जल वर्ष 2007 Water Year 2007

स्वच्छ सुरक्षित जल – सुन्दर खुशहाल कल

CONSERVE WATER - SAVE LIFE

GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION BOOKLET OF ERNAKULAM DISTRICT KERALA STATE

By

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DISTRICT AT A GLANCE

Sl No	ITEMS	STATISTICS
1.	**GENERAL INFORMATION**	
	i) Geographical area, sq km	2408.
	ii) Administrative Divisions (As on 31-03-2007) Number of Tehsil/Block Number of Panchayat/Villages	Taluks : 6 Blocks : 15 Municipalities : 8 Panchayats : 86
2.	**GEOMORPHOLOGY**	
	Major physiographic units	Coastal Plain , Midland and High land
	Major Drainages	Periyar and Muvattupuzha rivers and their tributaries
3.	**LAND USE, area in km^2**	
	a) Forest area	232.52
	b) Net area sown	1996.67
4.	**MAJOR SOIL TYPES**	Coastal Alluvium Riverine alluvium Brown hypdromorphic soil Lateritic soil
5.	**AREA UNDER PRINCIPAL CROPS, km^2**	Paddy : 539.88 Coconut : 659.25 Pepper : 58.37 Rubber : 552.78 Other non food Crops :37.00
6.	**IRRIGATION BY DIFFERENT SOURCES, Area in km^2**	
	Wells	103.34
	Tanks	25.32
	Canals	215.19
	Other Sources	162.14
	Net Irrigated area	505.06
7.	**NUMBER OF GROUNDWATER MONITORING WELLS OF CGWB (AS ON 31-3-2007)** No. of Dug wells No. of Piezometers	 49 21

8	**PREDOMINANT GEOLOGICAL FORMATIONS**	Archaean Crystalline formation (Charnockite group& migmatite group), Tertiary sedimentary formation, Sub-Recent laterite and Recent alluvium.
9.	**HYDROGEOLOGY** Major Water bearing formation Depth to water level (Pre-monsoon, 2006) Depth to water level (Post-monsoon, 2006) Long term water level trend in 10 years(1997-2006), m/yr	Weathered, fractured crystalline formations; semi consolidated Tertiary formations, laterites and Recent alluvium. 0.9 to 10.58 mbgl. 0.5 to 10.17 mbgl. No conspicuous change in trend in phreatic aquifers.
10.	**GROUND WATER EXPLORATION BY CGWB (As on 31-03-2007)**	
	No. of wells drilled (EW, OW, PZ, SH, Total)	EW – 34 OW-3, PZ –21, Total – 58
	Depth Range (m)	54 – 295.6
	Discharge (litres per minute)	6 – 1320
	Transmissivity (m^2/day)	4.72 -818
11.	**GROUND WATER QUALITY**	
	Presence of chemical constituents more than permissible limits	Quality is good. Major chemical constituents lie within the permissible limits..
12.	**DYNAMIC GROUNDWATER RESOURCES (2004) – in MCM**	
	Annual Replenishable Ground Water Resources	618.43
	Gross Annual Groundwater Draft	293.80
	Projected demand for Domestic and Industrial Uses up to 2025	115.54
	Stage of Ground Water Development,%	51.8
13.	**AWARENESS AND TRAINING ACTIVITY** Mass awareness programme organised place Water Management Training Programmes organized Date Place No. of Participants	 2002 Ernakulam 2005 Ernakulam 100
14.	**GROUND WATER CONTROL AND REGULATION**	
	Number of Over Exploited blocks	Nil
	Number of blocks notified	Nil
15.	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	Brackish quality of groundwater along tidal inlets. Anthropogenic pollution.

1.0 INDRODUCTION

The district is situated in the northern side of the state, bound by Trichur district on the north, Idukki on the east, Kottayam and Alappuzha districts on the south and the Lakshadweep Sea on the west. It has an area of 2408 sq. km. Ernakulam (Cochin) is the district headquarters. Cochin also known as the Queen of Arabian seas is a major port city of the west coast of India. The international airport of Cochin at Nedumbassery falls within the district. All the panchayats of the district are well connected with a good network of all weathered roads.

For administrative purposes, the district is divided into two revenue divisions and seven taluks. Muvattupuzha revenue division with Muvattupuzha as its headquarters comprises of Kunnathunadu, Muvattupuzha and Kothamangalam taluks, while Cochin division with its headquarters at Cochin consists of Aluva, Paravur, Cochin and Kanayanur taluks. There are 15 community development blocks, 86 village panchayats eight municipalities and one corporation in the district. The district has a population of 31,05,798 persons as per 2001 census.

The district is drained by the Periyar and its tributaries on the north and Muvattupuzha river on the south. Periyar, the longest river in the state originates from the cardamom hills of the Western Ghats and enters the district at Neriamangalam and near Bhuthathankettu, it is joined by major tributaries. At Alwaye the river bifurcates into two branches, which in turn branches into several distributaries before draining into Lakshadeep Sea.

The Muvattupuzha river is formed by the confluence of Thodupuzha river Kaliyar and Kothamangalam river at Muvattupuzha. These rivers originate from the Thodupuzha reserve forest. The Muvattupuzha river takes a rough east-west course up to Ramamangalam and thereafter it flows towards south leaving the districts south of Pazhur. In the upstream areas the drainage pattern in both Periyar and Muvattupuzha basin are trellis to sub-trellis. In the lower reaches dendritic pattern of drainage is observed.

Previous work

The CGWB has carried out hydrogeological studies and exploration of both sedimentary and hard rock areas. Exploration for groundwater in the district was taken up during the FSP 1965 – 66, 74 – 75, 83 – 87, 89 – 90, 98 – 2001 and 02. Systematic hydrogeological surveys were carried out in different parts of the district by S/Sh. S.V.N.S Rao (77-78, 82 – 83), GV.V.R.G.S.V. Rao (80 – 81), K.Md. Najeeb (81 – 82, 87 – 88), V. Dhinagaran (95 - 96). Detailed study of the groundwater conditions of the entire district were carried out by SIDA assisted Coastal Kerala, Ground Water Project during the period 83 – 88.

Irrigation and cropping pattern

About 83% of the total area of the district is cultivable land and nearly 10% of the area is under forest cover including reserve forest plantation; and water bodies constitute 5.3% and built up area for dwelling unit etc is nearly 2% of the total area. An area of 505 sq.km is under irrigation in the district. Periyar valley irrigation project with a barrage at Bootathankettu which uses the tail race water of Sengulam, Panniyur and Pallivasasl Hydro-electric projects and Chalakudy diversion project are source for canal irrigation in the district.

The major crops under irrigation are paddy, coconut, rubber, banana and arecanut. The gross area under irrigation is higher than the net as more than one crop of paddy is cultivated under irrigation. The crop wise area under irrigation is presented in Table.1.1

Table 1.1: Crop wise area under irrigation

Crop	Paddy	Coconut	Banana	Arecanut	Vegetable	Spices	Others	Total
Area, sq.km	417.25	181.94	812.61	8.88	4.35	8.18	9.15	642.56

(Source: Farm guide 2001)

Coconut is the major single crop in the district followed by paddy and rubber. Spices and vegetables are also cultivated in the district.

2.0 RAINFALL AND CLIMATE

Ernakulam district has wet monsoon type of climate. The district experiences heavy rainfall during southwest monsoon season followed by northeast monsoon. During the other months the rainfall is considerably less. March, April and May months are the hottest. December to February months are the coldest. The annual rainfall ranges from 3233 to 3456 mm at different places of the district.

The district receive on an average 3359.2 mm (based on 1901-99 data) of rainfall annually. The district received the maximum rainfall around Neriamangalam area. The rainfall is less in the western part and increase towards the east. Based on normal annual rainfall Neriamangalam received around 5883 mm. Cochin in the western part receives around 3233 mm annually.

Rainfall during South-west monsoon season contributes nearly 67.4% of total rainfall of the year, followed by the north-east monsoon which contributes nearly 16.6% and the balance of 16% is received during the month of January to May as summer/pre-monsoon showers. The mean monthly rainfall distribution for Ernakulam district (2003 to 2006) is given in Table 2.1.

