10.766	76.692	2000-01	200	HbGn	19.6	0.40		0.2			
24	Kottathara	11.136	76.702	2000-01	193	HbGn	10.3	1.80				1300	33
25	Agali goat farm	11.129	76.683	2000-01	200	HbGn	5.9	0.80		0.79		855	43
26	Chavadiyur	11.157	76.668	2001-02	169	HbGn	17.35	7.70		20.3		584	26
27	Melachundapetti	11.186	76.710	2001-02	187.2	HbGn	6.3	0.50	NA			710	13
28	Kulukkur	11.101	76.743	2001-02	129	HbGn	10.4	15.00		38.83		1610	65
29	Vattulukki	11.129	76.726	2001-02	193.4	HbGn	11.75	0.60	NA			981	106
30	Agali	11.103	76.656	2001-02	193.4	HbGn	22.3	0.80	17.01	0.79		855	43

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31	Chittur	11.063	76.654	2001-02	200	Sch	20.2	0.30	NA			2120	405
32	Chemmannur	11.073	76.563	2001-02	200	HbGn	13	0.80	34.43	3.16		430	11
33	Mukkali	11.058	76.539	2001-02	133.4	HbGn	9	19.00		68.32		596	14
34	Moolakombupirivu	11.154	76.647	2001-02	200	HbGn	22.6	7.00		13.18		741	36
35	Ummathampadi	11.157	76.637	2001-02	200	HbGn	14.3	4.00		8.5		730	28
36	Kunnanchala	11.104	76.622	2001-02	187.3	HbGn	10.4	0.10	NA			510	14
37	Velanthavalam	10.817	76.862	2002-03	104.9	HbGn	2.15	5.00		35.73		1119	121
38	Palayamanthurai	10.811	76.838	2002-03	89.7	HbGn	3.8	13.00		41.27	0.00375	770	50
39	Erumakaranur	10.794	76.820	2002-03	80	HbGn	3	10.00	1.3	29.84		1010	57
40	Malayandikaundannur	10.707	76.860	2002-03	101.35	HbGn	8	1.00	NA	0.61		815	46
41	Pothikal	10.749	76.872	2002-03	200	HbGn	10.4	0.10	NA				
42	Mallampathy	10.779	76.896	2002-03	200	HbGn	4.3	0.60	NA			1610	203
43	Puzhapallam	10.767	76.816	2002-03	101.35	HbGn	9.85	6.00	24.12	41.64		1493	163
44	Chinnamoolathara	10.727	76.864	2002-03	120	HbGn	3.75	2.00	16.43	4		2000	227
45	Moongilmada (Gopalapuram)	10.691	76.871	2002-03	200	HbGn	11.4	1.00	NA	2.34		1430	85
46	Kinarpallam	10.790	76.873	2002-03	200	HbGn	4.3	dry	NA				
47	Nellipalam	10.727	76.803	2002-03	92.7	HbGn	10.4	25.00				701	36
48	Vallickad	10.617	76.667	2002-03	200	HbGn	9	2.00				677	64
49	Kozhinjampara (6th mile)	10.689	76.833	2002-03	101.35	HbGn	6.95	2.00	41.55	1.91		1235	192
50	Kumbalakode	10.606	76.636	2002-03	200	HbGn	9.6	1.00				1270	99
51	Pothundy	10.547	76.619	2002-03	147.7	HbGn	6.1	2.50				702	14
52	Mambran	10.738	76.671	2002-03	101.35	HbGn	9	3.00	20.68	28		508	121
53	Kadumthrithi	10.742	76.648	2002-03	85.8	HbGn	21.75	14.00		142.22		972	164
54	Kollenkode Mundikavu	10.598	76.588	2002-03	65	HbGn	6.05	17.00				364	33
55	Peringode	10.864	76.477	2003-04	104	HbGn	8.1	10.00	16.83	15		311	20
56	Pattambi			2009-10	101			3.00					
57	Perur			2009-10	100	HbGn		1.00					
58	Ottapalam EW			2009-10	100	HbGn		15.00					
59	Puthukode EW			2009-10	100	HbGn		18.00					
60	Mayannur EW			2009-10	100	HbGn		12.00					
61	Kongad			2010-11	101	HbGn		5.0	14.89				
62	Vadanamkurussi			2010-11	101			2	13.39	105			

Chemical Analysis Data of GWMW samples collected from Palakkad district during April 2009

