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CONSERVE WATER – SAVE LIFE



GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION BOOKLET OF MALAPPURAM DISTRICT, KERALA STATE

By

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GROUND WATER INFORMATION BOOKLET OF MALAPPURAM DISTRICT, KERALA STATE

CONTENTS

DISTRICT AT A GLANCE

- 1.0 Introduction
- 2.0 Rainfall and Climate
- 3.0 Geomorphology and soil types
- 4.0 Ground water scenario
- 5.0 Groundwater management strategy
- 6.0 Groundwater related issues & problems
- 7.0 Awareness and training activity
- 8.0 Areas notified by CGWA/SGWA
- 9.0 Recommendations

LIST OF FIGURES

- 1 Index map of Malappuram district
- 2 Rainfall map
- 3 DTW map Pre monsoon period
- 4 DTW map Post monsoon period
- 5 Hydrogeological map of Malappuram district
- 6 Groundwater resources and draft
- 7 Artificial recharge structures proposed in Malappuram district

LIST OF ANNEXURES

- Ia Details of exploratory wells drilled in hard rock area of Malappuram district
- Ib Details of exploratory wells drilled in sedimentary areas of Malappuram district
- IIa Chemical analysis data of GWMW samples collected from phreatic aquifers
- IIb Chemical analysis data of GWMW samples collected from deeper aquifers

DISTRICT AT A GLANCE

SI No.	ITEMS	STATISTICS
1.	GENERAL INFORMATION	
	i) Geographical area (Sq km)	3550
	ii) Administrative Divisions (As on 31-03-2007) Number of Tehsil/Block Number of Panchayat/Villages	6/14 100/135
2.	GEOMORPHOLOGY	
	Major physiographic units	Low land, Midland and Highland
	Major Drainages	Bharathapuzha, Kadalundipuzha and Chaliyarpuzha
3.	LAND USE (ha)	
	a) Forest area	103417
	b) Net area sown	37706
4.	MAJOR SOIL TYPES	Laterite, Brown hydromorphic, Coastal and river alluvium and Forest loamy soil
5.	AREA UNDER PRINCIPAL CROPS (ha)	
	Rice	28936
	Pepper	7817
	Cashew nut	10596
	Tapioca	8790
	Coconut	102872
	Arecanut	14292
	Rubber	29907
6.	AREA IRRIGATED BY DIFFERENT SOURCES (ha)	
	Wells(Dug wells & Tube wells / Bore wells)	10741
	Tanks / Ponds	2660
	Canals	1463
	Other Sources	8313
	Net Irrigated area (Hectares)	23724
	Gross Irrigated area (Hectares)	26572

7.	NUMBER OF GROUNDWATER MONITORING WELLS OF CGWB (AS ON 31-3-2007) No. of Dug wells No. of Piezometers	84 64 39
8	PREDOMINANT GEOLOGICAL FORMATIONS	Achaeen crystalline formation (Gneiss, Schist Charnockite) Tertiary sedimentary formation, Sub-Recent laterite and Recent Alluvium
9.	HYDROGEOLOGY Major Water bearing formation Depth to water level (Pre-monsoon, 2006) m bgl Depth to water level (Post-monsoon, 2006) m bgl Long term water level trend in 10 years(1997-2006) in m/yr	Weathered, fractured crystalline formations, Semi consolidated Tertiary formations, Laterites and Recent alluvium 3.47 to 15.64 1.37 to 12.78 Rise -0.05 to 0.36 Fall - 0.008 to 0.40
10.	GROUND WATER EXPLORATION BY CGWB (As on 31-03-2007)	
	No. of wells drilled (EW, OW, PZ, SH, Total)	EW -28, PZ – 19,OW – 5 Total - 52
	Depth Range(m)	98 to 300
	Discharge (lpm)	0.01 to 15.3
	Transmissivity (m ² /day)	1.53 to 146
11.	GROUND WATER QUALITY	
	Presence of chemical constituents more than permissible limits	Quality is good. Major chemical constituents lie within the permissible limit.
12	DYNAMIC GROUNDWATER RESOURCES (2004) – in mcm	
	Annual Replenishable Ground Water Resources	507.64
	Net Annual Groundwater Draft	307.85
	Projected demand for Domestic and Industrial Uses upto 2025	183.31
	Stage of Ground Water Development, %	60.65

13.	AWARENESS AND TRAINING ACTIVITY Mass Awareness Programmes organized Month and Year Place No. of Participants	December, 2003 Malappuram 300
	Water Management Training Programmes organized Month and Year Place No. of Participants	Nil
14.	GROUND WATER CONTROL AND REGULATION	
	Number of Over Exploited blocks	Nil
	Number of Critical blocks	Nil
	Number of blocks notified	Nil
15.	MAJOR GROUND WATER PROBLEMS AND ISSUES	Isolated Salinity ingress in coastal aquifers

1.0 INTRODUCTION

Malappuram literally means an elevated place on the top of hills. The district has a unique importance in the geological history. Laterite was first identified in the area near Angadippuram Railway Station by Francis Buchanan. This is the type area of Laterite. The district lies between North latitudes $10^{\circ} 40'$ and $11^{\circ} 32'$ and East longitude $75^{\circ} 50'$ and $76^{\circ} 36'$. The Nilgiris of Tamil Nadu in the east and Lakshadweep Sea in the west provide natural boundaries. In the north it is bounded by Kozhikode and Wayanad and in the south by Palakkad and Trichur districts. The district has a geographical area of 3550 sq.km, which is 9.13 % of the total area of the State.

According to 2001 census, the district has a population of 3629640, which is about 12 % of the total population of the State. Of the total population 1759479 are males and 1870161 are females. The district has recorded a population growth rate of 17 % during 2001 which is the highest in the State. Malappuram ranks 3rd in the area and first in the population of the State.