Table 2.1: Mean monthly rainfall distribution for Ernakulam district (2003 to 2006)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
2003	0	46	72	144	142	577	551	456	60	415	95	26	2584
2004	9	2	37	65	738	640	377	482	215	539	104	0	3208
2005	52	1	8	240	118	822	873	305	489	284	188	21	3401
2006	13	0	56	45	626	576	569	595	499	466	390	20	3286

The mean monthly maximum temperature ranges from 28.1 to 31.4^{o}C and the minimum ranges from 23.2 to 26 ^{o}C. The maximum temperature occurs during March and April months and the minimum temperature occurs during December and January months. The humidity ranges from 68 to 89% during morning hours and 64 to 87% during evening hours. The maximum humidity is observed during May to October months.

The wind speed ranges from 6.7 to 10.9 km/hour with mean speed of 9.1 km/hour. The wind speed is high during the period from March to September. The PET ranges from 94.5 to 159.2 mm. The maximum PET occurs during March and minimum occurs during June. The PET is less than the rainfall from May to November indicating water surplus for recharge into ground water regime.

3.0 GEOMORPHOLOGY AND SOIL

The district can be broadly divided into three physiographical units viz. (1) the Coastal plains (low lands) (2) the mid lands and (3) the high lands. The general elevation of the coast is less than 8.0m.amsl and that of the midlands is between 8.0 and 76 m.amsl. The highlands are having the general elevation above 76 m with the maximum of around 504 m.amsl as in Malayattur Reserve forests. The entire taluks of Kochi and Parur and major parts of Kanayannur fall under the coastal plain. The municipalities of Paravur and Tripunithura the township of Kalamasseri and the corporation of Kochi are located in the coastal plains. All the other taluks except the northeastern parts of Kunnathunad taluk fall under the mid land area. The only high land belt of the district is the Malayattoor reserve forest in Koovappady block, which covers about 9% of the area of the district. The highest point is at Sulu Medu (534 m.amsl.

Pedology

On the basis of morphological features and physico-chemical properties, the soils of the district are classified as Lateritic, Hydromorphic saline, Brown hydromorphic, Riverine alluvium and Coastal alluvium.

Lateritic soil is the most predominant soil type of the district. In Muvattupuzha, Kothamangalam, Kunnathunadu and parts of Aluva taluks lateritic soil is encountered. These soils are well drained, low in organic matter and plant nutrients. The major crops grown are coconut, tapioca, rubber, areacanut, pepper, cashew and spices. Small patches of hydromorphic saline soil are encountered in the coastal tracts of the district in Kanayannur and Cochin taluk. The tidal backwaters contribute to the salinity of the soil. Coconut is grown in these soils.

Brown hydromorphic soil is the second most prevalent soil type of the district and they are encountered in valley bottoms. The soil is enriched in clay content and plant nutrients. The soil is suited for paddy cultivation.

Riverine alluvium is restricted to the banks of rivers and their tributaries. They are composed of sandy to clayey loam and are enriched in plant nutrients. It is suited for a large variety of crops like coconut, paddy arecanut, pepper, vegetables etc. In Cochin taluk and the western parts of Paravur and Aluva taluk coastal alluvium is encountered and is composed of sand and clay. Coconut is the major crop in these soils.

4. 0 GROUND WATER SCENARIO

4.1 Hydrogeology

Groundwater generally occurs under phreatic conditions in weathered and fractured crystalline rocks, laterites and unconsolidated coastal sediments. It occurs under semi-confined to confined conditions in the deep seated fractured aquifer of the crystallines rocks and Tertiary sediments. The weathered zone in the crystallines below acts as good storage for groundwater.

The hydrogeological map of Ernakulam district is shown in Figure 5. Based on nature of formation, the aquifer can be classified into hard rock aquifers and sedimentary aquifers.

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Hard Crystalline Formation

Groundwater occurs under phreatic conditions in the shallow weathered portions whereas it occurs under semi confined to confined condition in the deep-seated fractures of the crystalline formation. The hard rock formations in general lack primary porosity. The water is stored in the secondary pores developed as a consequence of weathering in fractures, fissures and joints etc. The movement of groundwater is controlled by the extent of the interconnection of the fractures.

In the shallow phreatic zone the depth of dug wells varies from 3.4 to 14.8 mbgl. The depth to water level in the wells ranges from 1.82 to 12.05 mbgl.

The Central ground water board has drilled nine exploratory wells in the hard rock areas of the district as a part of its exploration programme to explore the deeper confined aquifer. The depth of the wells ranged from 131 to 201 mbgl. Most of these wells were drilled in the Charnockitic area. The details of wells drilled in Hard rock area of the district is presented in Appendix – I. Fracture zones were encountered at depth ranging from 5 – 194 mbgl with yield ranging from 1 to 22 lps. The studies by CGWB have indicated that the wells located at intersections of lineaments are most potential. Among the lineaments the E-W, NNE – SSW and NE – SW lineaments are potential whereas the NNW – SSW are least potential lineaments. The deep fractured rock has transmissivity ranging from 15.64 to 319 m^2 /day.

Sedimentary formations

Exploratory drilling was carried out in 25 sites in sedimentary terrain. The depth of wells drilled ranged from 58 to 296 mbgl. The details of wells drilled in sedimentary area viz. the zones tapped, discharge, specific capacity, transmissivity and water quality are presented in Appendix -II **.** The sedimentary formations are confined to the coastal belt and the potential aquifers occurring at depth among are the Warkali and Vaikom beds.

Warkali Beds

The Warkali beds of the Tertiary formation are found to constitute aquifers of semi-confined to confined aquifers. In Ernakulam district, they are least extensive and are restricted to the southern coastal belt with thickness thinning out from South to north from 106.7m at chellanum in south to less than 13 m in north at Panangad. The Warkali aquifers are essentially composed of fine to medium grained sand. However in the district the formation water is found to be of brackish nature and not worth to be tapped except along certain pockets in and around Kumbalangi area. The central ground Water Board has constructed an exploratory well at Kumbalangi which is tapping the warkalai aquifer and also the Vaikom aquifer. The total dissolved constituents of the groundwater are found to be 1379 mg/l.

Vaikom Beds

The Vaikom beds are potential confined aquifers and are generally separated from the overlying potential Warkali formations by confining Quilon beds except in the northern portion of the district where the Vaikom beds are underlying the Coastal alluvium or Laterite. The Vaikom beds are composed of thick sequence of coarse to very coarse sand, gravel and pebble beds intercalated with ash, grey clay and carbonaceous clay. They extent North to South in the coastal belt with thickness increasing from 18 m at Panangad in north to 151 m at Chellanum in south. The wells tapping coarse sand and gravel aquifers of Vaikom with 6 to 14 m thick granular saturated zones have yield ranging from 1.2 to 10.1 lps and transmissivity of aquifer ranges from 193.6 to 818 m^2/day. Some of the wells were flowing wells at the time of construction.

The beds are coarse grained in nature. The quality of groundwater from these beds is brackish in nature with EC varying from 4000 to 17,300 µsiemens/cm at 25^0C. In small restricted pocket like Narakal, Subash Park, Naval base and Kumbalangi the water is fresh.

Laterite

The laterite are vastly occurring in the mid land areas of the district by weathering of the crystalline formation and also at depth in the sedimentary formation in the coastal belt. Along the coastal belt, they are discontinuous and are found to be eroded at places and generally they occur as a horizon between the Recent alluvium in top and Warkali beds or Vaikom beds below at depth ranging from 20 to 56 mbgl.

The laterites are highly porous and permeable. It is extensively developed by dug wells in the mid land area for domestic and to a limited extent for irrigation. The depth of wells in laterite ranges from 3.4 to 14.8 mbgl and depth to water level ranges from 1.55 to 11.06 mbgl. Wells located on slopes and elevated areas go dry or have very small water column during summer season. The yield of well ranges from 0.5 to 6 m^3/day and sustain pumping for 3 to 4 hrs a day.

