CONSERVE WATER – SAVE LIFE

MINISTRY OF WATER RESOURCES

CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION BOOKLET OF THRISSUR DISTRICT, KERALA STATE

By

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CONTENTS

DISTRICT AT A GLANCE

Sl No.	ITEMS	STATISTICS
1.	**GENERAL INFORMATION**	
	i) Geographical area (Sq km)	3032
	ii) Administrative Divisions (As on 31-03-2007) Number of Tehsils/Blocks Number of Panchayats	 05 / 17 97
2.	**GEOMORPHOLOGY**	
	Major physiographic units	Low land , Mid land and High land
	Major Drainages	Parts of Ponnani basin, Keecheri & Karuvannur basins (Kole lands) and parts of Chalakudy basins.
3.	**LAND USE (Sq km)**	
	a) Forest area :	1036.19
	b) Net area sown :	1537.41
	c) Cultivable area /Total cropped area	1931.87
4.	**MAJOR SOIL TYPES**	Laterite, Brown hydromorphic, River alluvium coastal soil and Forest Loam
5.	**AREA UNDER PRINCIPAL CROPS (Sq Km)**	 621.00 862.06 124.93 66.37
6.	**IRRIGATION BY DIFFERENT SOURCES (Areas (Sq.km)**	
	Wells (Dug wells / Tube wells & Bore wells)	179.79
	Tanks / Ponds	135.19
	Canals	230.31
	Other Sources	185.57
	Net Irrigated area	783.50
	Gross Irrigated area	
7.	**NUMBER OF GROUNDWATER MONITORING WELLS OF CGWB (AS ON 31-3-2007)** No. of Dug wells No. of Piezometers	 50 16

8	**PREDOMINANT GEOLOGICAL FORMATIONS**	Archaean Crystalline formation (Gneiss, Schist Charnockite), Tertiary formation, Sub-Recent laterite and Recent riverine Alluvium.
9.	**HYDROGEOLOGY** Major Water bearing formation	Weathered and fractured crystalline formations, semi consolidated Tertiary formations, laterites and Recent alluvium.
	Depth to water level (Pre-monsoon April 2006) , mbgl	1.40 to12.90
	Depth to water level (Post-monsoon Nov. 2006) ,mbgl	0.59 to10.86
	Long term water level trend in 10 years(1997-2006) in m/yr	
	Premonsoon Rise	0.0028 to 0.2025
	Fall	0.002 to 0.3683
	Postmonsoon Rise	0.0079 to 0.2352
	Fall	0.0016 to 0.4975
10.	**GROUND WATER EXPLORATION BY CGWB (As on 31-03-2007)**	
	No. of wells drilled (EW, OW, PZ, SH, Total)	EW –26, PZ-16 SH – Nil. Total –42.
	Depth Range (m)	35-301
	Discharge (litres per second)	0.50 –24.50
	Storativity(S)	1.18×10^{-2} - 8.90×10^{-3}
	Transmissivity (m^2/day)	22-288
11.	**GROUND WATER QUALITY**	
	Presence of chemical constituents more than permissible limits	Quality is good. Major chemical parameters are within the permissible limits.
	DYNAMIC GROUNDWATER RESOURCES (2004) – in MCM	
	Annual Replenishable Ground Water Resources	702.80
	Net Annual Groundwater Draft	326.44
	Projected demand for Domestic and Industrial Uses up to 2025 /2029	132.93
	Stage of Ground Water Development, %	46.45
12.	**AWARENESS AND TRAINING ACTIVITY** Mass Awareness Programmes organized Date Place No. of Participants Date Place No. of Participants	1) February 09, 2001 Guruvayur 200 2)February 2002 Kodungallur 300

	Water Management Training Programmes organized Date Place No. of Participants	Nil
13.	**EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING**	Nil
	Projects completed by CGWB (No & Amount spent)	
	Projects under technical guidance of CGWB (Numbers)	Nil
14.	**GROUND WATER CONTROL AND REGULATION**	
	Number of Over Exploited blocks	One
	Number of Critical blocks	Nil
	Number of blocks notified	one
15.	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	No severe problems noticed.

GROUND WATER INFORMATION BOOKLET OF THRISSUR DISTRICT, KERALA STATE

1.0 INTRODUCTION

Thrissur is one of the important historical city of Kerala which is known as the cultural capital of Kerala. The district has an area of 3032 sq.km and is located in the central part of the State.

1.1 Administration

Thrissur district lies between North latitudes 10^0 10' 22'' and 10^0 46' 54''; and East longitudes 75^0 57' 20'' and 76^0 54' 23'', in the Survey of India Topo sheet No. 58 B and 49 N. It is bound on the north by Malappuram district, on the northeast by Palakkad district and on the south by Ernakulam and Idukki districts, touching western part of Tamil Nadu at east and Lakshadweep Sea on the west. Thrissur district accounts for 7.8% of the area of the state.

The district has five taluks viz. Chavakkad, Talappilli, Thrissur, Kodungallur and Mukundapuram which comprises 17 blocks spread over a total of 97 panchayaths and 7 municipalities Fig. 1. Thrissur, the district Headquarters of the district is accessible from any part of the state by road and rail. The NH-47 connecting Kanyakumari-Salem passes through Thrissur. The coastal National Highway 17 passes through the western fringe of the area connecting Ernakulam to Mangalore. The major towns of the districts are connected by good network of roads. The Trivandrum-Mangalore broad gauge line passes through the district via Thrissur. In the western part of the district where lagoons and back water channels are prominent, country crafts and boats serve as useful means of communication cutting short the distance through roads.

The population of the district is 2975440 as per 2001 census and the male population is 1422047 while female is contributing 1553393. The decadal growth of the population is as per 1981-1991 is 12 % where as 8.7 % during 1991-2001. The density of the population is 903 in 1991 and 981 during the 2001 census.

1.2 Drainage and Irrigation practices

Thrissur district comprises three river basins viz. parts of Ponnani basin, Keecheri & Karuvannur basins (Kole lands) and parts of Chalakudy basins. The areas covered by each of

these basins are 510, 1691 and 830 sq.km respectively. The Kole lands are below sea level and are affected by tidal action. The over all drainage patterns of the rivers are controlled by the deformation structures in the basement rocks. The drainage pattern of the rivers are 'trellis' and 'sub trellis' type in the upper reaches and dendritic in coastal plain.

Two major irrigation projects in the district are Peechi and Vazhani. The Peechi project constructed across the Manali River where as the Vazhani dam constructed across the Keecheri River at Vazhani. These projects operating and supplying water for irrigation from August to December in every year. Another major irrigation project is Right canal system of Chalakudy diversion constructed across the Chalakudy River, which is irrigating southern part of district.

The minor irrigation projects like gravity flow (diverting water Form River through weirs) and lift irrigation (Lifting water from rivers) also is being practiced in this district. The irrigation by using ground water is common in valleys and topographically low land. The bore wells constructed along the fracture and lineaments are yielding good amount of water for irrigation. In costal and rural areas the people still depend on local ponds and tanks for irrigation purposes.

1.3 Works carried out by CGWB

The number of scientific studies has been carried out by different organization during the past years. Systematic hydrogeological surveys have been carried our by the Scientists of Central Ground Water Board, Kerala State. During the field season 1978-79, 79-80 and 80-81, Shri P. Lakshminarayanan carried out studies in the Peechi Canal Command area. During 1981-82 in Mukundapuram Taluk and Chalakudy Basin. Shri S.V.N.S. Rao carried out systematic surveys in 1978-79 in Thalappilli Taluk. Detailed work was done by the SIDA assisted coastal Kerala Ground Water Project (1983-88) of Central Ground Water Board in Thrissur district along with special studies in the Kole land basins and exploration in the hard rock areas during the period. Reappraisal hydrogeological survey was carried out by Shri A. Subburaj during the period 1995-96 and by Shri K. Balakrishnanduring the year 1999-2000.The ground water management studies were carried out by Dr S. Sakthi murugan in AAP 2006-2007.

2.0 RAINFALL & CLIMATE

The rainfall occurs more during southwest monsoon season during June to September and followed by northeast monsoon season during October to December. The average annual rainfall ranges between 2180.0 and 3484.0 mm in the district and mean annual rainfall for the district is 2924.4 mm. In general the rainfall increases from south to north and west to east. The highest rainfall of 3484.0 mm is recorded at Kunnamkulam and the lowest rainfall of 2182.0 mm is recorded at Vazhani. The decadal rainfall of Mupli raingauage station presented in Table 1 and shown in Fig. 2.

Seasonal distribution

The area is characterised by wet type of climate and four types of seasons are identified. The hot summer season from March to May, the southwest monsoon season from June to September, the northeast monsoon season from October to December and a general cool and salubrious climate period during climate period during January and February.

The maximum rainfall occurs during the period June to September (SW monsoon) and nearly 73.7% of the total rainfall is received during the season. 16.8% of the total rainfall is received during North East monsoon between October and December, 9.0% of the total rainfall is received during March to May and the balance 0.5% is accounted for during January and February months.