Headquarters of the district is at Malappuram. The district has two Revenue Divisions with Headquarters at Perinthalmanna and Tirur. There are 6 taluks namely Ernad (Head quarters at Manjeri), Perinthalmanna, Tirur, Ponnani, Nilambur and Tirurangadi (headquarters at Parappanangadi), 14 blocks, 100 panchayats and 135 villages. There are five municipalities namely Malappuram, Manjeri, Tirur, Ponnani and Nilambur.

The district is accessible by air, rail and road. The Kozhikode airport which operates several international flights to Gulf countries is situated near Kondotty in the district. The Kanyakumari-Mangalore-Mumbai broad gauge railway line passes through the western parts of the district. There is another branch rail line to Nilambur from Shornur (Palakkad district). The NH 17 which connects Cochin and Mangalore passes through the western portion of the district. The index map showing location of blocks, drainage, exploratory wells, piezometers and ground water monitoring wells are given in Figure 1.

Drainage

Malappuram district is mainly drained by the Kadalundi river, Chaliyar and Bharathapuzha. Of these rivers, only Chaliyar and Bharathapuzha are perennial and all others

get dried up in summer and hence Malappuram district is highly drought prone. The Kadalundi river is formed by the confluence of its two main tributaries viz; the Olipuzha and the Veliyar. The Olipuzha takes its origin from 'the Cherakkobban Mala' (1160 m amsl) and the Veliyar originates from the forest of the 'Erattakomban Mala' (1190 m amsl). The Kadalundi river is 130 km long with a drainage area of 1274 sq. km. The river joins the Lakshadweep Sea at about 5 km south of the Chaliyar river mouth.

The Chaliyar river, one of the major rivers of the State, originates from the Ilambalari Hills in Nilgiri district of Tamilnadu (2066 m amsl). The river flows along the northern boundary of Malappuram district through Nilambur, Mambad, Edavanna, Areakode and Feroke. It joins the Lakshadweep Sea near Beypore. The river is 169 km long with a drainage area of 2535 sq. km in Kerala State.

The Bharathapuzha or the Ponnani river is the second longest river of Kerala, originating from the Anamalai Hills (1964 m amsl) in the Western Ghats. The river below the confluence of Bharathapuzha and Gayathripuzha is called the Ponnani river. It flows through the districts of Palakkad, Malappuram and Trichur and drains into the Lakshadweep Sea near Ponnani town in Malappuram district.

The drainage pattern of the three rivers in the district is generally dendritic. Tidal effects are experienced in places such as Vallikkunnu and Tirurangadi, which are 6 to 8 km away from the coast.

Analysis of the drainage characteristics of the two basins reveals that Kadalundi river is a fourth order stream, the Ponnani river is fifth order stream and the Chaliyar river is a seventh order stream.

Land use

The Kerala State Land Use Board has computed the area under various uses. The following Table 1 represents the land under various categories.

Table 1

Sl.No	Category	Area in hectares	% of total area
1	Geographical area	355000	100
2	Built up land	2322	0.65
3	Agriculture land	266890	75.18
4	Forest land	75699	21.32
5	Water bodies	4994	1.41
6	Waste land	5094	1.44

7	Others	Nil	Nil
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Studies / Activities carried out by CGWB

Systematic hydrogeological surveys in the district were carried out during 1975 – 76. Detailed water balance studies of Kadalundi and Ponnani river basins are carried out during the erstwhile SIDA assisted coastal Kerala Ground water Project (1983-88). Subsequent reappraisal surveys were carried out during 1997 – 98 & 2002 – 03.

Under groundwater exploration 25 exploratory borewells were drilled by Central Ground Water Board both SIDA assisted Coastal Groundwater Project in 1975 -76 and Hydrology Project in 1997.

2.0 RAINFALL & CLIMATE

The district has more or less the same climatic conditions prevalent elsewhere in the State viz. dry season from December to February and hot season from March to May, the South-West monsoon from June to September and the North East monsoon from October to December. The normal rainfall of the district is 2793.3 mm. Out of this, major rainfall contribution is from SW monsoon followed by the NE. The South West monsoon is usually very heavy and nearly 73.5% of the rainfall is received during this season. NE monsoon contributes nearly 16.4% and March to May summer rain contributes nearly 9.9% and the balance 0.2% is accounted for January and February months.

The monthly rainfall for the Malappuram district during the period 2001 – 06 is tabulated in Table 2 below and is shown in Figure 2.

Table 2

Rainfall in mm during the year 2001 - 2006

Month	2001-02	2002-03	2003-04	2004-05	2005-06
April	269	73	165	99	116
May	229	306	70	598	106
June	709	461	669	708	550
July	553	257	525	271	887
August	294	460	279	404	125
September	150	48	52	156	369

October	256	456	292	371	283
November	188	175	94	52	162
December	1	9	1	5	25
January	0	0	0	10	0
February	0	31	0	8	0
March	17	48	1	0	67
Total	2666	2324	2148	2682	2690

Temperature

The climate is generally hot and humid. March and April months are the hottest and January and February months are the coldest. The maximum temperatures ranges from 28.9 to 36.2°C and the minimum temperatures range from 17.0 to 23.4°C. The temperature starts rising from January and reaches the peak in the month of March and April and then decreases during the monsoon month and again rising from September onwards.

Relative Humidity

The relative humidity ranges from 84 to 94 % during morning hours. The humidity is more during the peak monsoon months from June to September.

Wind

The wind is predominant from east as well as west during morning and evening hours. The wind speed is more during December to February months. It ranges from 2.9 to 7.2 km per hour.