Alluvial Formations

The alluvial formations occurring in the coastal belt are constituted by sand, silt, clay of the lagoonal and back water deposits, beach deposits and the river/flood plain deposits in mid land areas. The thickness ranges from less than 1m to 54 m at

Kandakadavu in south. It forms potential phreatic aquifer extensively developed by dug wells and filter point wells. They are tapped to meet domestic and other needs. The dug wells range in depth from 2.14 to 13 m in general and depth to water level range from 0.35 to 7.03 mbgl. The dug wells have an average yield ranging from 15 to 20 m^3/day.

Filter point wells are common wherever the average saturated thickness of alluvial sand exceeds 5 m and have depth ranging from 5 to 15 mbgl. They have yield ranging from 12 to 18 m^3/day.

Water levels

The Central Ground Water Board is maintaining a total of 70 NHS in Ernakulam district. Of these 49 are dug wells and 21 are piezometers. They are monitored 4 times a year i.e., during January, April, August and November. Water samples are collected annually during April (pre monsoon) for analysis and analysed for major elements and other parameters.

Depth to water level

The depth to water level in the district shows wide variation on account of the physiographical units in which the wells are located and undulating terrain in the mid land. Water level is shallower in western coastal part and is less than 2 mbgl in general although occasionally it is deeper at around 4 to 4.5 mbgl except for a small pocket in and around Chengamanad where it is more than 11 m.bgl. Fig. 2 and 3 shows the depth to water table of Ernakulam district for pre monsoon (April 2006) and Post monsoon (November 2006). In the eastern part of the district also it is observed that the water level is shallow and is following the riverine alluvial belt of Periyar river. In the midland region the water table is between 5 and 10 mbgl and at isolated pockets and is found to be deeper levels of more than 10 m depth.

Compared to the pre monsoon period, in the post monsoon period (November 2006) the water level has risen in general. In the coastal belt, the water level is very shallow and less than 2 mbgl through out. Besides in most areas of the districts the water level has risen and is at depth of less than 5 mbgl. However in the isolated pockets in the northwestern segment of the district it is deeper than 10 m.

Long term trend analysis in water level

The long term behaviour of water level in dug wells is mainly controlled by the rainfall recharge received and also the return seepage due to canal flow and irrigation.

The pre-monsoon water level trend reflect the trend of groundwater development, the post monsoon water level trend brings out the actual rise or fall in the area. Around 12 hydrograph stations consisting of either dug wells or piezometers were selected for the long term trend of water level. These wells are N. Parur, Elur North, Mulamthuruthy, Ramamangalam, Veliyanad, Mulamthuruthy, Ramamangalam, Kuttatukulam, N. Palakuzha (Pz), Chellanum and Puthotta. Analysis of the hydrographs show that some are showing rising trend of water level while some other are showing declining trends. Among the wells, those located in the coastal belt are having water level at shallow depth of 2 or less than that and out of North Parur, Elur north are showing rising trends while Chellanam, Puthotta, Fort Cochin are showing declining trends.

The other stations are in the mid land areas have deeper water levels. The Kodusery piezometer and Veliyanad piezometer are showing rising trend and wells at Mulamthuruthi, Ramamangalam, Kuttatukulam and North Palakuzha piezometer are showing declining trends. The hydrograph of Chalakka well is showing neither rise nor fall in water level.

4.2 GROUND WATER RESOURCES

Ground water Recharge

Rainfall is the major source of recharge to ground water in the district. The average annual rainfall of the districts is about 3400 mm of which 84% is received during the two monsoons. On average there are about 133 rainy days a year. The potential evapotranspiration is less than the average rainfall for eight months a year from April to November. Thus water surplus is available during these period for effecting recharge into ground water.

The groundwater resource of the district was computed as per the guidelines of the Ground water estimation Methodology 1997. The total annual recharge of groundwater has been computed block wise using average water level fluctuation in NHS and Specific yield of the respective aquifers. The net annual groundwater availability is 567.84 MCM. The resources available varied from block to block depending on the geographical area of the block and ranges from 8.36 to 107.66 MCM. The block wise details of total recharge and the net available recharge are presented in Table 3.

Table 3: Net Annual Ground Water Availability (MCM) as on March 2004

Sl. No	Block	Total Annual Recharge, MCM	Net Annual GW Availability, MCM	Existing gross GW draft for irrigation, MCM	Existing gross GW draft for domestic & industrial use, MCM	Existing gross groundwater draft for all uses	Stage of GW development %	Categorization for future GW development
	Alangadu	23.96	23.96	7.34	8.44	15.78	72.99	Semi critical
2	Angamaly	69.69	66.44	32.93	7.24	40.17	60.46	Critical
3	Edappali	23.41	21.10	5.57	6.26	11.83	56.04	Safe
4	Koovapdy	112.88	107.66	21.21	5.48	26.69	24.79	Semi critical
5	Kothamangalam	57.73	51.96	17.32	7.11	24.43	47.02	Safe
6	Mulamthuruthy	26.69	24.02	15.87	5.21	21.08	87.76	Semi critical
7	Moovattupuzha	46.47	41.79	14.25	5.68	19.93	47.69	Safe
8	Palluruthy	9.27	8.36	2.84	2.36	5.20	62.14	Safe
9	Pampakuda	46.09	41.66	24.90	8.36	33.26	79.84	Critical
10	Parakadavu	22.77	21.11	15.01	6.06	21.07	99.81	Critical
11	Paravoor	16.47	14.62	7.96	5.47	13.43	91.83	Semi critical
12	Vaduvacode	75.07	68.17	11.08	5.71	16.79	24.63	Safe
13	Vazhakulam	53.2	47.93	18.82	8.60	27.42	57.21	Safe
14	Vypin	24.57	22.15	4.04	7.41	11.45	51.67	Safe
15	Vytilla	10.46	9.25	2.72	2.57	5.29	57.14	Critical
Total		618.43	567.84	201.84	91.96	293.80	57.14	

The withdrawal of ground water is mainly for irrigation followed by domestic and industrial purposes. The gross draft in the district was worked out to be about 293.80 MCM of which about 201.84 MCM is for irrigation. The block wise details of draft fokr irrigation, domestic and industrial purposes are given in Table 3.

Based on the stage of development and long term groundwater trend the blocks are categorized as safe, semi critical, critical and over exploited. The categorization based on stage of development and long term water level trend is given in Table 3. Thus as on 31.03.2004, 7 blocks are categorised as safe, 3 as semi critical and 4 as critical. The long term water level trend in these blocks are showing declining trend. Two blocks namely

Koovapady and Vytilla are showing significant declining trend in water level due to which they were classified as semi-critical and critical.

4.3 Ground water Quality

Shallow aquifer

The ground water quality of the shallow aquifers of the district is generally very good. Samples collected during April 2006 from the groundwater monitoring stations are analysed. The range of chemical constituents (Major ions) is summarised in Table 4. Results of analysis is given in appendix – III.

Table 4: The range of chemical constituents

Chemical constituent	Range in concentration	
	Minimum	Maximum
EC, μ siemens / cm At 25^0C	27	9370
Total hardness, mg/l as Ca CO_3	4	1075
Ca, mg/l	1.6	144
Mg, mg/l	trace	174
Cl, mg/	5.7	3138
F, mg/l	0	0.47

The data indicates that the ground water in the phreatic aquifers of the area is very low in mineralisation and is fit for all domestic, industrial and agricultural purposes in general.

On the basis of USSL classification of groundwater, water samples from the study area have been classified into Good, Marginally saline and Saline. Majority of the samples (97.8 %) falls in the category of Good water. Marginally saline water is absent in the study area while the groundwater sample collected from Chellanum is found to be saline.

Groundwater quality in deeper aquifers

In general the quality in deeper aquifers is good in most of the hard rock areas of the district. The exploratory drilling data has revealed the quality to be good. However, it has also revealed the presence of inland salinity in some areas namely Deshom and Sree moolanagaram where the EC is found to be very high of the order of more than 17,000 micro siemens/cm at 25^0C.

In the coastal sedimentary aquifers, the quality of the water of Vaikom aquifers is saline in most part of the district except for small pockets like Narakal and Kumbalangi where it is fresh. The EC is found to range between 4000 micro siemens/cm to 17,300 micro siemens/cm at 25^0C. The Warkalai aquifer is completely saline in the district.