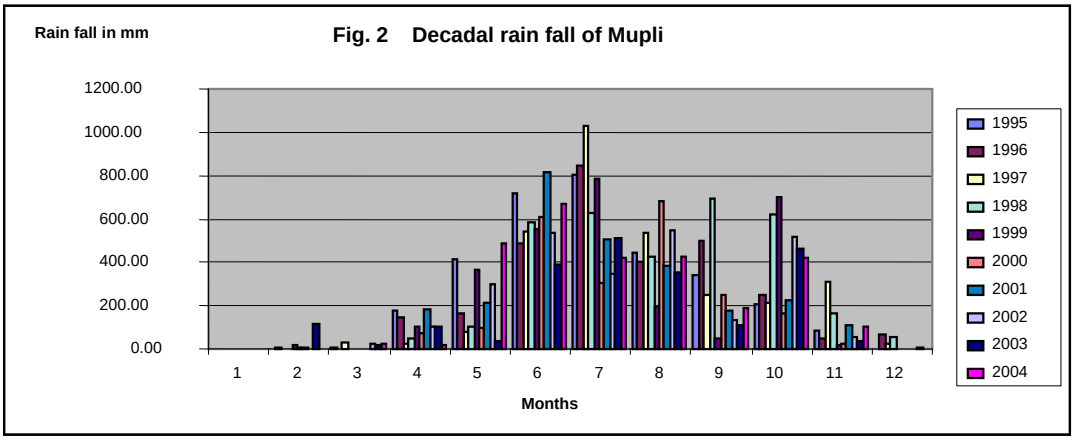
Variability of rainfall

The year to year variability of annual rainfall is around 22%. In general it varies from 18.6 to 24.0%. The highest coefficient of variation is for Wadakanchery and the lowest is for Trichur. In the district the highest rainfall of 4826.9 mm is recorded in the year 1961 at Irinjalakuda and the lowest rainfall of 883.1 mm is recorded at Wadakancherry in the year 1924.

Table 1. Decadal rain fall data of Mupli rain gauge station.

Year	Jan.	Feb.	March	April	May	June	July	August	Sep.	Oct.	Nov.	Dec.
1995	0.00	0.00	8.50	175.60	412.00	717.20	804.40	441.71	339.60	205.00	84.00	0.00
1996	0.00	5.30	0.00	143.70	162.30	484.80	845.40	402.40	499.00	251.20	48.00	68.10
1997	0.00	0.00	32.90	27.00	78.20	545.10	1030.8	534.50	248.40	214.00	310.60	27.40
1998	0.00	0.00	0.00	49.00	100.70	583.40	626.40	426.00	696.20	622.50	165.80	51.90
1999	0.00	20.20	0.00	101.10	366.60	551.90	784.80	194.30	50.00	698.40	19.00	0.00
2000	0.00	7.00	0.00	72.40	99.90	609.70	304.20	681.70	249.50	165.60	26.90	0.38
2001	0.00	4.26	0.00	183.80	211.30	816.60	503.90	383.20	176.85	224.48	107.20	0.00
2002	0.00	0.00	23.00	105.60	295.70	538.70	348.20	548.40	131.80	520.10	55.40	0.00
2003	0.00	118.20	17.50	101.80	37.00	390.20	511.90	353.70	109.20	463.30	34.40	5.80
2004	0.00	0.00	21.80	18.90	488.50	668.30	419.40	427.40	188.20	418.20	103.20	0.00

Figure 2 Decadal rainfall of Mupli



Meteorological Parameters

Temperature

The maximum temperature ranges from 29.3 to 36.2^{0}C where as the minimum temperature ranges from 22.1 to 24.9^{0}C. The average annual maximum temperature is 32.30^{0}C and the average annual minimum temperature is 23.3^{0}C. Generally March and April months are the hottest and November, December, January and February months are the coldest.

Relative Humidity

The humidity is higher during monsoon months from June to October and is around 93% during morning hours and 76% during evening hours.

Wind Velocity

The wind speed is more during December and January months and it is less during October.

Evaporation

It is high during the months of December to April because of more bright sunshine hours and less number of rainy days. It is less during the monsoon months from June to October. The maximum rate of 7.4 mm/day is recorded in the month of January and the minimum rate of 2.9 mm/day is recorded in the month of July.

Potential evapo-transpiration

The annual PET for Vellanikara is 1776.3 mm-based on Thornthwaite's method.

Aridity index

The ratio of potential evaportranspiration to rainfall is known as aridity index and it is around 0.6 for Vellanikara.

3.0 GEOMORPHOLOGY AND SOIL TYPES

There are three well marked geomorphological features are seen in this district i) Coastal plain ii) Mid lands and iii) High lands.

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The coastal plain

The coastal plain with an average width of 7 km have elevation ranging from 1m below mean sea level to as much as 7.6 m above mean sea level. This coastal belts consists of number of beach ridges.

The kole land, which has elevations in the range of 1-2 m below, mean sea level and water logged for 5-6 months in a year due to tidal effects.

The Midland

Two geomorphic zones mark the midland region. These are the flat-topped landform covered by a thick blanket of laterite, which is immediately to the east of coastal plain and rises up to 20 m above mean sea level. The laterite is quite thick and in some places attains thickness up to 25 m. The mounds occur all along the midland portion, occasionally rising to 70 m above mean sea level. The second geomorphic zone is represented by infilled valleys, which occur between lateritic mounts and varying in length from 100m to 3.5 km comprising alluvial sediments and are intensively cultivated and get flooded during the monsoon periods.

The High lands

The hill ranges along the eastern part constitute the rugged terrains of Western Ghats. Pappattaparamudi (elevation 1160 m amsl) and Mangattukumban are the high peaks in the area. The eastern high lands exhibit a typical topography with a steep hills dissected by deep 'V' shaped valleys drained by youthful rivers.

Soil Characteristics

The soils in Thrissur district have been classified in the following types, based on the morphological features and physiochemical properties.

The laterite Soil

The predominant soil type observed is the lateritic soil, which covers almost the entire midland areas of the district. These soils are in general well drained, low in essential plant nutrients and organic matter. They exhibit very low cation exchange capacity and are generally acidic.

Brown hydromorphic soils

The second prominent soil type is the 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 have been formed as a result of transportation and sedimentations of materials from adjoining hill slopes and also by deposition from rivers. The soils are very deep and brownish in colour. The surface texture varies from sandy loam to clay.

Hydromorphic Saline Soils

Very small patches of hydromorphic saline soils are found in the coastal tracts of the district. They are brownish, deep and imperfectly drained, showing wide variation in texture. In the estuarine areas of the district, these soils are found with wide fluctuations in the intensity of salinity.

Coastal Alluvium

These soils are seen on the coastal tracts stretching from Kodungallur to Chettuvai. These have been developed from recent marine deposits with a texture dominated by partially sorted sand fraction. They are excessively drained with very rapid permeability. Water holding capacity of these soils is low.

Riverine Alluvium

These soils consist of moderately well drained and distributed mainly on the banks of rivers and their tributaries. They are light to medium textured with good physical properties and contain organic matter, nitrogen and potash moderately. They show wide variations in

their physico chemical properties. They are very deep soils with surface texture ranging from sandy loam to clayey loam, predominated by the fine sand fractions.

Forest Loamy Soil

These soils are found in the southeastern hilly areas of the district, bordering Tamil Nadu. These are characterized by a surface layer very rich in organic matter. They are dark reddish brown to black with loam to silty loam texture. The soils are generally acidic.

4.0 GROUND WATER SCENARIO

Groundwater occurs under water table conditions in alluvium, laterites and weathered mantle of the crystalline, where as in the deeper fractured crystalline the groundwater occurs under semi confined to confined conditions.

4.1 Hydrogeology

The aquifer system in the district can be broadly divided into hard rock aquifers, the laterite aquifers and sedimentary aquifers. The hard rock and laterite aquifers constitute major aquifer system of the district while the sedimentary aquifers are seen along the coast and river courses. Groundwater occurs under phreatic, semi confined to confined conditions in the weathered and fractured portions of the crystalline formations and occurs semi-confined and confined condition in deep seated fractured and sedimentary formations. The hydrogeology map of Thrissur district presented in Fig. No.3

Hard Rock Aquifers

Along the weathered portion, the groundwater occurs under water table conditions and mainly controlled by geologic and geomorphic features. The weathered rocks form potential aquifers and the thickness of weathered portion ranges from 4.5 m to 21.0 meters. The depth to water level in the wells during pre monsoon period varies from 1.40 to 12.90 mbgl and during post monsoon period 0.59 to 10.89 mbgl. The shallow aquifer in these formations is developed by open dug wells and shallow bore wells. The design of dug wells in consolidated crystalline are 4m dia. and 12 m depth and shallow bore wells can be drilled up to a depth of 50 mbgl.

Groundwater occurs under semi confined to confined conditions in the fractured portions of the crystalline rocks. The studies carried out in the district indicate that the

intersections of fractures are most potential followed by E-W and NW-SE fractures. The E-W and NW-SE fractures form potential zones for bore wells in the northeastern part of the district.

The fractured deep aquifers were explored up to a depth of 300m by CGWB. The depth of casing ranges from 2.13 to 34.50 m and potential fractures encountered between 18 to 137 metres. The thickness of fracture varies from less than a meter to more than 10 metres. The yield of bore wells ranges from 0.50 to 24.5 lps. The transmissivity ranges from 22-288 m^2/day and Storativity ranges from 1.18 X 10^{-2}- 8.90 X $10^{-3.}$

Laterites

This is the most commonly occurring aquifer system in the district. The laterites are highly porous and due to this the aquifer gets recharged fully by the initial few rains itself. Subsequent rains contribute little to the aquifer system and escapes as rejected recharge. Due to this high porosity the stored water escapes as sub surface run off from the elevated areas and slopes once the rain recedes. The laterite forms highly potential aquifers along topographic lows and valleys.

Depth of dug wells in these formations ranges from 5.00 to 25.62 metres. The depth to water level ranges from 1.13 to 24.00 mbgl in premonsoon period and 0.98m to 20.10 meters in post monsoon period. The yield of wells tapping laterite ranges from 20 to 40 m3/day. The specific capacity of the wells ranges from 5.04 X 10^{-3} to 182.7 X 10^{-1}.

The dug wells tapping the laterites are generally unlined up to lithomarge clay zone. The wells are lined to avoid caving along the lithomargic zone. Mostly cement rings are used for lining but the lining using the brick wall or laterite bricks are found quick recuperation and allow free flow of groundwater into the well. In the lateritic area the dimension of wells is 1.5mx6.0m to 3.0mx7.5m in the valley areas and in midlands 2 x 10.5 m to 4 x 12.0 metres.