3.0 GEOMORPHOLOGY AND SOIL TYPES

Geomorphologically the district can be divided into three viz. coastal plain (less than 7.5 m amsl) mid land (7.5 – 75 m amsl) and highland (above 75 m amsl). The coastal plains extend as a narrow stretch of land lying along the coast from Kadalundi Nagaram in the north to Ponnani in the south. It becomes very narrow towards north of Tirur and the maximum width is seen along Chauravallam - Tirurangadi area. The area lying between the coastal plain in the west and the high ranges in the east is occupied by midlands. This is the most prominent physiographic unit of the district. This is characterised by flat topped hillock with steep ‘U’ shaped valleys and ridges. The valley forms potential area for agriculture including paddy,

arecanut, vegetable, banana and coconut. The hill tops are generally barren and covered by thick and compact laterite. The eastern parts of the district are characterised by steep hills, gorges and escarpments. The elevation of the hill ranges goes upto 1127 m amsl. Most of the high lands are occupied by forests.

The soils of the district can be broadly divided into the following categories

(i) Soils of the low lands (Alluvial soil)

Those are mainly seen along the coastal plains and valleys. The soils range from exclusively drained to moderately/well drained sand to sandy clay in nature.

(ii) Soils of Mid/Up lands (Lateritic soil)

These are mostly lateritic soil, and is seen along the mid land portion of the district. These are deep to very deep, well drained gravelley to clayey.

(iii) Soils of Central Sahyadri (Hydromorphic soil)

These are deep moderate, well drained and clayey soils with high gravel content. Erosion is moderate to severe. Hard laterites with rock out crops are present.

(iv) Soils of eastern part of Malappuram (Forest loamy soil)

These soils are deep or very deep and well drained with loamy to clayey textures and having fairly high gravel content.

4.0 GROUNDWATER SCENARIO

Most of the district is underlain by laterites and crystalline rocks of Archaean age. Along the western coastal area Tertiary formation overlaid by Recent alluvial deposits are seen. The crystalline group of rocks in the district comprises of Charnockite, Charnockite gneiss, Biotite gneiss, Biotite hornblende gneiss and Migmatites. Charnockites occupy maximum area in the district. Charnockites are exposed over the hills around Edavanna, Palpatta, Pandikkad, Manjeri, Nediyrrippu and Nilambur area. Apart from these rock types, dykes are also occurring in the district. A major gabbro dyke is seen from Cherukara south west of Perinthalmanna to north west of Manjeri. The dyke is trending NW and the width of the dyke varies from 30 to 50 m. Few dolerite dykes are seen traversing the basement rocks. Most of the dykes are running in NW-SE direction.

Tertiary formations are seen along the western fringe of the district bordering the Lakshadweep Sea. Sandstone, clays with seams of lignite is seen and they are classified as the Vaikom beds of the Tertiary formation of Kerala. The Tertiary sediments are lateritised at the top. Exposures of Tertiary rocks are seen between Thirunnavaya and Kuttippuram and also around Tirur area. These are overlain by recent alluvial formation and the thickness of this formation is generally less than 75 m. Laterite is the most important lithologic unit of the district and is widely seen almost all along the midland region of the district. The thickness of the laterite goes upto 25 m at places.

4.1 Hydrogeology

The aquifer system in the district can be broadly divided into Crystalline aquifers, Laterite aquifers and Alluvial aquifers. Crystalline and Laterite aquifers constitute major part of the district. The hydrogeology is shown in Figure 3.

Crystalline aquifers

In the crystalline rocks of the area viz. Charnockite, Biotite gneiss and Migmatite, the occurrence and movement of ground water are dominantly controlled by the nature and extent of weathering and the presence of structural features like fractures, joints and shear zones which generally varies from place to place. Ground water occurs in the secondary intergranular pores and voids, under unconfined conditions in the shallow weathered and fractured rocks and under semi-confined to confined conditions in the deeper fractured zones.

Weathered rock forms potential aquifers and the thickness of weathered rock ranges from 4 to 12 mtrs below ground level. Along valley portions in the area ground water is developed mostly by means of dug wells. The wells piercing the weathered zone vary from 15 to 20 m and ranges in diameter from 2 to 5 m. Their depth varies from 3.5 to 21.2 m bgl. The yields of those wells are of the order of 6 to 12 m³/hrs. The wells located in the hornblende biotite gneiss vary in depth from 6 to 15 m bgl. The yield of these wells ranges from 4 to 5 m³/hrs. They can sustain pumping for only few hours and recuperation rate is very poor.

Fractured aquifers in the crystalline areas form potential aquifers and ground water occurs under semi-confined to confined conditions. The occurrence and movement of ground water is controlled by the presence of lineaments, fractures and joint pattern. The studies and exploration carried out in the district indicate the intersections of exploratory wells fractures are

most potential followed by NE – SW fractures. Ground water is developed by means of bore well. In the case of deep crystalline aquifers the fractures are fairly deep and inter connected, which increases the yield capacity of aquifer. The exploratory wells drilled in hard rock areas are given in Annexure Ia.

The wells tapping deep crystalline aquifers range in depth from 90 to 300 m bgl. The yield of these wells ranges from 0 to 920 lpm. The depth of over burden varies from 3 to 35 mts. The water bearing fractured zone were encountered at depth ranges of 20 to 30, 40 to 60, 70 to 80, 90 to 120 and 150 to 160 m bgl.

Laterite Aquifers

This is the most commonly occurring aquifer system in the district and occupies the midland region. The laterite constitutes the potential aquifer because of the porous and highly permeable nature. Ground water occurs under water table conditions. Due to this porosity, the stored water escapes as sub-surface run-off from the elevated hills and slopes once the rain recedes. The laterites are derived from both the Tertiary formation and also from the crystallines. The laterites mainly occupy the hill top areas as laterite capping. Also occupy in low land areas where thickness is very meager.