Sl. No	Location	pH	EC in $\mu\text{s}/\text{cmat}$ 25 ⁰ C	TH as CaCO ₃	Ca	Mg	Cl	F	NO ₃
PALAKKAD DISTRICT									
1	Adiparanda	8.88	145	40	6.4	5.8	17	0.28	0.61
2	Agali	8.04	818	180	40	19	156	0.39	-
3	Alanallur	7.79	280	54	10	6.8	51	0.35	15
4	Alathur	-	548	134	35	11	153	0.45	2.5
5	Ambalappara	7.9	135	32	8	2.9	21	0.23	0.17
6	Ariyur	7.83	62	28	9.6	0.97	5.7	0	0.04
7	Athipetta	8.51	476	122	18	15	74	0.56	0.86
8	Chalisseri	7.31	162	28	6.4	2.9	31	0.08	5.1
9	Chavadiyur	8.33	472	120	10	23	20	0.63	12
10	Chemmampathi	-	607	85	28	3.6	107	1.04	34
11	Cherpulassery	-	194	22	7.2	0.97	26	0.38	2.8
12	Chittoor	-	798	70	10	11	178	0.5	3.5
13	Chullimade	8.53	1041	185	14	36	199	0.7	1.1
14	Gopalapuram	-	981	150	32	17	192	1.12	149
15	Kakkupady	8.15	143	46	13	3.4	8.5	0.2	6.3
16	Kalladikode	8.05	127	24	8.8	0.49	17	0	1.1
17	Kanjikode	-	847	20	6	1.2	114	0.312	12
18	Kanjirapuzha	8.11	99	28	9.6	0.97	7.1	0.08	1.2
19	Karimpuzha	7.74	61	18	5.6	0.97	7.1	0.31	0.32
20	Kodavayur	-	197	24	7.2	1.5	21	1.21	0.86
21	Kollengode	8.85	541	142	15	25	67	0.65	1
22	Koppam	8.01	182	38	8	4.4	40	0.07	0.41
23	Kottapuram	7.95	196	48	14	3.4	31	0.16	21
24	Kozhinjampara	-	438	90	33	1.9	91	0.33	6.2
25	Kumaramputhur	8.17	105	36	9.6	2.9	9.9	0.2	0.52

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26	Kuzhalmannam	-	462	78	9.6	13	52	0.56	1
27	Malampuzha	8.21	362	90	21	9.2	61	0.16	0.57
28	Mankara	7.79	324	64	14	6.8	38	0.16	11
29	Mannarghat	-	138	30	8.8	1.9	16	0.19	1.8
30	Mattathukkad	8.55	921	175	10	36	85	2.9	52
31	Meenakshipuram	8.44	914	175	22	29	107	0.59	98
32	Meenkara	8.7	1290	260	10	57	206	0.91	8.5
33	Mundur	8.26	235	58	13	6.3	18	0.7	0.28
34	Nemmara	-	266	60	6.4	11	31	0.3	4.6
35	Odannur	8.25	163	46	8.8	5.8	18	0.31	8.1
36	Ottapalam	8.02	488	62	14	6.3	92	0.16	45
37	Palappuram II	8.76	721	125	22	17	103	0.72	123
38	Palghat	-	399	36	9.6	2.9	78	0.73	8.9
39	Pattambi	8.08	296	64	16	5.8	41	0.27	11
40	Punchapadam	7.77	115	32	10	1.5	9.9	0.35	1
41	Shornur	8.35	357	144	32	16	18	0.33	0.18
42	Tachanattukara	7.91	147	28	7.2	2.4	21	0.12	12
43	Tannirkode	7.81	104	26	6.4	2.4	14	0.26	1.4
44	Tavalam	8.67	297	88	15	12	43	0.25	16
45	Tenkara	7.96	112	34	9.6	2.4	7.1	0.3	2.6
46	Thachanpara	7.7	135	16	6.4	0	23	0.09	0.55
47	Tholanur	8.44	379	102	25	9.7	47	0.44	0.26
48	Trittala	8.09	494	146	33	16	61	0.2	1.3
49	Vadakkancherry	-	486	90	14	14	82	0.29	35
50	Vallapuzha(nearby well)	8.25	183	64	17	5.4	18	0.11	9.5
51	Vaniyamkulam	-	862	105	32	6.1	224	0.19	60
52	Vattassery(Kottassery)	8.14	109	34	8	3.4	7.1	0.23	4.6
53	Walayar(near by well)	8.71	753	200	18	38	167	0.75	17
54	Athikode	8.73	1840	260	8	58	498	1.58	2.7
55	Chakkantara(nearby well)	-	284	46	8	6.3	30	0.16	0.64
56	Erattakulam	-	176	38	6.4	5.4	18	0.35	1.4

57	Kombazhichungam	8.86	477	158	16	29	71	0.61	17
58	Karumkulam	8.42	413	150	18	26	43	0.42	2.3
59	Koduvayur	8.36	661	210	38	28	160	0.33	0.08
60	Kollengode School	8.78	1196	195	16	38	196	2.46	0.53
61	Kongad	-	353	72	23	3.4	61	0.27	56
62	Kottanad	8.43	147	40	8	4.9	21	0.17	4.8
63	Kopanur	-	1559	90	8	17	142	7.3	2.6
64	Kozhippara	8.53	1041	280	8.8	55	210	0.14	0.37
65	Kudallur	7.09	177	32	8	2.9	36	0.06	6.4
66	Kumaranallur	7.81	122	24	8	0.97	21	0.04	2.7
67	Mattumanda	-	302	38	10	2.9	64	0.3	4.2
68	Nadupeni	-	1423	95	6	19	217	1.64	2.7
69	Oottara	-	869	125	6	27	100	1.22	1.8
70	Panayur	-	321	54	7.2	8.8	41	0.7	3.2
71	Peringode(nearby well)	8.58	257	70	15	7.8	26	0.4	1
72	Pudhunagaram	-	1033	40	6	6.1	174	0.95	13
73	Pudhupariyaram	-	322	22	8	0.49	45	0.45	1.8
74	RVP Pudur(nearby well)	-	764	150	14	28	89	0.89	42
75	Kallikkad	7.94	100	28	9.6	0.97	7.1	0.47	3.5
76	Chunnambukkalthodu	8.91	968	215	12	45	160	1.42	0.68
77	Vandithavalam	8.48	810	210	26	35	146	0.52	8.3
78	Kottayi	-	353	68	14	7.8	58	0.07	19
79	Nellimedu	8.3	1942	370	52	58	505	0.46	50