Table 5: The range of chemical constituents

Chemical constituent	Range in concentration	
	Minimum	Maximum
EC, µ siemens / cm At 25^0C	27	9370
TDS		
Cl, mg/	5.7	3138
F, mg/l	0	0.47

5.0 GROUND WATER DEVELOPMENT AND MANAGEMENT

Ground water Development

In the district groundwater is developed for irrigation mainly by marginal farmers from wells used for both domestic and irrigation. The crops irrigated are chiefly coconut, plantain and vegetables. Groundwater is also developed for water supply schemes in rural areas by and to a limited extent in urban areas.

Though groundwater development for the district is observed to be only about 52 %, the groundwater development for four blocks viz. Parakadavu, Parur, Pampakuda and Mulanthuruthy are having a higher stage of development of above 75%. Besides the above, some blocks like Alangadu, Angamali, Koovapaddi and Vytilla whose stage of development is even though at lesser rate, the water level are showing declining trend. Hence in these blocks, further development of ground water should be done with caution and suitable conservation methods are to be resorted.

In crystalline aquifers dug wells can be constructed wherever sufficient weathered thickness of the saturated zone is available. Existing low yielding wells can be revitalized by deepening such wells to tap the entire thickness of weathered zone. Dug wells located along lineaments and fracture directions can be revitalized by converting them into dug cum bore wells. Bore-wells are feasible in crystalline areas tapping deep fractures and are site specific.

Tube wells are feasible in coastal belt in freshwater pockets of Vaikom aquifer. Tube wells may be constructed tapping 15 to 20 m of aquifer material with slot size of 3.1 mm and gravel pack. In the Laterite terrain dug wells and dug cum bore wells are feasible with depth of 10 to 16 m and diameter of 2 to 4 m and in the valley areas dug wells of 6 to 8 m depth and 1.5 to 3.0 m diameter are feasible.

In the coastal alluvium dug-wells with depth of 4 to 7 m and diameter 1.5 to 2.0 m and filter point wells wherever saturated thickness of 5 m or more are feasible

6.0 GROUND WATER RELATED ISSUES AND PROBLEMS

Vulnerable areas

Even though the district is receiving very good rainfall of about 3400 mm annually it is paradoxical that acute water scarcity is felt in certain areas. The Vypin Island along the coastal parts of the district is one such area where the water scarcity is very acute during summer months. The vypin block with an area of km is highly populated with total population of 197624 persons. Similar water scarcity is recorded all along the coastal parts of the district down to Chellanam. The major problem here is the limited top sand layer and at places its hydraulic continuity with tidal backwater rendering it saline during summer months. In the southern parts of the district, in the top layer sand, the quality is brackish. In these areas, rainwater harvesting with modification of the aquifer will help to improve the aquifer condition and its water quality.

In the midland areas of the district as in Mulanthuruthy, Pampakuda, Kothamangalam blocks, the dug wells dry up in summer, as the zone of weathering is very limited and the topography is sloping. In these areas to check the subsurface out flow of ground water, subsurface dams can be constructed to improve the recharge of water.

Other problems

The district being the industrial capital, the problems related to industry was studied. It is observed that the pollution due to industrial effluents is not on an alarming scale. It is mainly restricted to surface water. The pollution studies conducted by CGWB indicate that the ground water pollution is highly localized with in 80m of the dumpage of industrial waste.

Water Conservation and Artificial recharge

The district is having ideal site for implementing ground water conservation structures and rainwater harvesting structures. The subsurface dam constructed at Odakkali in the premises of Aromatic and Medicinal Plant Research Station of the Kerala Agricultural University has improved the ground water conditions of the area and it ensures sustain water for irrigation for the farm area of the university. The structure was constructed during 1988 with a cost of Rs. 1.67 lakhs. The length of the dam is 80 m and the depth is about 6m.

Similar structures can be constructed along the narrow valleys of the district. In addition to this, gully plugging and check dams will also be of great use in improving the groundwater resources of the district. In the coastal area, roof top rainwater harvesting is to be given a thrust. The artificial recharge schemes recommended for different blocks are given in Fig.6.

7.0 AWARENESS AND TRAINING ACTIVITY

The central ground water board has carried out mass awareness programme and water management training programmes in the district. Mass awareness programme was conducted in Ernakulam district during the year 2002 at Ernakulam. Water management training programme was conducted in Ernakulam district during the year 2005 at Ernakulam.

8.0 AREAS NOTIFIED BY CGWA/SGWA

In the district no blocks are over-exploited and therefore there are no areas notified.

9.0 RECOMMENDATIONS

The stage of ground water development in the district is 57.14 % leaving scope for future development of ground water in the district except in the critical blocks and semi-critical blocks where groundwater development may be on a cautious scale.

In the coastal blocks of the district particularly the Vypin Island where acute water scarcity is felt during summer months, rain water harvesting techniques can be carried out to solve the water problem. Tube wells are feasible in the coastal blocks where fresh water pockets have been demarcated in the deeper confined aquifer such as at Narakal and Kumbalangi. Tube wells may be constructed tapping 15 to 20m thickness aquifer with slot size of 3.1 mm and gravel pack.

The mid land areas are covered by Laterite formations and the ground water can be developed in these areas by dug wells and dug cum bore wells. The dug wells located in elevated areas/slope tend to dry up in summer. The porous nature of laterite tends to this. These areas can be developed by construction of large diameter dug wells in the valleys and dug cum bore wells in elevated areas. The sub surface dam constructed at Odakalli, in the premises of Aromatic and Medicinal plant Research station of KAV has improved the ground water conditions of area and sustain water for irrigation. In Mulanthuruthy, Pampakada and Kothamangalam blocks sub surface dams can be constructed in suitable locations for artificial recharge and improve the recharge.

In the eastern blocks with elevated hills and narrow valleys, gully plugging and contour bunding, check dam etc can be practiced to improve the recharge condition.

The ground water development may be done on water shed basis for better water management also in conjunctive with surface water management. Mass Awareness Programme can be organized to make the public aware of the importance of adopting water conservation techniques.