The thickness of laterite and overlying charnockites varies from 1 to 3 m and from 15 to 20 m in hornblende gneiss. Majority of well tapping laterites dry up during summer months. The bottom part the wells are mainly of lithomargic clay and becomes low yielding during peak summer periods. Subsequent rains contribute little to the aquifer system and escapes as rejected recharge. However in the lower attitudes especially in valley portions the water table is shallow and appreciable thickness of saturated zone is available for ground water development. Yield ranges from 8 to 10 m³ per hour.

Alluvial aquifers

This is the most potential aquifer in the district. The coastal alluvium is essentially composed of sand, silt and clay. The ground water occurs under water table conditions. Large number of dug wells and filter point wells tap this aquifer to meet the domestic and agricultural needs. The coastal alluvium can sustain medium to heavy duty pumping. Filter point wells are feasible along the coast wherever the saturated sand thickness exceeds 5 m. Such potential areas are seen around Ponnani, Chamravattom, Mangalam, B.P Angadi, Tirur, Tanur,

Parappanagadi and Kadalundi. Riverine alluvium of considerable thickness is seen in and around Thirunavaya, Kuttipuram area along the northern side of Bharatapuzha (Ponnani) river. Open dug wells and shallow tube wells are feasible in the stretch.

Valley fill materials are seen along almost all major valleys. The formations form potential aquifers wherever the sandy portion is more. Dug wells tapping this aquifer often meet entire needs of minor irrigation schemes. The alluvial deposits are tapped by dug wells. Shallow dug wells piercing alluvium over laying the lateritic horizon vary in depth from 20 to 15 m bgl. The water level ranges from 1.6 to 13.3 m bgl. The exploratory wells drilled in sedimentary areas are given in Annexure Ib.

Aquifer Parameters

The specific yield values for the unconfined aquifer are tabulated below.

Sl No	Nature of aquifer material	Specific yield (%)
1	Coastal riverine alluvium	10 – 20
2	Valley fill material in the mid land region	10 – 15
3	Weathered fractured granite	1 – 3
4	Laterites	2 - 5

The transmissivity values for the deeper confined aquifers are compiled below.

Rock type	Transmissivity, m ² /day
Charnockite	30 – 150
Hornblende biotite gneiss	5 - 50

Water level and their long term behaviour

The Central Ground Water Board is having 64 Ground Water Monitoring Wells (GWMW) in Malappuram district. These stations are monitored for ground water level four times a year i.e April, August, November and January. The analysis data indicate that the depth to water level in the weathered crystalline ranges from 6.91 to 9.41 m bgl during pre-monsoon and from 4.75 to 6.62 m during Post-monsoon. The depth to water level in the wells tapping laterite ranges from 2.62 to 13.07 m bgl during pre-monsoon and from 1.10 to 11.55 m bgl during post monsoon. The water level ranges from 1.6 to 13.3 m bgl in alluvium. Depth to water level maps during premonsoon and postmonsoon are shown in Figures 4 & 5.

4.2 Ground water Resources

A perusal of the groundwater resources of the district indicated a bright scope for developing the same for future use. All the 14 blocks of the district are safe. The district has a net annual ground water availability of 507.64 MCM with a net availability of 185.68 MCM for the future use. The maximum stage of development is in Tanur block (94%) and the minimum development in Nilambur block (38 %).

The Malappuram district receives a normal rainfall of 2793.3 mm, which forms the most important source of recharge. Recharge also taken place partly by irrigation and seepage from canals. Other source of recharge includes surface water bodies. The ground water assessment was done block-wise using GEC 1997 methodology and is computed as on March 2004 and these figures are used in this report.

Computation of Recharge

The total annual groundwater recharge of the district has been computed block-wise using the data of average water level fluctuation in Groundwater Monitoring wells and specific yield of the aquifers in the district. The monsoon recharge is worked out as 320.10 MCM. The non monsoon recharge is 156.06 MCM and return flow from irrigating fields and other possible sources of recharge was computed separately and it is around 81.14 MCM. The ground water resources available vary considerably from block to block depending on the geographical area of the block and ranges from 22.31 MCM in Andathodu block to 61.94 MCM in Nilambur block. The block-wise net ground water resources available in Malappuram district are given in Table 3.

Table 3

BLOCK WISE NET GROUND WATER AVAILABILITY AS ON 31st MARCH, 2004

(in MCM)

SI. No	Assessment Unit/Block	Command/non-command/Total	Recharge from rainfall during monsoon season	Recharge from other sources during monsoon season	Recharge from rainfall during non monsoon season	Recharge from other sources during non-monsoon season	Total Annual Ground water Recharge (4+5+6+7)	Natural discharge during non monsoon season	Net Annual Ground water Availability (8-9)
1	2	3	4	5	6	7	8	9	10
1	Nilambur	Non-command	40.86	Nil	16.53	7.81	65.20	3.26	61.94
2	Kondotti	"	20.13	"	8.14	6.09	34.36	3.44	30.92
3	Manjeri	"	33.38	"	15.48	5.54	54.40	5.44	48.96

4	Wandur	“	40.26	“	17.45	10.44	68.15	6.81	61.34
5	Vengara	“	13.69	“	7.53	4.3	25.52	2.55	22.97
6	Malappuram	“	21.2	“	9.83	4.4	35.43	3.54	31.89
7	Mankada	“	29.12	“	13.5	7.3	49.92	4.93	44.99
8	Perinthalmanna	“	25.61	“	14.0	11.2	50.81	5.08	45.73
9	Tanur	“	15.06	“	7.23	4.2	26.49	2.65	23.84
10	Tirur	“	15.91	“	7.64	5.8	29.35	1.47	27.88
11	Kuttiipuram	“	19.76	“	15.01	2.56	37.33	3.73	33.6
12	Ponnani	“	12.20	“	6.79	6.5	25.49	1.27	24.22
13	Andathodu	“	14.64	“	8.15	2.0	24.79	2.48	22.31
14	Tirurangadi	“	18.28	“	8.78	3.0	30.06	3.01	27.05
Total			320.10	Nil	156.06	81.14	557.30	49.66	507.64

Groundwater Draft

Groundwater withdrawal is taking place for irrigation, domestic and industrial purposes. The domestic and industrial requirements were computed as per the norms considering population of 2001 and also based on the projected population for the year 2025. The irrigation draft was calculated based on the number of groundwater abstraction structures and the number of hours the well is in use per day and average number of days of irrigation in a year. The groundwater draft is showing an increase in trend during the recent years. In the Nilambur and Wandur blocks there is a significant rise in draft. The groundwater resources and draft as per GEC 2004 are shown in Figure 6.