Semi Consolidated (Vaikom Formation)

The Vaikom formation contains coarse grained sands, gravel, clay, marl, carbonaceous clay and lignite intercalated with granular formations. In this formation the ground water occurs as semi confined to confined condition. The Vaikom formation is found laterised on the top where ever it's exposed. In kattur, the exploratory drilling reveal that the

Vaikom formation occurred at a depth of 17m bgl which is covered by thick alluvium of coastal sediments and not exposed on the surface. The thickness of granular zone varies from 8 to 30m bgl. The transmissivity and storativity of Vaikom formation ranges from 22 to 105 ^{m2}/day and 4.1 X 10 $^{-3}$ to 4.8 X $10^{-4.}$

Alluvial Aquifer

In general ground water occurs under water table condition along the river courses, intermontane valleys and along the costal plain. The depth of dug wells located in these formations is ranging from 5.00 to 9.00 mbgl and depth of water level varies from 0.5 to 6.58 mbgl.

In the coastal alluvium the aquifer can be developed through construction of dug wells and filter point wells for both domestic and irrigation. The drilling data reveals that the alluvial thickness is around 15m. The depth of dug wells is ranging from 3.00 to 9.57 mbgl and depth to water level ranging from 1.87 to 6.10m in pre monsoon and 0.58 to 3.52 m in post monsoon. The specific capacity of the dug wells rages from 6.34X10^{-3} to 1.44 X 10^{-1}m3/min/mdd.

The depth ranges of filter points wells ranges from 6 to 10 mbgl with a slotted length of 1 to 3m at bottom. The yield of filter point wells ranges from 12 to 18 m^3/day .Such potential areas are seen around Andathodu, Engandiyur, Nakitta, Perinjanam, Triprayar and Erriyad etc. All the dug wells tapping the alluvial formation are lined with concrete ring or bricks. Filter point wells are constructed along the coastal area wherever the saturated sand thickness exceeds five meters.

Depth to Water level

The depth to water level in pre-monsoon period ranges from 1.40 to 12.90 m bgl (Fig. 4)and in post-monsoon period 0.59 m to 10.86 m bgl (Fig. 5). In general the water level is shallow during both monsoon particularly along valleys and topographically low areas. The ground water monitoring wells data shows that around 7 % of the wells fall with in 10.00 to 20.00 mbgl categories while 56 % of the wells fall in the water level showing 5.00 to 10. 0 m bgl category and 26 % of the wells falls in the 2.00 to 5.00 m bgl category during the pre monsoon. The post monsoon data reveals that the 40 % of the wells falls under 5.00 to 10.00 mbgl category and 34 % wells falls than 2.00 to 5.00 mbgl category and one well is falls in 10.0 to 20.00 m category in Puzhakal block. The depth to water level ranges of

pre & post monsoon and fluctuation frequency data of April& November presented in table No 2 and 3.

Table. 2 Depth to water level Range- Pre and Post monsoon (April & November 2006)

Formations	**DTW ranges in GWMW mbgl**							
	0.0-2.0m		**2.0-5.0m**		**5.0-10.0m**		**10.0-20.0m**	
Pre monsoon April 2006	No.of wells 2	2 (4.44 %)		14 (31.11%)		26 (57.78)		3 (6.67)
Post monsoon November 2006	No.of wells 11	11 (23.40)		16 (34.04)		19 (40.43)		1 (2.13)

The analysis of the long-term water level does not pose any severe problems in the district. The long-term trend of pre monsoon water level between 1997 to 2006 indicates a fall of 0.0022 to 0.3683 meter/year. The rising trend are also seen which ranges from 0.0028 m/year to 0.2524 m. The post monsoon period falling trend rages from 0.0016 to 0.4975 m/year and rising trend rages from 0.0079 to 0.2352.

In general this falling trend is not at all alarming and most of the area indicate a rising trend. This may be due to the canal command irrigation in the district.

Table 3. Fluctuation and frequency data distribution of April- November 2006

Rise		Fall		Rise			Fall		
Mini.	Max.	Mini.	Max.	0-2	2-4	>4.0	0.20 >4.0	2-4	
0.07	5.30	0.95	1.80	16 37.21 %	20 46.51 %	4 9.30 %	3 6.98 %	-	-

4.2 Ground Water Resources

The ground water assessment was done block wise as per GEC-1997 methodology as on March 2004. The net annual groundwater availability is 702.80 MCM where as the draft for all uses is 326.44 MCM. The Kodungallur block falls under over exploited category and already notified by central ground water Authority and State Ground Water Authority. The Ollurkara, Thalikulam, Mathilakam and Mala blocks are fall under semi critical blocks and all other blocks are under safe category. The block wise ground water resource of Thrissur district is given in Table. 4

Table 4. Block wise ground water resource of Thrissur district.

S.No.	Blocks	domestic 2004	domestic 2029	industrial 2004	industrial 2029	Total Annual GW recharge (MCM)	Natural discharge during non-monsoon season (MCM)	Net annual GW availability (3-4) (MCM)	Existing gross ground water draft for irrigation (MCM)	Existing gross ground water draft for domestic & industrial water supply (MCM)	Existing gross ground water draft for all uses (6+7) (MCM)	Allocation for domestic and industrial water supply upto next 25 years (MCM)	Requirement for domestic and industrial water supply upto next 25 years (MCM)	Net GW availability for future Irrigation development (5-6-9) (MCM)	Stage of Development in % (8/5x100)	Category
1	Chavakkad	6.41	7.77		0.32	35.20	3.52	31.68	7.45	6.41	13.86	8.09	8.52	16.14	43.75	Safe
2	Chowannur	5.31	6.44		0.23	30.68	1.53	29.15	6.14	5.31	11.45	6.67	8.52	16.34	39.28	Safe
3	Vadakkancherry	8.5	10.31		0.61	61.36	6.14	55.22	28.55	8.50	37.05	10.92	10.91	15.75	67.10	Safe
4	Pazhayannur	6.43	7.79		0.48	47.29	4.73	42.56	7.04	6.43	13.47	8.27	8.30	27.25	31.65	Safe
5	Mullasseri	3.44	4.17		0.23	32.55	3.26	29.29	6.17	3.44	9.61	4.40	4.64	18.73	32.79	Safe
6	Puzhakkal	5.17	6.27	0.11	0.45	74.60	7.46	67.14	12.20	5.28	17.48	6.72	8.81	48.23	26.03	Safe
7	Ollurkara	6.3	7.63	0.036	0.68	69.46	6.95	62.51	18.61	6.34	24.94	8.31	12.06	35.60	39.90	Semi critical
8	Thalikulam	4.92	5.96		0.18	23.67	2.37	21.30	12.88	4.92	17.80	6.14	6.60	2.28	83.57	Semi critical
9	Anthikkad	4.09	4.96		0.27	42.40	4.24	38.16	10.84	4.09	14.93	5.23	5.65	22.09	39.12	Safe
10	Cherpu	3.6	4.36		0.23	39.89	2.00	37.89	5.43	3.60	9.03	4.59	9.70	27.88	23.82	Safe
11	Kodakara	7.94	9.62	0.4	1.01	79.38	7.94	71.44	9.32	8.34	17.66	10.63	10.52	51.50	24.71	Safe
12	Mathilakam	5.47	6.63		0.26	25.87	1.29	24.58	13.60	5.47	19.07	6.89	7.37	4.10	77.56	Semi critical
13	Irinjalakuda	4.67	5.66		0.22	43.84	4.38	39.46	18.55	4.67	23.22	5.88	6.11	15.03	58.84	Safe
14	Vellangallur	4.28	5.18		0.24	39.09	3.91	35.18	14.46	4.28	18.74	5.42	5.73	15.30	53.27	Safe
15	Kodungalloor	3.76	4.56		0.12	9.86	0.49	9.37	7.40	3.76	11.16	4.68	5.05	0.0	119.05	Over Exploited
16	Mala	5.41	6.56		0.24	45.02	4.50	40.52	31.50	5.41	36.91	6.80	7.17	2.23	91.08	Semi critical
17	Chalakudy	5.49	6.66		0.62	74.83	7.48	67.35	24.60	5.49	30.09	7.28	7.27	35.47	44.68	Safe
	Total					774.99	72.19	702.80	234.38	91.74	326.44	116.92	132.93	353.88	46.45	

4.3 Ground Water Quality

The chemical quality of groundwater is generally good in both phreatic as well as deeper fractured rock aquifers. In the deeper sedimentary area the formation water is slightly brackish. Around 38 Nos of Ground Water samples are showing EC less than the 300 µs/cm at 25^0C while the 15 Nos of samples with less than 100 µs/cm. The EC ranges from 31 to 742 µs/cm at 25^0C and the total hardness ranges from 8 to 220 mg /litre. The chloride ranges from 4.30 to 132 mg/litre and the chemical data presented in table no. 5

Table No. 5. Ground water quality of ground water monitoring wells.