Fig.No.1

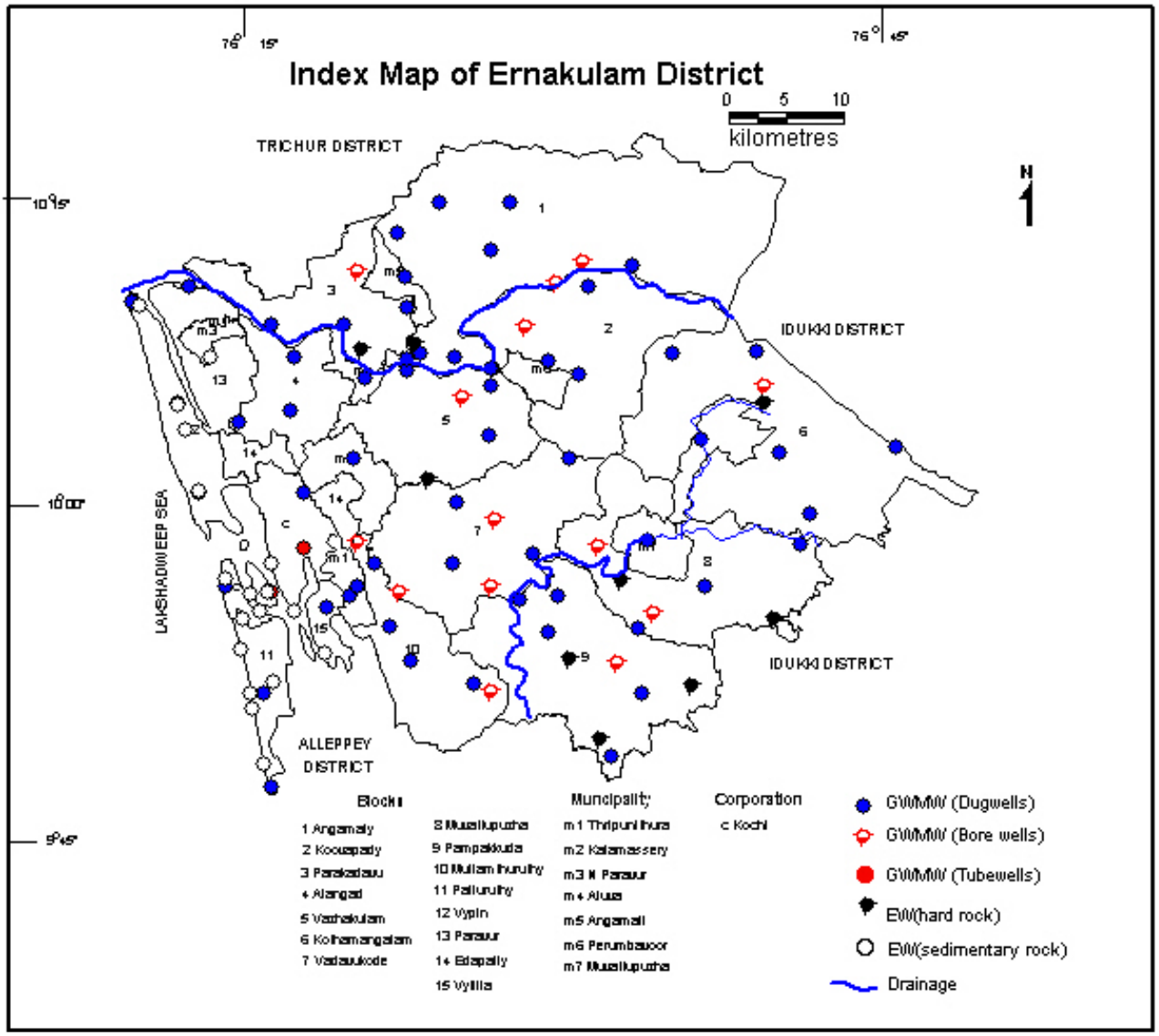

Index Map of Ernakulam District
0 5 10
kilometres
N
TRICHUR DISTRICT
IDUKKI DISTRICT
IDUKKI DISTRICT
ALLEPPEY DISTRICT
LAKSHADWEEP SEA
Block
1 Angamaly
2 Koovappady
3 Parakadavu
4 Alangad
5 Vazhakulam
6 Kothamangalam
7 Vadavukode
8 Muvattupuzha
9 Pampakkuda
10 Mullam thuruthy
11 Paliyuruthy
12 Vypin
13 Paravur
14 Edapally
15 Vyttila
Municipality
m1 Thripunithura
m2 Kalamassery
m3 N Paravur
m4 Aluva
m5 Angamali
m6 Perumbavoor
m7 Muvattupuzha
Corporation
c Kochi
G\W/M/W (Dugwells)
G\W/M/W (Bore wells)
G\W/M/W (Tubewells)
E\W(hard rock)
E\W(sedimentary rock)
Drainage

Fig.No.2

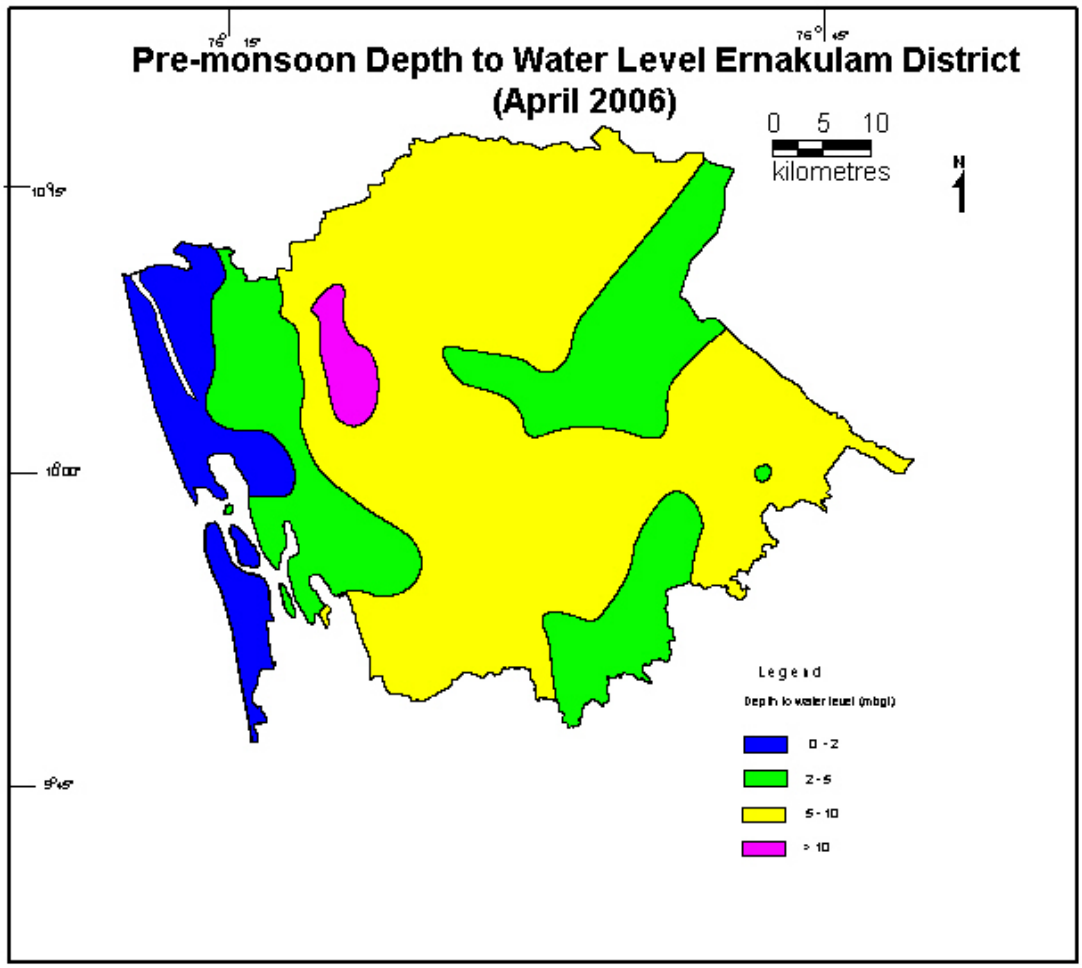

Pre-monsoon Depth to Water Level Ernakulam District
(April 2006)
0 5 10
kilometres
N
Legend
Depth to water level (mbgl)
0 - 2
2 - 5
5 - 10
> 10