The stage of development in Malappuram district is 60.65%. Maximum development is seen in Tanur block (94.21%) and minimum in Perinthalmanna (38.38%). The groundwater draft, net groundwater availability and stage of groundwater development are given in the following Table 4.

Table 4

BLOCK – WISE GROUND WATER DRAFT, FUTURE UTILISATION, STAGE OF GROUND WATER DEVELOPMENT

DISTRICT: MALAPPURAM

Sl. No	Assessment Unit/Block	Command/ non-command/ Total	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for irrigation	Existing Gross Ground Water Draft for domestic and industrial water supply	Existing Gross Ground Water Draft for all uses	Allocation for domestic and industrial requirement supply up to next 25 years	Net Ground water Availability for future irrigation development (10-11-14)	Stage of Ground water development (13/10)*100 (%)
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1	2	3	10	11	12	13	14	15	16
1	Nilambur	Non-command	61.94	12.35	12.4	24.75	18.08	31.51	39.96
2	Kondotti	Non-command	30.92	9.80	9.38	19.18	13.51	7.61	62.03
3	Manjeri	Non-command	48.96	26.85	8.71	35.56	12.74	9.36	72.65
4	Wandur	Non-command	61.34	12.34	12.24	24.58	17.87	31.13	40.07
5	Vengara	Non-command	22.97	11.69	8.83	20.52	12.66	0.0	89.33
6	Malappuram	Non-command	31.89	10.29	7.64	17.93	11.11	10.49	56.22
7	Mankada	Non-command	44.99	16.79	11.03	27.82	15.94	12.26	61.84
8	Perinthalmanna	Non-command	45.73	9.99	7.56	17.55	11.04	24.7	38.38
9	Tanur	Non-command	23.84	11.05	11.41	22.46	16.29	0.0	94.21
10	Tirur	Non-command	27.88	11.03	7.94	18.97	11.49	5.36	68.00
11	Kuttipuram	Non-command	33.6	16.54	8.03	24.57	11.59	5.47	73.13
12	Ponnani	Non-command	24.22	11.88	4.44	16.32	6.48	5.86	67.38
13	Andathodu	Non-command	22.31	11.64	5.62	17.26	8.21	2.46	77.36
14	Tirurangadi	Non-command	27.05	8.68	11.40	20.08	16.3	2.07	74.22
Total			507.64	180.92	126.63	307.55	183.31	148.28	60.65

Comparison of Ground water draft, stage of groundwater development and categorisation of blocks of GEC 1999 with 2004 is given in Table 5.

Table 5

Comparison of stage of Development, Total gross draft and categorization of blocks of Malappuram district between 1999 and 2004 estimates.

Sl. No.	Name of block	Net Ground water availability (MCM)	Total gross draft (MCM)		Stage of development		Categorization of blocks	
			1999	2004	1999	2004	1999	2004
1	Nilambur	61.94	20.27	24.75	32.73	39.96	Safe	Semi critical
2	Kondotti	30.92	19.08	19.18	61.71	62.03	Safe	Semi critical
3	Manjeri	48.95	33.60	35.56	69.08	72.65	Safe	Semi critical
4	Wandur	61.34	20.42	24.58	33.29	40.07	Safe	Critical
5	Vengara	22.97	18.88	20.52	82.19	89.33	Safe	Semi critical
6	Malappuram	31.89	17.18	17.83	53.87	56.22	Safe	Safe

7	Mankada	44.99	25.81	27.82	57.37	61.84	Safe	Safe
8	Perinthalmanna	45.73	15.45	17.55	33.79	38.38	Safe	Safe
9	Tanur	23.84	20.32	22.46	85.23	94.21	Safe	Semi critical
10	Tirur	27.88	17.42	18.97	62.66	68.00	Safe	Safe
11	Kuttippuram	33.60	22.20	24.57	66.07	73.13	Safe	Semi critical
12	Ponnani	24.22	15.87	16.32	65.52	67.38	Safe	Safe
13	Andathodu	22.31	15.98	17.26	71.63	77.36	Safe	Semi critical
14	Tirurangadi	27.05	17.95	20.08	66.36	74.22	Safe	Semi critical

4.3 Ground water quality

The chemical quality of the ground water in the district is generally good. The shallow groundwater from the alluvial formation has higher total dissolved solids and major ion constituents than that of other formation. This is due to the proximity of the pond water channels and tidal influence in the area occupied by coastal alluvium. In the coastal alluvium the electrical conductivity ranges from 1360 – 2130 micro-siemens/cm at 25° C. In the other areas the EC is within permissible limit. Since the district is devoid of any major industries the ground water pollution is minimum. However ground water pollution due to a small factory at Tirur is reported by Central Ground Water Board. The chemical analysis data of samples collected from dug wells and bore wells are given as Annexures IIa and II b.

5.0 GROUND WATER DEVELOPMENT

The district has a bright scope for the development of ground water resource. The shallow phreatic aquifers are developed through dug wells. The depth of dug wells in the weathered crystalline ranges from 4.00 to 9.50 m bgl. The depth to water level ranges from 3.5 to 8.00 m bgl. The yield of these wells ranges from 100 – 200 lpm. The fractured deep aquifers are explored upto a depth of 300 m by Central Ground Water Board. The depth of casing in these bore wells ranges between 7 and 25 m and the potential fractures 23 and 201 m bgl. The thickness of fracture zone varies from less than a metre to 37 m. Laterites are the most extensive aquifer in the district and the depth of wells in these formations ranges from 5.6 to 28 m bgl. The yield potential of deeper fractures in the crystalline rocks ranges from 10 to 600 lpm.