Sl.No	Location	EC in us/cm at 250 C	Total Hardness asCa co3	Ca	Mg	Cl	F
1	Kodungallur	582	115	32	8.5	71	0.28
2	Azhikode	742	170	44	15	117	0.42
3	Eriyad	261	42	11	3.4	44	0.24
4	Perinjanam	113	34	9.6	2.4	9.9	0.17
5	Triprayar	408	116	42	2.9	38	0.52
6	Manalur	50	8	2.4	0.5	7.1	0.45
7	Engandiyur	291	80	28	2.4	28	0.39
8	Chavakkad	311	78	25	3.9	34	0.25
9	Punnayur	118	44	18	0.5	4.3	0.28
10	Kallumpuram	474	76	15	9.2	81	0.27
11	Kunnamkulam	190	36	9.6	2.9	28	0.26
12	Erumapetti	103	16	5.6	0.5	14	0.22
13	Kundannur	589	220	26	38	96	0.57
14	Wadakkancherry	95	20	6.4	1	13	0.18
15	Cheruthuruthi	339	120	18	18	20	0.5
16	Chelakod	300	38	7.2	4.9	68	0.6
17	Chelakkara	388	140	37	12	38	0.58
18	Athani	113	22	4.8	2.4	21	0.36
19	Mulankunnathukavu	343	72	18	6.3	43	0.35
20	Trichur	65	14	4	1	9.9	0.3
21	Vellanikkara	102	28	6.4	2.9	14	0.24
22	Pattikkad	104	30	5.6	3.9	9.9	0.18
23	Kombazha	170	36	9.6	2.9	20	0.16
24	Adatt	121	20	4.8	1.9	23	0.11
25	Parappur	150	18	5.6	1	24	0.05
26	Guruvayur	197	60	18	3.9	18	0.14
27	Keecheri	545	35	8	3.6	132	0.34
28	Ollur	500	75	20	6.1	96	0.19
29	Cherukunnu	127	18	4	1.9	26	0.1
30	Manamangalam	38	8	1.6	1	5.7	0.37
31	Kallur	167	40	10	3.4	21	0.21
32	Velupadam	164	22	4.8	2.4	31	0.24
33	Echipara	53	14	4	1	5.7	0.15
34	Mattathur	54	12	4	0.5	7.1	0.07
35	Vellikulangara	52	10	2.4	1	8.5	0.07
36	Konnakuzhi I	31	8	2.4	0.5	5.7	0.09
37	Konnakuzhi II	31	8	2.4	0.5	5.7	0.06
38	Konnakuzhi III	35	8	2.4	0.5	5.7	0.2
39	Chalakudi	62	12	3.2	1	9.9	0.07
40	Muringur	236	86	19	9.2	11	0.2
41	Potta	91	20	4	2.4	13	0.1
42	Pudukkad(not in NHS list)	197	58	19	2.4	18	0.14
43	Cherpu	119	20	6.4	1	14	0.15
44	Irinjalakuda	163	54	18	2.4	11	0.17
45	Muriyad	154	28	8	1.9	26	0.47
46	Tekkumkara	76	18	5.6	1	9.9	0.27
47	Puthenchira	86	14	3.2	1.5	14	0.12
48	Mala(nearby HP well)	173	40	12	2.4	18	0.44
49	Annamanada	162	24	7.2	1.5	28	0.16

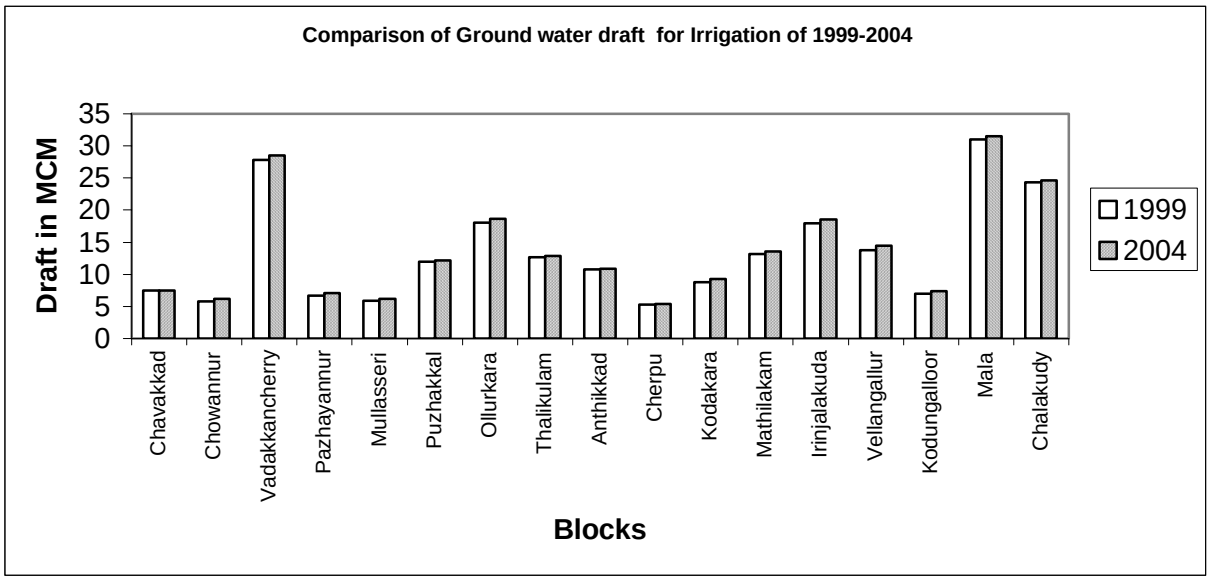
4.4 Status of Ground Water Development

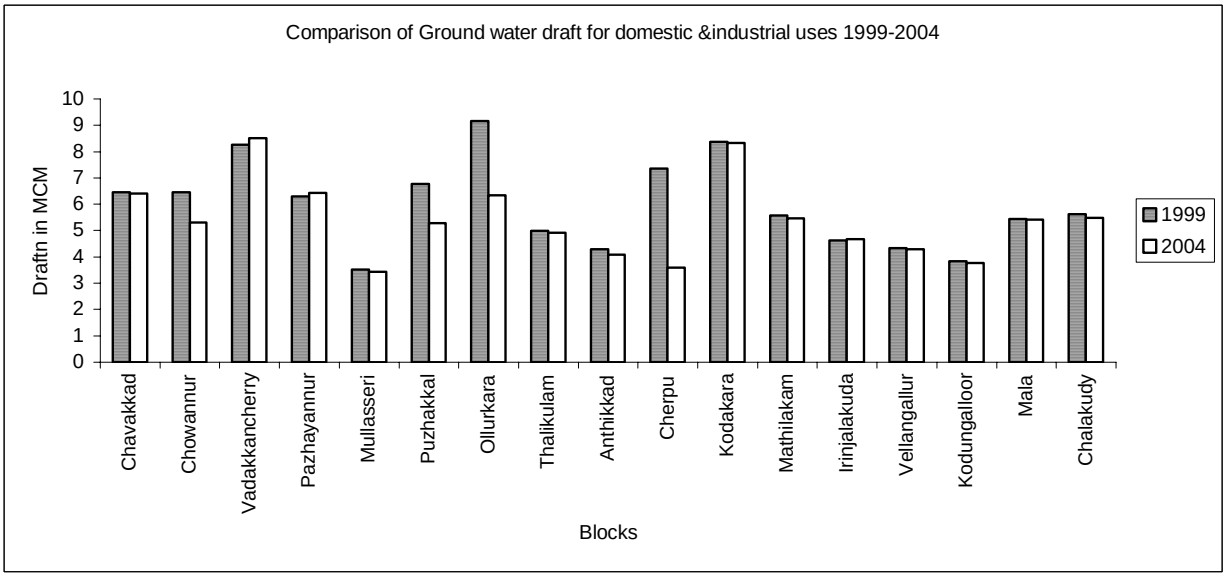
The stage of development in this district is 46.45 % as per 2004 estimation.. The maximum stage of development is seen in Kodungallur block (119%) while minimum is in Cherpu block (23.82 %). The lifting devices of water are through centrifugal pumps, jet pumps for dug wells and submersible pumps and compressor for bore wells. Water is also being lifted by bucket and rope from dug wells for domestic purposes. The stage of groundwater development reveals that large quantity of water is available for future development. Future developments can be possible for the blocks falling under safe category. The springs seen in hilly areas of the district can be developed. Most of the rural water supply schemes in the district depend on ground water by means of dug wells, tube wells and bore wells. Based on drilling data the potential fracture zones are with in 100 mbgl. For example the high yield bore wells drilled by Central Ground Water Board near Pazhayannur has been providing water supply to the near by villages for the last 15 years. The comparison of gross draft for all uses presented in Fig. No 7.

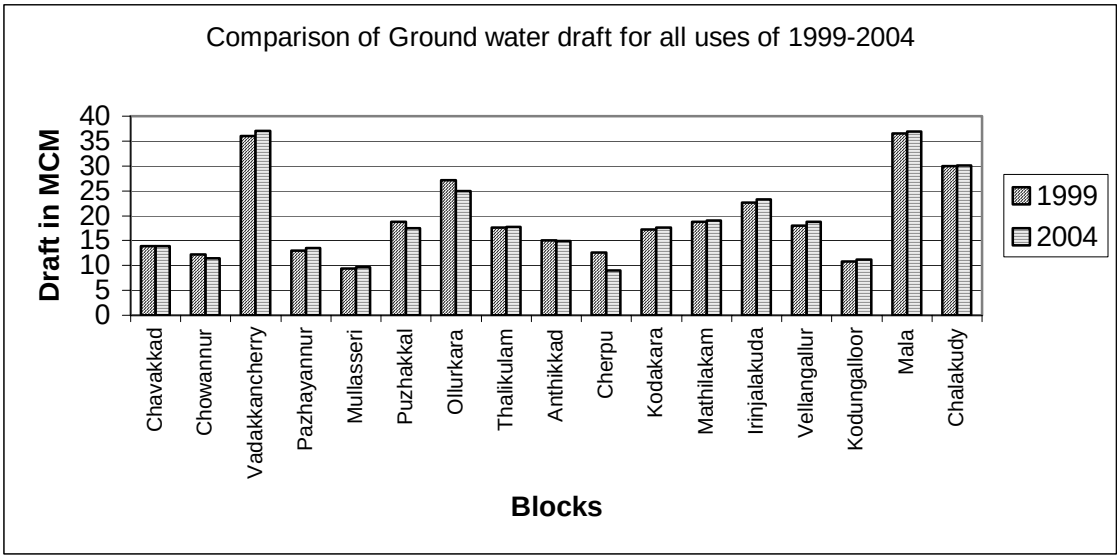
Table. 6 Comparison of gross draft for all uses of as per the year 1999 with year 2004