Fig.No.3

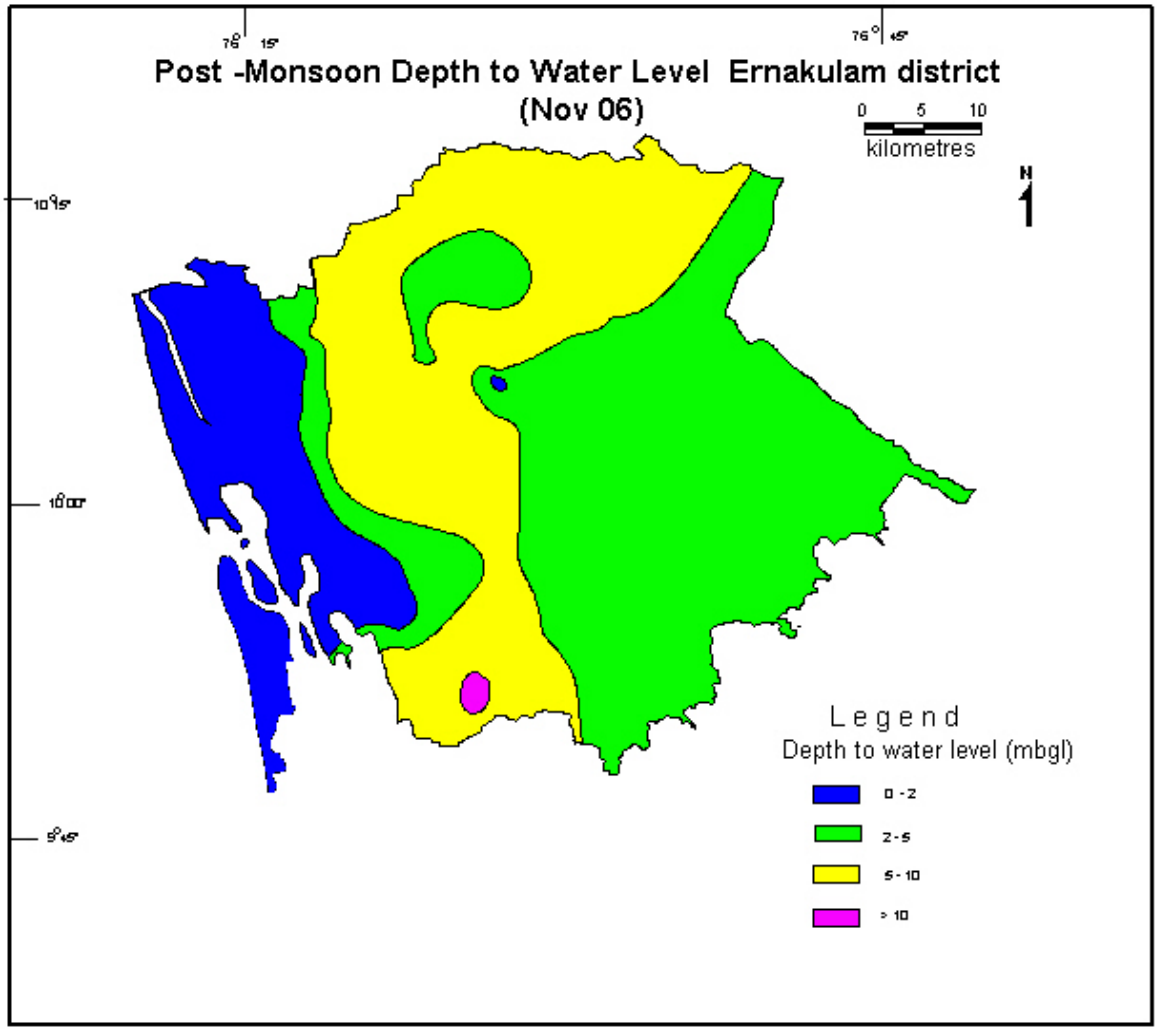

Post -Monsoon Depth to Water Level Ernakulam district
(Nov 06)
0 5 10
kilometres
N
76° 15'
76° 45'
10° 15'
10° 00'
9° 45'
Legend
Depth to water level (mbgl)
0 - 2
2 - 5
5 - 10
> 10

Fig. No.4

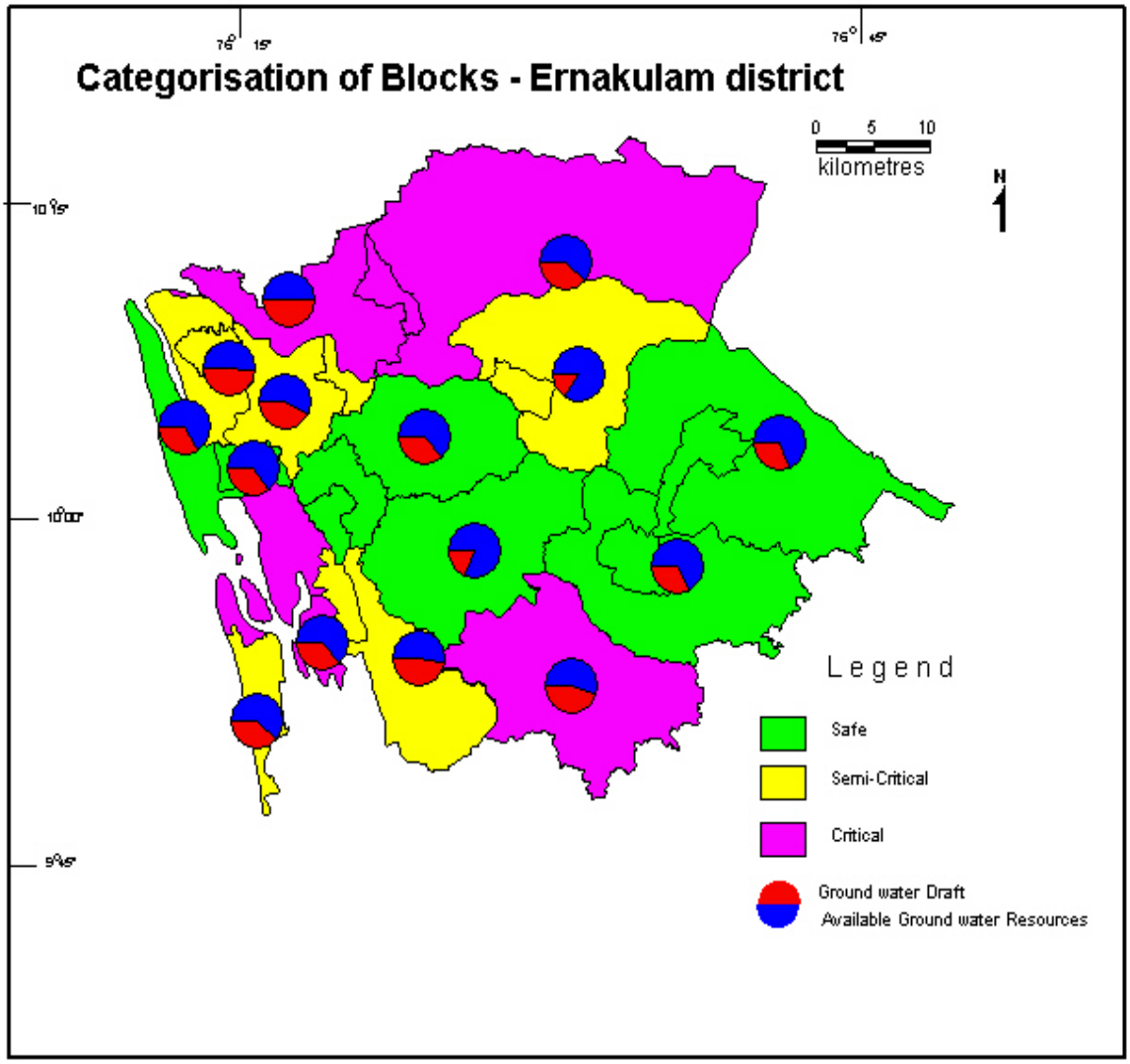
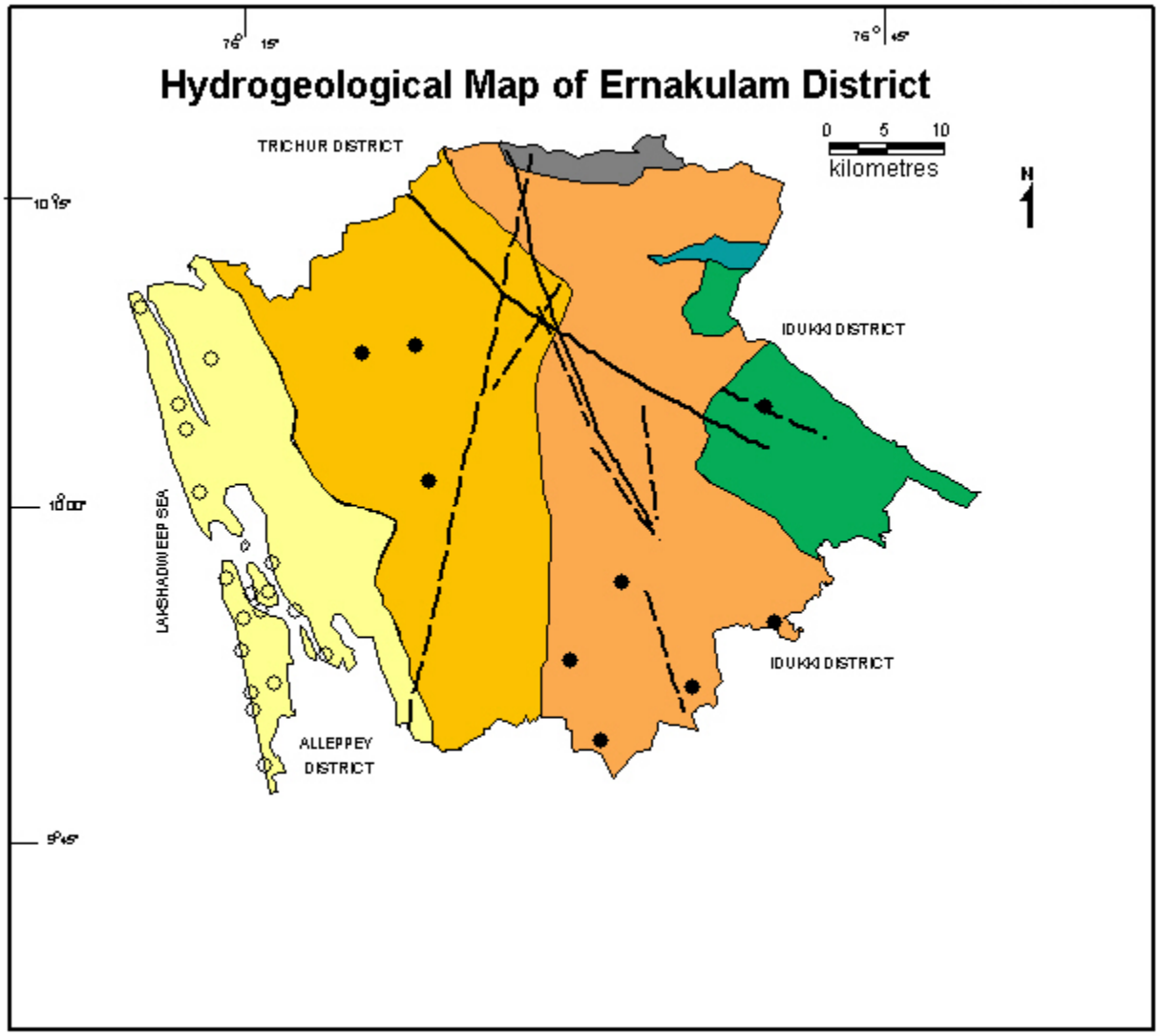