There is no major urban water supply scheme in the district. However major schemes are river based. But majority of rural water supply scheme depend on ground water. About 32 % of

the schemes depend on open wells and 36 % of the schemes are borewell based. About 2 % of the schemes are a combination of open and bore wells. Springs constitute for 1.5 % of schemes. Only 21 % of the schemes depend on groundwater as their source. Irrigation practices using groundwater is at infant stage. However there is an increase in using ground water for irrigating vegetable crop during summer.

The following areas have been suggested for further development of deeper confined aquifers in the hard crystalline basement rock.

- (1) The Karipuzha and Chaliyar lineaments are potential zones for the development of deeper aquifers in Chaliyar basin.
- (2) The Olipuzha – Kadalundi lineament (ENE – WSW) is a potential area for the development of deeper aquifers in Kadalundi basin.
- (3) Minor lineaments trending E – W, WNW – ESE (Kottakkal, Kulattur) are also potential in Kadalundi basin
- (4) The EW and NNW - SSE trending minor lineaments are good for ground water development potential in Ponnani basin
- (5) The NW – SE trending major lineament is not always promising due to the local filling of the aquifer with clay.
- (6) The intersection points of the major NW – SE lineaments with minor fractures are having very good groundwater potential

The approximate casing depth varies from 5 to 25 m. No formation instability during drilling operation is expected in the district.

Water Conservation & Artificial recharge

So far no large scale planned artificial recharge schemes have been implemented in the district so as to augment the natural recharge to the aquifer system. Overall the district offers tremendous scope for artificial recharge due to the highly porous and deep lateritic profile, especially at places where the ground water is deep. Since the district is characterized by the presence of table topped mountain and ridges covered by lateritized beds, construction of artificial recharge by tapping surface run off is a feasible proposition. Abandoned lateritic quarry pits can be used as percolation tanks for this purpose. The proposed Artificial Recharge structures in Malappuram district are shown in Figure 7.

6.0 GROUNDWATER RELATED ISSUES AND PROBLEMS

In general the district is devoid of any serious ground water related issues in terms of quantity and quality. However, the dug well in the lateritic aquifer goes dry immediately after the monsoon season causing severe drinking water shortage to rural population.

7.0 AWARENESS AND TRAINING ACTIVITIES

CGWB has conducted a mass awareness programme on conservation and protection of groundwater resources at Malappuram on December 2003. The programme attained wide publicity and was attended by about 300 participants

8.0 AREA NOTIFIED BY CGWA/SGWA

No blocks have been notified by CGWA/SGWA so far in the district as all the blocks are of safe category.

9.0 RECOMMENDATIONS

- (1) There are no major irrigation projects in the district. An area of 16287 ha is being irrigated using minor and lift irrigation schemes. Ground water irrigation is still in the infant stage in the district and is confined to cash and garden crops. The government should introduce more beneficial schemes to promote ground water irrigation in the district.
- (2) The deep fractures in the crystalline basement offers huge prospects for further ground water development. The following areas have been identified for the development of the above said resource.
 - (i) The Karimpuzha and Chaliyar lineaments in the Chaliyar basin
 - (ii) The Olipuzha – Kadalundi lineaments (ENE – WSW) in Kadalundi basin
 - (iii) Minor lineaments trending E- W, WNW- ESE (Kottakkal – Kulathur) in Kadalundi basin.
 - (iv) The E-W and NNW – SSE trending minor lineaments in Ponnani basin.

- (v) Intersection points of major NW – SE lineaments with minor fracture/joints have very good ground water development potentials.
- (3) Abandoned laterite quarries can be developed as percolation tank for recharging laterite/hard rock aquifer by tapping surface run off/rainfall.
- (4) Check dams are recommended for the recharge of the vast alluvial track in Bharathapuzha basin.
- (5) The intersection of Palakkizhi lineament with Olipuzha lineament (at Kizhuttur, about 3 km south of Melattur) is a potential area for development of deeper aquifer.
- (6) Indiscriminate sand mining in Bharathapuzha river bed is depleting the ground water resource of the alluvium as well as lateritic aquifer in the district.
- (7) Indiscriminate destruction of laterite hillocks for filling up paddy fields and other low lying areas are serious threats to the precious groundwater resource of the district.

There are about 26 springs reported in the district. They emerge along the contact between laterite and crystalline along topographic lower valleys. The yield of the spring ranges from 1 to 500 lpm. These springs can be developed for planned rural water supply schemes.