Sl. No	Blocks	Net Groundwater availability	Groundwater draft for irrigation		Groundwater draft for domestic & industrial uses		Groundwater draft for all uses	
	year	2004	1999	2004	1999	2004	1999	2004
1	Chavakkad	31.68	7.45	7.45	6.45	6.41	13.9	13.86
2	Chowannur	29.15	5.79	6.14	6.45	5.31	12.24	11.45
3	Vadakkancherry	55.22	27.78	28.55	8.26	8.5	36.04	37.05
4	Pazhayannur	42.56	6.65	7.04	6.3	6.43	12.95	13.47
5	Mullasseri	29.29	5.93	6.17	3.52	3.44	9.45	9.61
6	Puzhakkal	67.14	11.99	12.2	6.78	5.28	18.77	17.48
7	Ollurkara	62.51	18.02	18.61	9.17	6.34	27.19	24.94
8	Thalikulam	21.3	12.64	12.88	5	4.92	17.64	17.8
9	Anthikkad	38.16	10.74	10.84	4.28	4.09	15.02	14.93
10	Cherpu	37.89	5.29	5.43	7.35	3.6	12.64	9.03
11	Kodakara	71.44	8.81	9.32	8.37	8.34	17.18	17.66
12	Mathilakam	24.58	13.14	13.6	5.58	5.47	18.72	19.07
13	Irinjalakuda	39.46	17.95	18.55	4.63	4.67	22.58	23.22
14	Vellangallur	35.18	13.73	14.46	4.34	4.28	18.07	18.74
15	Kodungalloor	9.37	7.01	7.4	3.83	3.76	10.84	11.16
16	Mala	40.52	31.04	31.5	5.43	5.41	36.47	36.91
17	Chalakudy	67.35	24.31	24.6	5.62	5.49	29.93	30.09
	Total	**702.8**	**228.27**	**234.38**	**101.36**	**91.74**	**329.63**	**326.44**

Fig. 7. Comparison of gross draft for all uses of 1999-2004







5.0 GROUND WATER MANAGEMENT STRATEGY

Groundwater in the district is mostly developed through dug wells, dug cum bore wells, and bore wells for domestic and irrigation needs. In the valley fill and laterites areas, groundwater is developed mostly through dug wells. The groundwater is developed through bore wells for irrigations and domestic purposes particularly midlands and in eastern uplands.

5.1 Ground Water Development

Out of seventeen blocks, one over exploited block (Kodungallur) is notified by Central Ground water Authority as per recent Ground water estimation Committee. The stage of ground water development is 46.45 % and hence enough water is available for further development. Groundwater can be developed through construction of dug wells; dug-cum bore wells and bore wells. In alluvium, dug wells with depth of 2 to 5 metres and diameter of 1.5 to 2.50 metres are feasible. In laterite terrain, dug wells are feasible in the valley and gentle slopes with a depth range of 4 to 10 metres and diameter of 2.0 to 3.5. In the valley fill areas the dug wells are feasible with depth range of 4 to 8 metres with a diameter of 2 to 3.0 metres. In the crystalline formations dug wells feasible with a depth range of 5.0 to 15.0 metres with a diameter of 2.0 to 3.00 metres. The bore wells are feasible in crystalline and Laterite areas, which can be drilled at a depth range of 50 metres to 150 metres bgl. The favourable bore wells sites are along the lineaments, fractures, shear zones etc which can be located by using remote sensing and geophysical investigation. For proper site selection and other ground water related issues farmers may make use of the technical know-how of the Central ground water board and state ground water agencies. There should be a mode for

disseminating the scientific and technical knowledge through village and block panchayats. The block-wise stage of development is presented in Table no.7 and Fig. No. 8.

Table 7. Block wise categorisation and stage of development

S.No.	Blocks	Net annual groundwater availability (MCM)	Net groundwater available for future development (MCM)	Stage of groundwater development (%)	Categorization for future groundwater development
1	**Chavakkad**	31.68	16.14	43.75	Safe
2	**Chowannur**	29.15	16.34	39.28	Safe
3	**Vadakkancherry**	55.22	15.75	67.10	Safe
4	**Pazhayannur**	42.56	27.25	31.65	Safe
5	**Mullasseri**	29.29	18.73	32.79	Safe
6	**Puzhakkal**	67.14	48.23	26.03	Safe
7	**Ollurkara**	62.51	35.60	39.90	Semi critical
8	**Thalikulam**	21.30	2.28	83.57	Semi critical
9	**Anthikkad**	38.16	22.09	39.12	Safe
10	**Cherpu**	37.89	27.88	23.82	Safe
11	**Kodakara**	71.44	51.50	24.71	Safe
12	**Mathilakam**	24.58	4.10	77.56	Semi critical
13	**Irinjalakuda**	39.46	15.03	58.84	Safe
14	**Vellangallur**	35.18	15.30	53.27	Safe
15	**Kodungalloor**	9.37	0.0	119.05	Over Exploited
16	**Mala**	40.52	2.23	91.08	Semi critical
17	**Chalakudy**	67.35	35.47	44.68	Safe
	Total	**702.80**	**353.88**	**46.45**	

5.2 Water Conservation and Artificial Recharge

The over exploited and semi critical blocks should be given immediate attention to stop the over exploiting of the ground water. In those areas more mass awareness and training programme should be conducted to educate the importance of the conservation recharge of ground water for future use of ground water. The artificial recharge projects like construction of ponds and tanks, check dam, gully plugs, subsurface dyke and rooftop rain water harvesting to be implemented in both Urban and rural areas (Fig. 9)

6.0 GROUND WATER RELATED ISSUES AND PROBLEMS

Acute water scarcity being faced in the hilly areas in summer period due to drying up of dug wells and hand pumps. Dug wells in midland region get dried up if monsoon is delayed or if there are no summer showers. The increased dependence on bore wells in midland areas leads to drying up of dug wells in lateritic mounds and slopes, which affects the drinking water needs of those areas. The coastal areas stretching from Engandiyoor to Chettuva and the villages of Eriyad, Nattika and Chamakala experiences severe sea erosion frequently which leads degrading ground water quality near by coastal aquifer. In kole land and adjoining areas are water logged about six months in year in those area the conjunctive use of both ground and surface water to be adopted for irrigation and industrial uses. In kole land the salinity has been observed more at high tides and less at low tides and increasing

from February to May. This salinity problem has been partly solved by the construction of bunds/regulators across the rivers draining into sea. In general the quality problems are seen highly localised which is found along the coastal area where the streams are confluence with sea particularly during summer months.

7.0 AWARENESS AND TRAINING ACTIVITY

Mass Awareness Programme was organised at Kodungallur and Guruvayoor to give awareness to the local people pertaining to rain water harvesting and optimum utilisation of ground water particularly along the coastal areas.

8.0 AREAS NOTIFIED BY CGWA/SGWA

Most of the blocks are falls under safe category, however the Kodungallur block is falls under over exploited category and notified by Central Ground water Authority the State Ground water Authority.

9.0 RECOMMENDATIONS

Ground water development studies should be carried out coupled with conservation of ground water resources and management of rainwater harvesting. The existing dug wells, ponds, tanks etc should be renovated and protected for future uses. Artificial recharge schemes should be practiced in large scale along with rainwater harvesting.

The Kodungallur block categorised as over exploited due to the stage of ground water development being 119.05 %. So, it is recommended that the existing local ponds should be retained particularly along the coast for collecting rainwater and that roof top rainwater harvesting may be implemented wherever possible. It is recommended that all the over exploited and semi critical blocks may be given immediate attention for implementing artificial recharge schemes through state and central Governments. The deeper potential aquifers in the safe blocks may be developed for drinking and agricultural purpose with sustainable pumping rate.

Most of the area falls under safe category and the groundwater can be developed for irrigation and other purposes. In some part of the area, the scarcity of water is observed during summer period. In those areas the following artificial rainwater harvesting structure are recommended for augmenting the groundwater. The urban areas are suitable for roof top rainwater harvesting. It can be practiced by all government buildings and individuals with small land holding. The same can also be adopted along high land and rural areas where water scarcity is reported during peak summer.

Gully plugs in areas with local break in slope and plateau terrain, which is suitable for midland region of Vellangallur, Mala, Puzhakkal, Kodakara and Chownnur blocks. The percolation Tanks can be constructed in alluvial patches particularly along eastern parts of district and also along laterite hilltops. Check dams can be constructed across the streams with gentle slope with permeable beds and the suitable areas are Wadakkancherry, Ollukara and Pazhayannur blocks. Sub-surface dyke along gently slopping wide valleys with narrow out let. However, necessary studies are to be carried out before construction to avoid the failures of the schemes.