Categorisation of Blocks - Ernakulam district
76° 15'
76° 45'
10°15'
10°00'
9°45'
0 5 10
kilometres
N
Legend
Safe
Semi-Critical
Critical
Ground water Draft
Available Ground water Resources

Fig. No.5


Hydrogeological Map of Ernakulam District
TRICHUR DISTRICT
IDUKKI DISTRICT
IDUKKI DISTRICT
LAKSHADWEEP SEA
ALLEPPEY
DISTRICT
0 5 10
kilometres
N

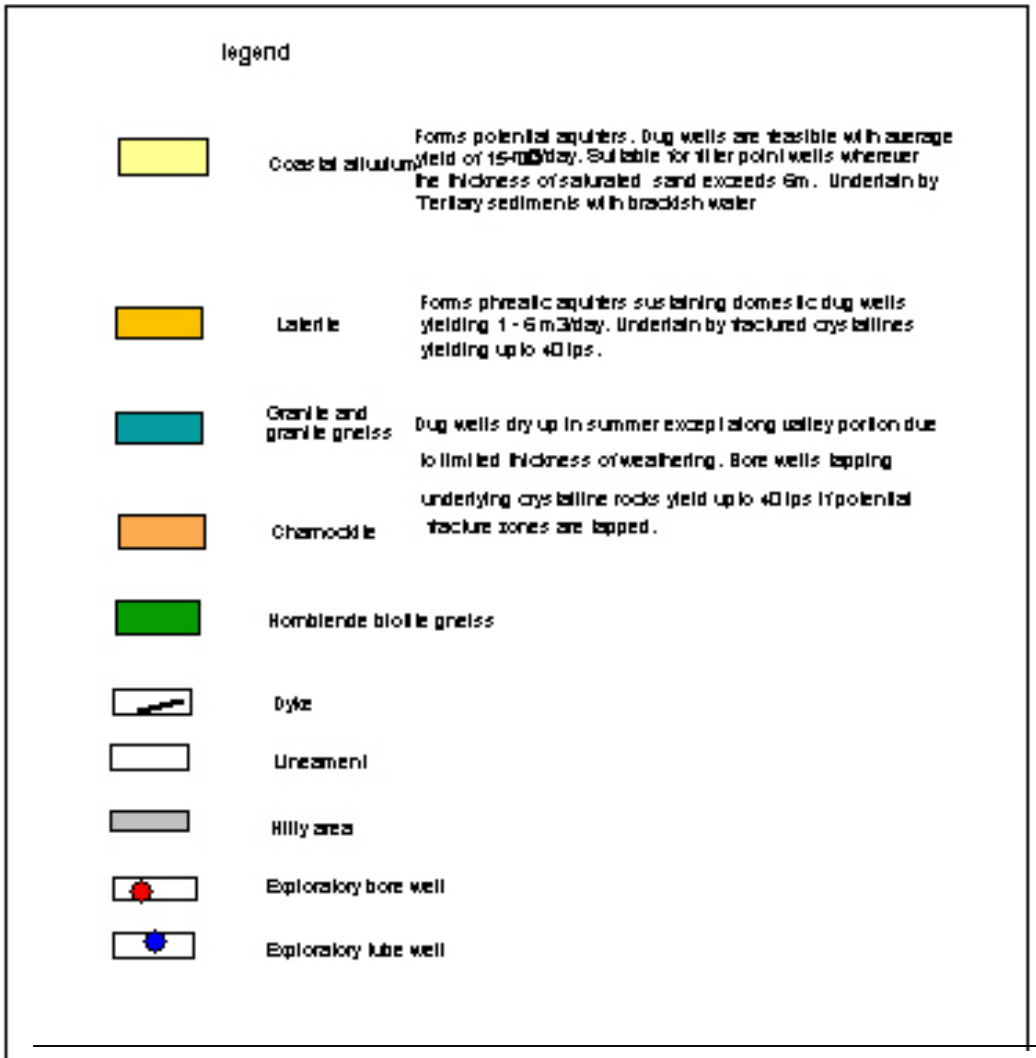
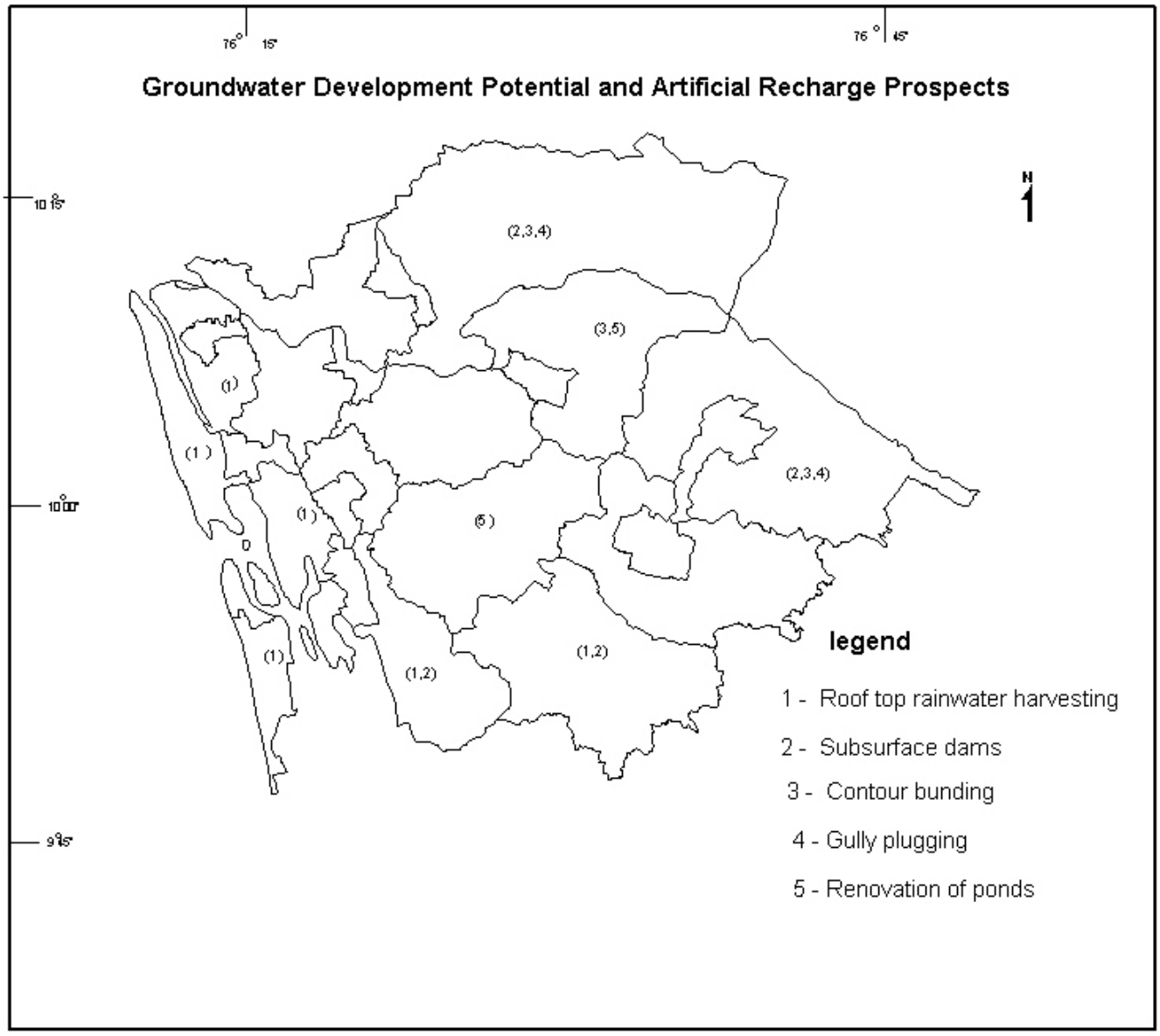