Annexure I a

Details of wells drilled in hard rock areas of Malappuram district

	Year of construction	Coordinates	Lineament Direction	Depth drilled	Depth of casing (m bgl)	Fracture zones (m bgl)	Discharge (lpm) during drilling	SWL (m bgl)	T m ² /day	EC μ /cm at 25°C	Cl (ppm)	Rock Type
il	1984-85	11°0'10" 76°0'45"	NW	229.01	13.72	23-40, 54-61, 103-111, 114-119	920	1.97	50-98	890	18	Charnockite gneiss
ppatta	1985-86	11°04'25" 76°07'45"	NW	300.81	7.00	Nil	0.20	4.53	NA	60	11	Charnockite gneiss
Olakara	1985-86	11°05'45" 75°54'30"	NS	300.81	14.95	Nil	Negligible	7.3	NA	210	17	Charnockite
ram-I mp	2003-04	11°02'20" 76°05'22"	E-W	200.00	11.60	29.0-32.0	19.2	13.35	0.14	296	7.1	Charnockite
a	2003-04	11°03'05" 76°00'55"	E-W	200.00	17.40	59.0-62.0	240	47.45	13.55	370	8.5	Charnockite
ram-II ff	2003-04	11°02'10" 76°05'27"	E-W	200.00	16.20	59.0-62.0	60	16.6	0.203	197	8.5	Charnockite
umuri	2003-04	11°03'16" 76°06'30"	NW-SS	102.00	15.00	32.0-44.0	840	10.8	138	217	5.7	Charnockite
thol	2003-04	10°56'22" 76°11'59"	NW-SE	200.00	15.50	46.0-49.0	360	28	115	265	2.8	Charnockite
otta	2003-04	10°57'38" 76°09'04"	NW-SE	200.00	16.00	47.5-49.5	30	38.75	0.331	247	4.3	Charnockite
arambu	2003-04	10°51'04" 76°13'32"	NW-SE	200.00	3.70	108.0-111.0	60	17.12		459	9.9	Charnockite
	2003-	10°54'56"	NE-	172.	7.30	66.0-68.0	420	16.31	35	26	7.1	Charnockite

	04	76°07'18"	SE	00		72.0-74.0 90.0-93.0				7		e	
	Year of construction	Coordinates	Lineament Direction	Depth drilled (m bgl)	Depth of casing (m bgl)	Fracture zones (m bgl)	Discharge (lpm) during drilling	SWL (m bgl)	T m ² /day	EC μ/cm at 25°C	Cl (ppm)	Rock Type	
	2003-04	10°48'22" 76°00'32"	N-S	200.00	10.00	123.0-126.0	240	9.73	37	764	64	Pyroxene Granulite	
r	2003-04	10°51'08" 76°59'02"	E-W	200.00	7.30	29.0-35.0	Dry					Charnockite	
r	2003-04	11°08'20" 75°57'27"	NW-SE	200.00	18.50	54.0-72.0 154.0-157.0	30	23.8	0.145	272	9.9	Charnockite	
	2003-04	10°59'40" 75°58'05"	NW-SS	200.00	13.10	16.0-26.0 43.0-56.0 78.0-85.0 98.0-109.0	90	14.9	0.253	270	4.3	Charnockite	
palam	2003-04	11°07'27" 75°53'48"	NW-SS	111.50	14.40	48.0-55.0 86.0-110.0	600	30.74	34	314	14	Charnockite gneiss	
imanna ion	2003-04	10°58'22" 76°14'10"	N-S	200.00	13.40	75.0-78.0 96.0-99.0 120.0-124.0	Nil					Charnockite gneiss	
rambu	2003-04	11°05'55" 76°15'16"	NW-SE	200.00	22.00	48.0-51.0	30	11.8	5	175	4.3	Hornblende Biotite Gneiss	
ram	2003-04	11°03'21" 75°56'02"	NW-SS	187.30	23.00	35.0-40.0 156.0-165.0	150	14.4	5	175	4.3	Hornblende Biotite Gneiss	
r	2003-04	11°16'13" 76°13'15"	NE-SW	200.00	33.85	44.0-49.0	60	15.36	0.65	98	7.1	Hornblende Biotite Gneiss	
	2003-04	11°06'28" 76°19'42"	NE-SW	200.00	7.30	Nil	Dry					Hornblende Biotite	

												Gneiss
ad	2003-04	11°06'49" 76°16'42"	NE-SW	162.90	7.40	47.0-50.0 69.0-73.0 115.0-120	300	6.00	45	371	5.7	Hornblende Biotite Gneiss
esery	2003-04	11°18'25" 76°15'29"	E-W	89.70	24.60	29.0-35.0 72.0-78.0	420	17.38	74	384	5.7	Hornblende Biotite Gneiss

Annexure I b

Details of wells drilled in Sedimentary areas of Malappuram district

Location, Coordinates & Sheet No.	RL m amsl	Depth drilled (m bgl)	Depth constructed (m bgl)	Recent	Laterite	Warkalai	Quilon	Vaikom	Alleppey	Depth to basement (m bgl)	Remarks
00'' 40'' 3	1.73	67.06	41.04	18.2				47.24		65.63	EC=4950 Cl=1716 SWL=1.53 m bgl
30'' 50'' 3	NA	73.25	57	12	0	0	0	59	0	71	
uram, 55'' 10'' 3	4.47	64.32	Nil	18.29	6.09			30.48		54.86	E.log EC>3800 below 15 m bgl
50'' 05'' 6	NA	65.75	32	NA	NA	NA	NA	NA	NA	NA	
anangadi 30'' 30'' 6	NA	46	44	14.75	7	0	0	23	0	44.75	

Annexure IIa

Chemical analysis data of water samples collected from GWMW during April 2006

District: Malappuram

Sl. No.	Location	EC in $\mu\text{s}/\text{cm}$ at 25°C	Total Hardness as CaCO_3	Ca	Mg	Cl	F
1	Amminikkad	225	92	22	8.8	7.1	0.62
2	Arikode	281	68	21	3.9	36	0.12
3	Athiramada	67	10	4	0	9.9	0.15
4	Buliyampadam	454	102	35	3.4	31	0.12
5	Chamravattom	234	70	21	4.4	21	0.21
6	Cherukara	70	10	2.4	1	11	0.08
7	Chokkad	362	106	25	11	44	0.06
8	Chungathara	913	260	36	41	142	0.36
9	Edappal	128	36	7.2	4.4	11	0.15
10	Edavanna	162	40	10	3.4	20	0.13
11	Iswaramangalam	354	104	22	12	44	0.36
12	Kadalundi	1060	350	80	36	132	0.46
13	Kalikavu	195	30	7.2	2.9	24	0.05
14	Kanjiramukku	134	24	7.2	1.5	27	0.09
15	Karavarakundu	68	12	3.2	1	8.5	0
16	Kariavattom	116	20	4	2.4	20	0.11
17	Karipol	59	12	3.2	1	8.5	0
18	Karulai	396	126	24	16	41	0.27
19	Kizhmuri	184	58	15	4.9	13	0.32
20	Kondotty	124	24	4.8	2.9	20	0.08
21	Kottakkal	643	90	22	8.5	121	0.15
22	Kulattur	201	66	21	3.4	18	0.32
23	Kuruva	81	24	8.8	0.5	4.3	0.1
24	Kuttiipuram	378	32	12	0.5	57	0.46
25	Malappuram	125	28	8	1.9	17	0
26	Manjeri	573	70	16	7.3	117	0.3
27	Marancheri	118	24	7.2	1.5	13	0.04
28	Maruda	150	26	5.6	2.9	31	0.05
29	Melattur	182	50	13	4.4	23	0.11
30	Mudikode	171	66	18	5.4	5.7	0.11
31	Nilambur	324	64	14	7.3	47	0.09
32	Olavattur	64	14	4.8	0.5	7.1	0.03