Fig No.1

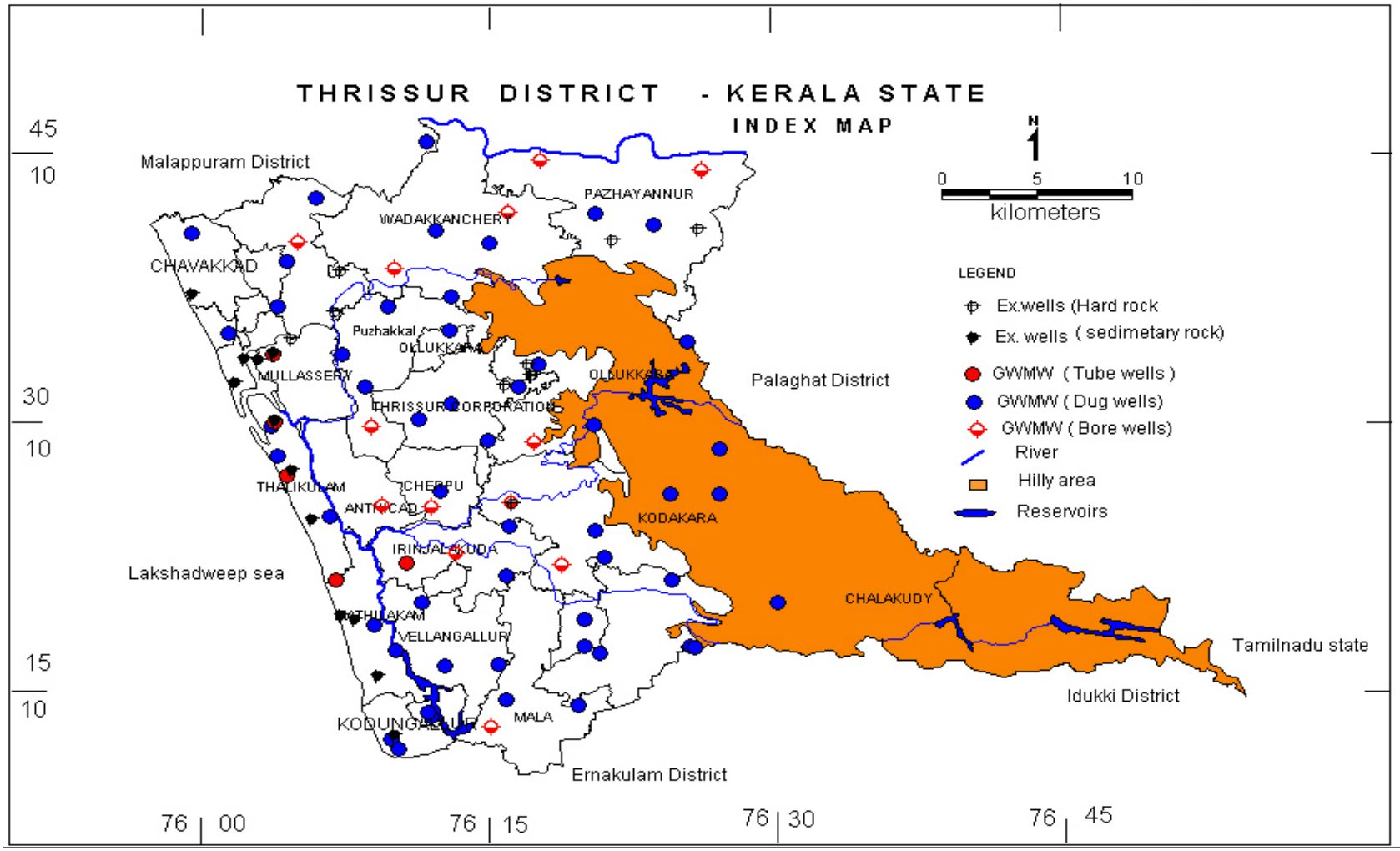

THRISSUR DISTRICT - KERALA STATE
INDEX MAP
N
0 5 10
kilometers
LEGEND
Ex.wells (Hard rock
Ex. wells (sedimetary rock)
GWMW (Tube wells)
GWMW (Dug wells)
GWMW (Bore wells)
River
Hilly area
Reservoirs
Malappuram District
PAZHAYANNUR
WADAKKANCHERY
CHAVAKKAD
Puzhakkal
OLLUKKARA
MULLASSERY
THRISSUR CORPORATION
Palaghat District
THALIKULAM
CHERPU
ANTHICAD
KODAKARA
IRINJALAKUDA
Lakshadweep sea
CHALAKUDY
Tamilnadu state
VELLANGALLUR
MALA
Idukki District
Ernakulam District
45
10
30
10
15
10
76 00
76 15
76 30
76 45

Fig. No. 03

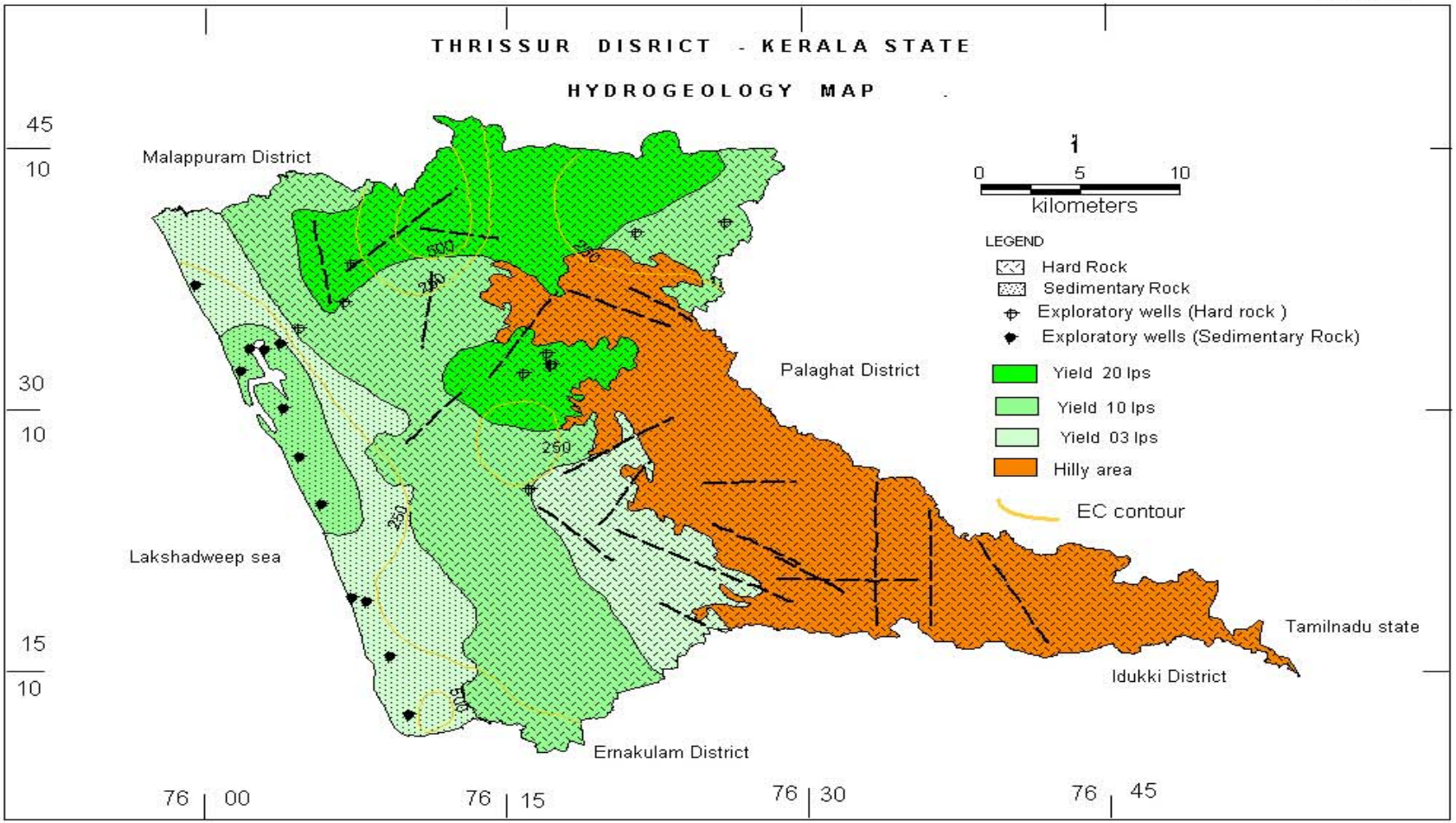

THRISSUR DISRICT - KERALA STATE
HYDROGEOLOGY MAP
45
10
30
10
15
10
76 00
76 15
76 30
76 45
Malappuram District
Palaghat District
Lakshadweep sea
Tamilnadu state
Idukki District
Ernakulam District
0 5 10
kilometers
LEGEND
Hard Rock
Sedimentary Rock
Exploratory wells (Hard rock)
Exploratory wells (Sedimentary Rock)
Yield 20 lps
Yield 10 lps
Yield 03 lps
Hilly area
EC contour
500
250
250
250
500