legend
Coastal alluvium
Forms potential aquifers. Dug wells are feasible with average yield of 15-m3/day. Suitable for filter point wells wherever the thickness of saturated sand exceeds 6m. Underlain by Tertiary sediments with brackish water
Laterite
Forms phreatic aquifers sustaining domestic dug wells yielding 1 - 6 m3/day. Underlain by fractured crystallines yielding up to 40 lps.
Granite and granite gneiss
Dug wells dry up in summer except along valley portion due to limited thickness of weathering. Bore wells tapping
Charnockite
underlying crystalline rocks yield up to 40 lps if potential fracture zones are tapped.
Hornblende biotite gneiss
Dyke
Lineament
Hilly area
Exploratory bore well
Exploratory tube well

Fig No 6


76° 15'
76° 45'
Groundwater Development Potential and Artificial Recharge Prospects
10° 15'
10° 00'
9° 45'
N
1
(2,3,4)
(3,5)
(1)
(1)
(1)
(1)
(5)
(2,3,4)
(1)
(1,2)
(1,2)
legend
1 - Roof top rainwater harvesting
2 - Subsurface dams
3 - Contour bunding
4 - Gully plugging
5 - Renovation of ponds

Appendix – I

Details of wells drilled in Hard rock area, Ernakulam District, Kerala

Well No. EKH	Location, coordinates & toposheet No.	Lineament Direction	Depth drilled/ SWL mbgl	Depth of casing mbgl	Fracture zones with yield lpm	Discharge lpm during drilling recommended	T m^2/day	EC micromhos/cm at 25^0C
1	Ilanji, $9^0$49'45", $76^0$32'30", 58 C/9	NW-SE	200.53, 0.8	6.6	27-35.0/260. 111.0 – 114/456	456, 906	319	290
2	Kozhipalli, $9^0$52'15", $76^0$36'50", 58 C/9	NW-SE	187.79, 2.12	4.25	12.03/260, 65/490, 145.0/610	600, 1158	35.9 $9.8*10^{-4}$	290
3	Onakkur, $9^0$53'30", $76^0$31'00", 58 C/9	Nil	20.53, 2.95	9.10	Nil	Nil	NA	NA
4	Kadalikad, $9^0$55'20", $76^0$40'45", 58 C/9	NE-SW	200.53, 1.20	6.46	15.6/180, 38/240, 95/600	600, 1002	69.3, $2.8*10^{-2}$	260

Details of wells drilled in Sedimentary area, Ernakulam District, Kerala

Well No. EKS	Location	Year of construction	Location, coordinates	RL m amsl	Depth drilled (mbgl)	Depth constructed m bgl	Zones tapped	Discharge lps	Static Water Level in mbgl	SP capacity lpm/m	T m²/
1	Chellanum	1973	9⁰48'40", 76⁰16'40"	0.63	295.6	Nil	149.6-175.4	NA		NA	N
2	Kandanakadavu	1973	9⁰51'15", 76⁰16'00"	0.76	240.8	186.8	177.4-185.1(Upper zone brackish)	10.1		59	8
3	Kumbalangi	1973	9⁰52'30", 76⁰17'00"	2.178	150.8	110.76	70.1-71.9, 90.2-94.8,100.6-104.8,106.7-109.0	8.5		89.5	1
4	Panangad	1984	9⁰53'50", 76⁰19'25"	2.4	69.2	60	29-38, 50-58.0(Vaikom)	6		174.5	19
5	Wellington Island	1998	9⁰56'40", 76⁰16'00"	1.79	116.5	105	97-103	1.2		NA	N
6	Vaittila	1999	9⁰58'00", 76⁰18'10"	2.645	54.66	58	42-45	2.5		NA	N
7	Narakkal	1990	10⁰02'45", 76⁰12'57"	0.947	118.15	101	93-99.5	7.33		NA	N
8	Nayarambalam	1990	10⁰04'20", 76⁰12'47"	1.512	106.5	70	53-61 (Vaikom)	NA		NA	N
9	Cherai	1989	10⁰08'33", 76⁰11'31"	0.863	102.4	Nil	48-54,68-74	NA		NA	N
Well No. EKS	**Location**	**Year of construction**	**Location, coordinates**	**RL m amsl**	**Depth drilled (mbgl)**	**Depth constructed m bgl**	**Zones tapped**	**Discharge lps**	**Static Water Level in mbgl**	**SP capacity lpm/m**	**T m²/**
10	Palluruthy-EW-I	1999-00	9⁰55'50",		146.25	100	95.5-96.5	3.34	2.16		4.

			76^{0}16’20”								
11	Palluruty-EW-II	1999-00	9^{0}55’50”, 76^{0}16’20”		146.25	143	122.5-140.5	3.34	1.02		16
12	Malipuram-I	1999-00	10^{0}01’28”, 76^{0}13’30”		174	121	109-118	3.14	0.7		16
13	Malipuram-II	1999-00	10^{0}01’28”, 76^{0}13’30”		173.67	170	146-167	3	0.7		10
14	Palliport –I	1999-00	10^{0}10’05”, 76^{0}10’40”		103.5	91	82-86	2.9	0.7		
15	Paliport-II	1999-00	10^{0}10’05”, 76^{0}10’40”		31	30	24-27	0.481	1.16		
16	Edavanakkad	2000-01	10^{0}05’30”, 76^{0}12’30”		116.5	106	97.0-103.0	4.4	1.4		
17	Kaitharam	2000-01	10^{0}07’40”, 76^{0}14’00”		53	51	46.0-49.0	2.11	1.7		
18	Wellingdon Port Trust qtrs	2000-01	9^{0}56’45”, 76^{0}16’45”		133.5	105	96.0-102.0	3.14	1.7		
19	Subash Park	2000-01	9^{0}58’03”, 76^{0}16’55”		100	96	81.0-84.0, 90.0-93	3.14	1.7		
20	Thevara	2000-01	9^{0}56’07”, 76^{0}18’02”		127	99	85.0-97.0	3.7	5.5		28
21	Kannamali-EW1	2001-02	9^{0}52’00”, 76^{0}16’00”		222	199	181.0-196.0	1.22	0.6		
22	Kannamali-EW2	2001-02	9^{0}52’00”, 76^{0}15’55”		100	100	85.0-97.0	3.7	5.82		
23	Mundanveli	2001-02	9^{0}55’30”, 76^{0}15’30”		207	122	109.0-118.0	3.1	0.79		8
24	INS Dhronacharya Fort Kochi	2001-02	9^{0}57’00”, 76^{0}14’45”		198	181	166.0-178.0				
25	Fort Kochi - Veli	2002-03	9^{0}57’20”, 76^{0}14’45”		186						