Sl. No.	Location	EC in $\mu\text{s}/\text{cm}$ at 25°C	Total Hardness as CaCO_3	Ca	Mg	Cl	F
			<-----in mg/l----->				
33	Pandikkad	161	54	18	2.4	11	0
34	Paral	78	16	6.4	0	5.7	0
35	Parappanangadi	436	106	31	6.8	44	0.06
36	Perumpadappu	188	56	22	0.5	18	0
37	Ponnani	1260	285	92	13.00	248.00	0.12
38	Pukattery	159	46	11	4.40	9.90	0.14
39	Pulamanthol	485	80	19	7.80	88.00	0.07
40	Tachinganedam	158	32	7.2	3.40	21.00	0.10
41	Tanur	356	36	9.6	2.90	72.00	0.00
42	Tazhekode	161	34	7.2	3.90	18.00	0.02
43	Tavanur	131	30	9.6	1.50	14.00	0.00
44	Tirunavaya	452	164	38	16.00	40.00	0.24
45	Tirur	115	22	7.2	1.00	23.00	0.05
46	Tirurangadi	276	66	21	3.40	43.00	0.15
47	Tripunchi	81	20	3.2	2.90	11.00	0.63
48	Vadakkemanna	225	46	10	4.90	43.00	0.19
49	Valancheri	412	80	20	7.30	91.00	0.00
50	Vazhikadavu	360	82	13	12.00	62.00	0.12
51	Wandur	216	34	7.2	3.90	40.00	0.05

Chemical analysis of water samples from deeper fractured aquifer

Sl. No.	Location	Source	Date	pH	EC in $\mu\text{s/cm}$ at 25°C	TH as CaCO_3	Ca	Mg	Na	K	CO_3	HCO_3	SO_4	Cl	F	NO_3
						<-----in mg/l----->										
1	Kottakkal	EW	12.04.03	7.80	570	250	60	24	16	2.9	0	166	45	72	0.39	0.2
2	Jawahar Navodya Vidyalaya	EW	24.06.03	7.98	370	154	33	18	12	3.1	0	149	57	8.5	0.26	0.8
3	Jawahar Navodya Vidyalaya	EW	29.07.03	7.77	384	152	24	22	12	3.1	0	139	58	5.7	0.3	1.2
4	MSD Camp, Malappuram	EW	05.06.03	8.05	296	112	19	16	9.2	3.2	0	139	16	7.1	0.47	1
5	ARP Camp, Malappuram	EW	12.08.03	7.60	217	86	14	13	6.7	2.4	0	120	3.7	5.7	0.04	0.6
6	Thevarapambu	EW	30.08.03	7.76	459	194	47	18	11	2.8	0	264	21	9.9	0.37	0.2
7	MSD Staff Quarters	EW	05.08.03	7.76	197	66	14	7.8	9.2	3.8	0	93	9.4	8.5	0.05	2
8	Tenhipalam	EW	06.12.03	7.16	314	126	28	14	11	3.5	0	163	14	5.7	0.40	0.2
9	Klari	EW	29.12.03	7.82	270	100	22	11	9.8	3.3	0	102	45	4.3	0.26	1.6
10	Karippur	EW	19.12.03	7.96	272	102	19	13	13	3.7	0	146	11	9.9	0.22	0.2
11	Chirattamala	EW	15.09.03	8.46	265	116	25	13	8.1	2.1	7.2	124	21	2.8	0.22	0.03
12	Chirattamala	OW	20.09.03	8.00	712	200	46	21	71	4.1	0	110	258	14	0.52	0.4
13	Paloorokotta	EW	30.09.03	8.48	247	106	18	15	8	4.1	7.2	124	17	4.3	0.39	1.6
14	Vengad	EW	17.10.03	8.16	267	112	20	15	10	4.2	0	149	9.6	7.1	0.36	0.4
15	Vengad	OW	08.11.03	8.55	326	146	28	18	11	4.8	14	159	16	7.1	0.34	0.2
16	Edappal	EW	20.11.03	8.32	764	345	62	46	27	3.1	6	140	197	64	0.57	0.1
17	Kollaparambu	EW	31.01.04	7.66	175	60	13	6.8	9.7	3.6	0	93	7	4.3	0.61	0.8
18	Karuvarakundu	EW	19.03.04	7.74	371	132	33	12	18	8.2	0	227	0	5.7	0.24	0.3
19	Nilambur	EW	03.03.04	7.06	98	26	5.6	2.9	7.5	2.6	0	41	1.9	7.1	0.09	2.6
20	Kollapuram	EW	12.02.04	7.77	163	52	9.6	6.8	7.6	3.7	0	78	2.2	8.5	0.31	1
21	Valluvacherry	EW	11.04.04	7.92	384	158	48	9.2	16	4.2	0	229	5.9	5.7	0.38	0.1