Fig. No.4

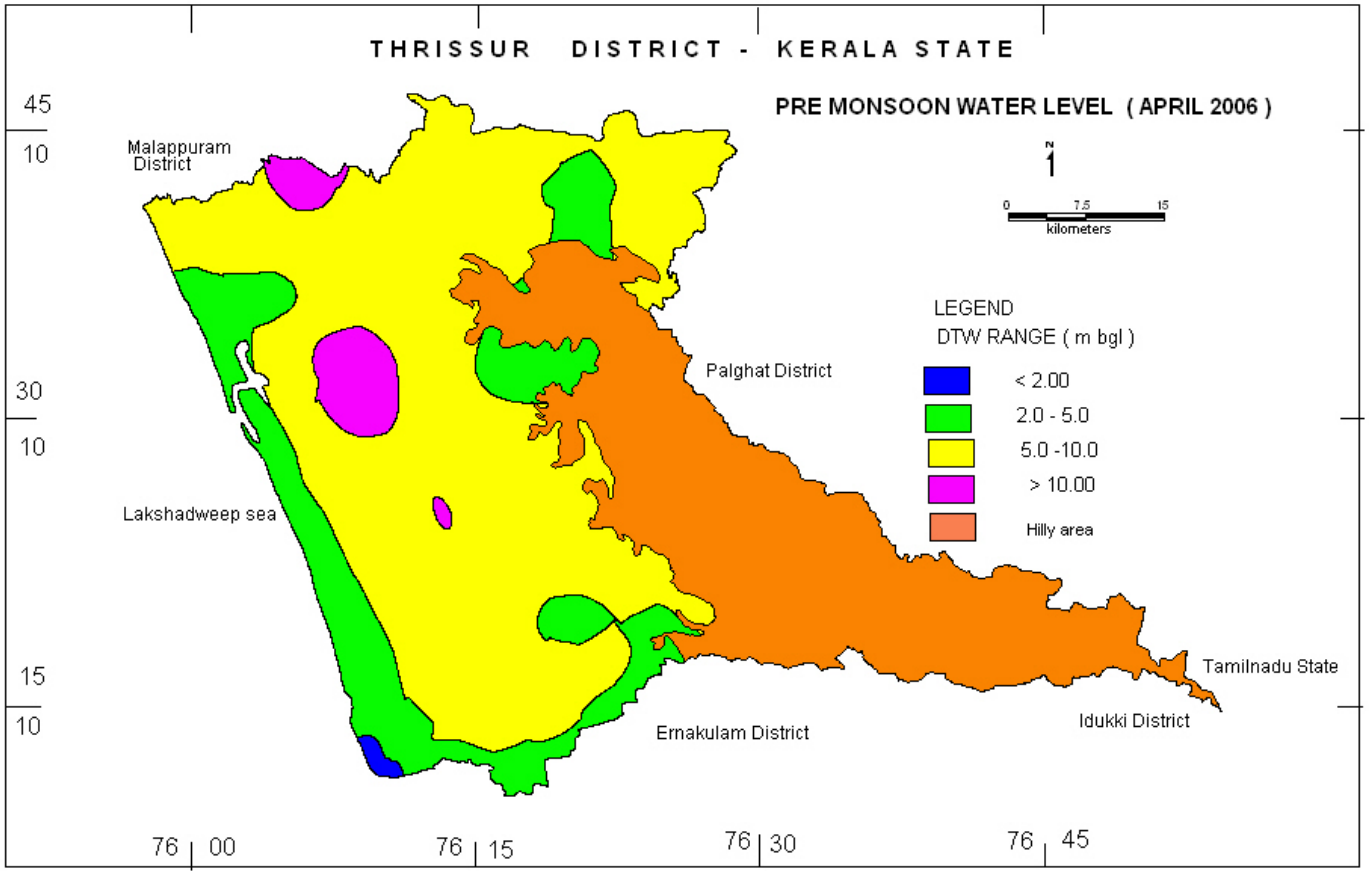

THRISSUR DISTRICT - KERALA STATE
PRE MONSOON WATER LEVEL (APRIL 2006)
N
0 7.5 15
kilometers
LEGEND
DTW RANGE (m bgl)
< 2.00
2.0 - 5.0
5.0 -10.0
> 10.00
Hilly area
Malappuram District
Palghat District
Lakshadweep sea
Ernakulam District
Idukki District
Tamilnadu State
45
10
30
10
15
10
76 00
76 15
76 30
76 45

Fig. No.5

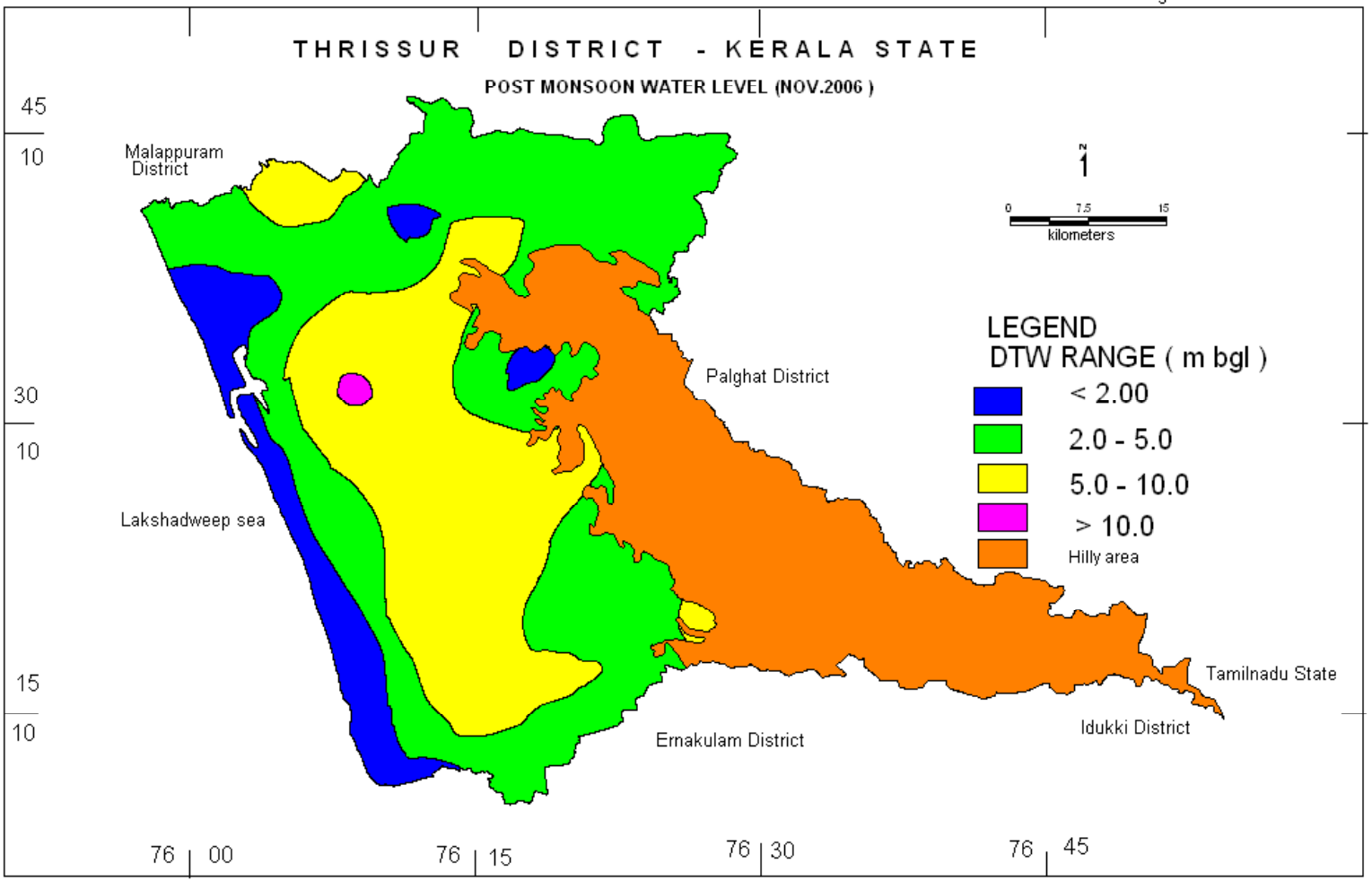

THRISSUR DISTRICT - KERALA STATE
POST MONSOON WATER LEVEL (NOV.2006)
45
10
30
10
15
10
Malappuram District
Palghat District
Lakshadweep sea
Ernakulam District
Idukki District
Tamilnadu State
N
0
7.5
15
kilometers
LEGEND
DTW RANGE (m bgl)
< 2.00
2.0 - 5.0
5.0 - 10.0
> 10.0
Hilly area
76 00
76 15
76 30
76 45

Fig. No.6

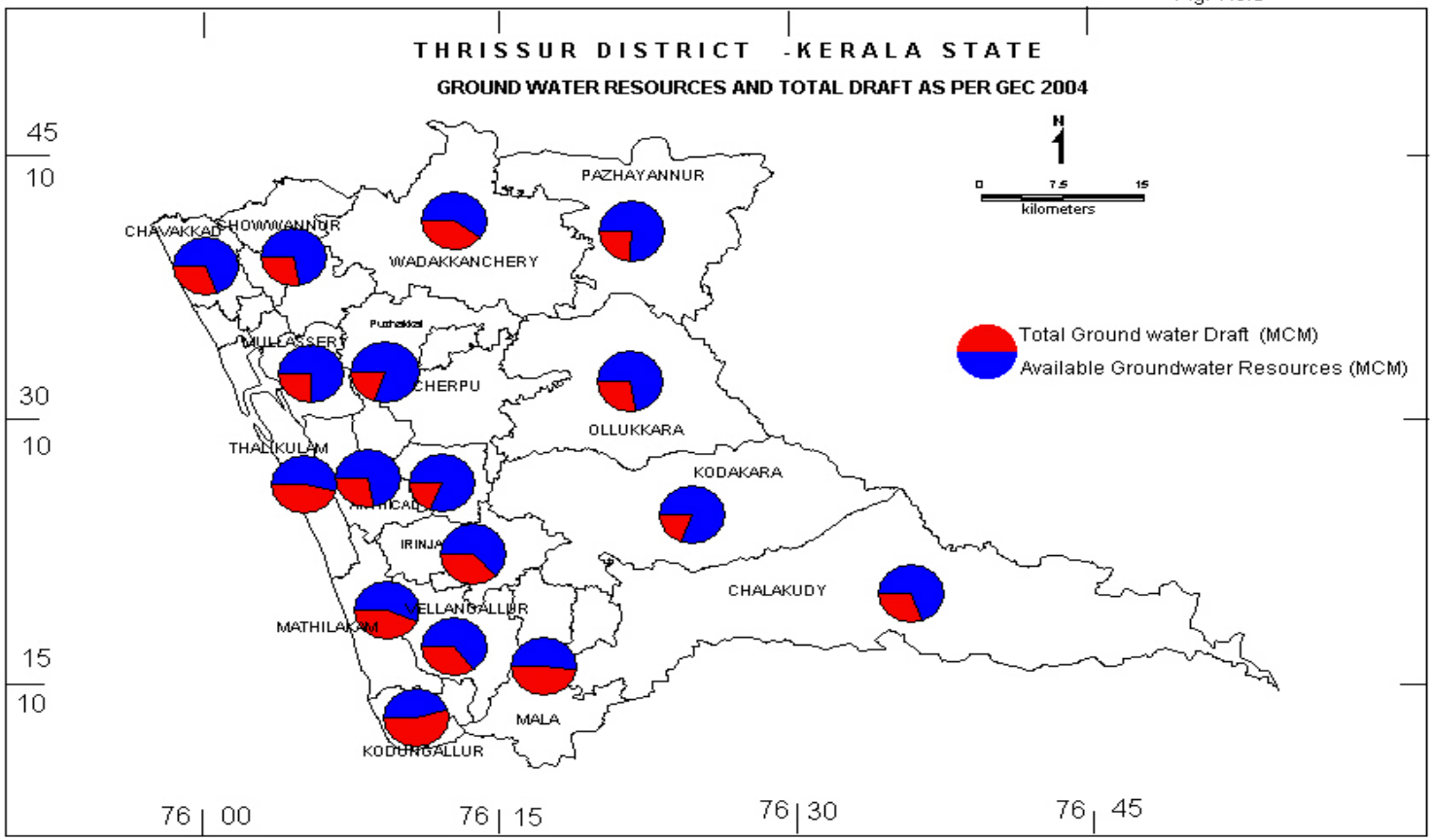

THRISSUR DISTRICT -KERALA STATE
GROUND WATER RESOURCES AND TOTAL DRAFT AS PER GEC 2004
N
1
0
7.5
15
kilometers
Total Ground water Draft (MCM)
Available Groundwater Resources (MCM)
45
10
30
10
15
10
76 | 00
76 | 15
76 | 30
76 | 45
PAZHAYANNUR
CHAVAKKAD
CHOWWANNUR
WADAKKANCHERY
Puzhakkal
MULLASSERY
CHERPU
OLLUKKARA
THALIKULAM
KODAKARA
IRINJ
CHALAKUDY
VELLANGALLUR
MATHILAKAM
MALA
KODUNGALLUR

Fig. No.8

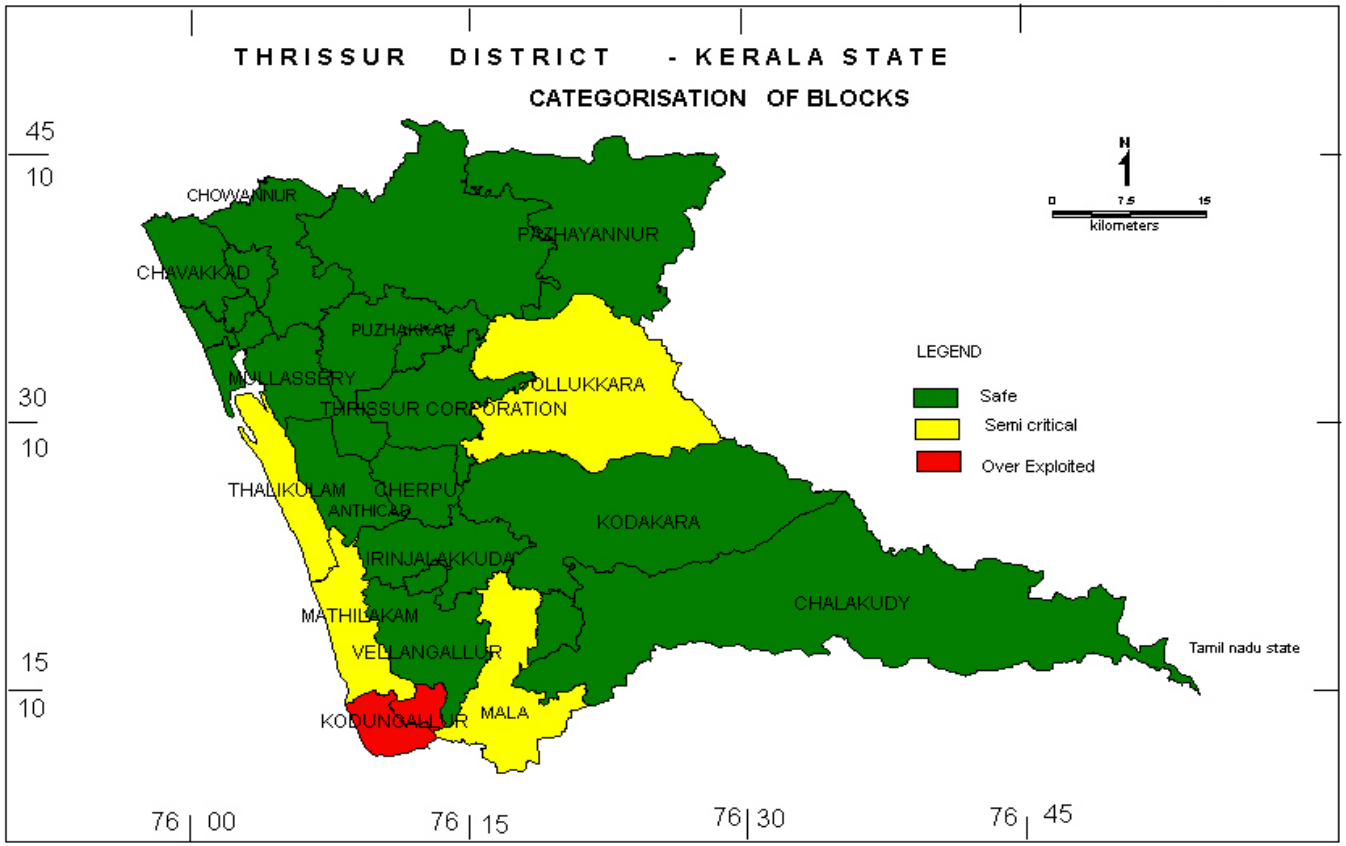
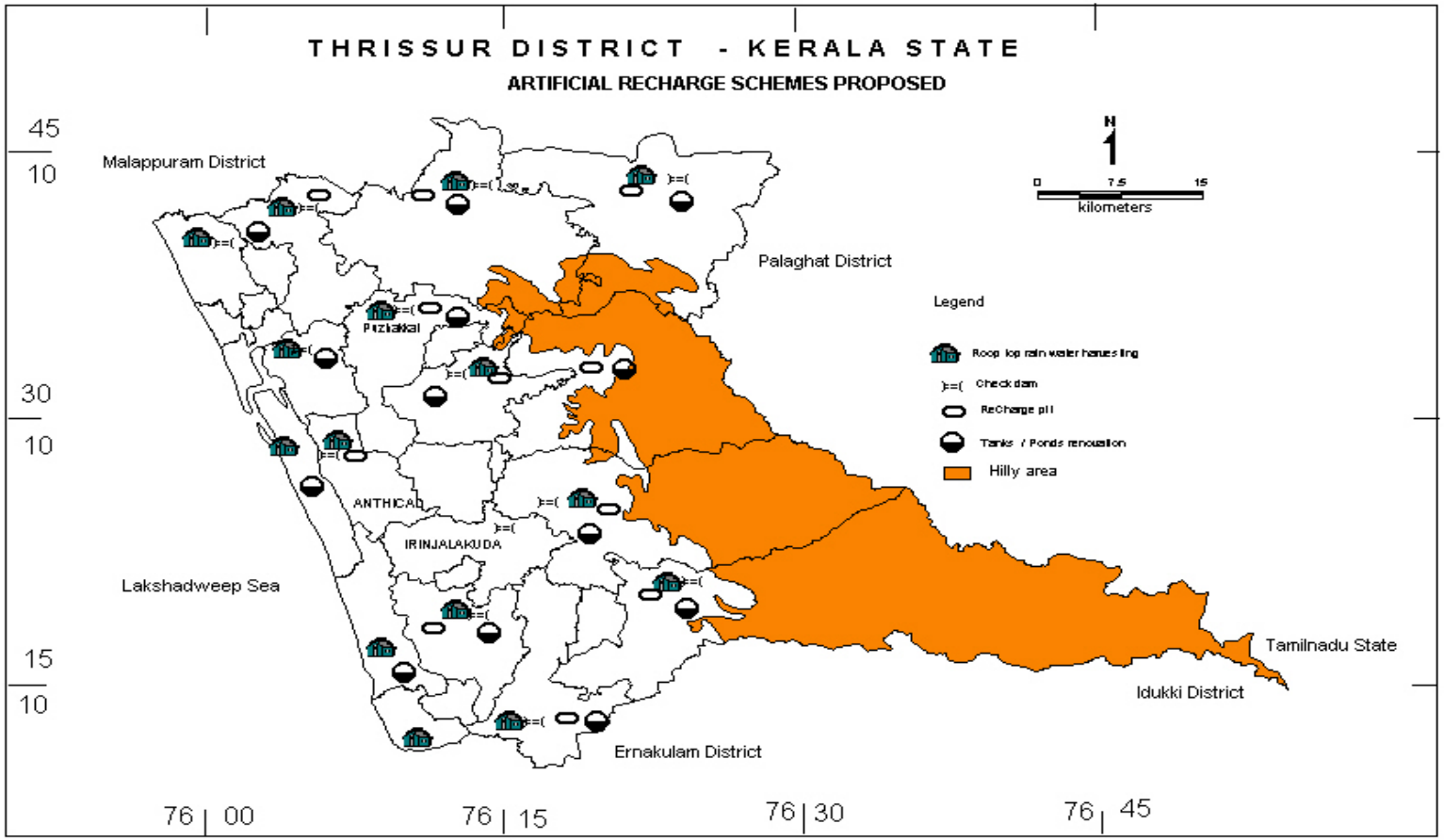

THRISSUR DISTRICT - KERALA STATE
CATEGORISATION OF BLOCKS
45
10
30
10
15
10
76 | 00
76 | 15
76 | 30
76 | 45
N
0
7.5
15
kilometers
LEGEND
Safe
Semi critical
Over Exploited
CHOWANNUR
CHAVAKKAD
PAZHAYANNUR
PUZHAKKAL
MULLASSERY
OLLUKKARA
THRISSUR CORPORATION
THALIKULAM
CHERPU
ANTHICAD
KODAKARA
IRINJALAKKUDA
CHALAKUDY
MATHILAKAM
VELLANGALLUR
KODUNGALLUR
MALA
Tamil nadu state

Fig. No.9


THRISSUR DISTRICT - KERALA STATE
ARTIFICIAL RECHARGE SCHEMES PROPOSED
45
10
30
10
15
10
Malappuram District
Palaghat District
Pazhakkal
ANTHICAD
IRINJALAKUDA
Lakshadweep Sea
Tamilnadu State
Idukki District
Ernakulam District
Legend
Roop top rain water harvesting
Check dam
ReCharge pit
Tanks / Ponds renovation
Hilly area
N
0
7.5
15
kilometers
76 | 00
76 | 15
76 | 30
76 | 45