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Seasonal Variation of Groundwater Quality along Coastal Areas of Kozhikode District

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ABSTRACT : *Population density in the coastal belt of Kerala and the agricultural and industrial growths in these areas have resulted unusual stress on the drinking water availability and its quality. In the light of above, field investigations on the groundwater quality along Kozhikode coast has been investigated. To study the behaviour of ground water quality of open wells along the various coastal stretches of Kozhikode District, CWRDM has set up few observation network of open wells along the coast. The results of water quality of these wells in premonsoon, monsoon, and postmonsoon seasons have been analysed and presented in this paper. Field observations indicate that depending on location within the coastal belt, every centimeter drop of groundwater table is met with an increase of 1 to 200 ppm total dissolved solids and increase of 0.5 to 8 ppm of Chloride. Study also reveals that seawater has an effect upto 400 metres from the shore.*

1.0 Introduction

The quality and quantity of groundwater vary greatly in different parts of coastal belt of Kerala State. This variability is due to the complex geology, topographic, climatic and existing surface hydrological conditions. The lack of data on the occurrence of groundwater, quality and the aquifer productivity are commonly considered to be the greatest constraint in resources assessment for the regional development planning. This particular paper presents the results of ground water quality variation along the coastal stretches of Kozhikode District in the South Western side of Indian Peninsular.

2.0 General Features of the Study Area

The Kozhikode coastal belt lies between north latitudes 11°08' and 11°42' and east longitudes 75°31'48" & 75°49'30". Kozhikode coast is 70 Km long and it stretches from Kadalundikadavu in South to Azhiyur in the north covering an area of 91 sq. km. The average rainfall in the area is about 3000 mm and the temperature varies between 23.5° to 31° celsius. The coast is drained by a large number of west flowing rivers. The important of them are Morat, Kallai, Chaliyar and Kadalundi. Another important feature of this coast is the presence of back water bodies such as Agalapuzha and Elathur.

3.0 Hydrogeological Features of Coast

Geologically, Kozhikode coast is composed of recent to subrecent sediments underlain by laterites. These laterite formation are resting on gneissic and charnockite type of rock. Based on the lithological character and topography the coast can be grouped into the following subdivisions and are shown in Figs. 1 and 2.

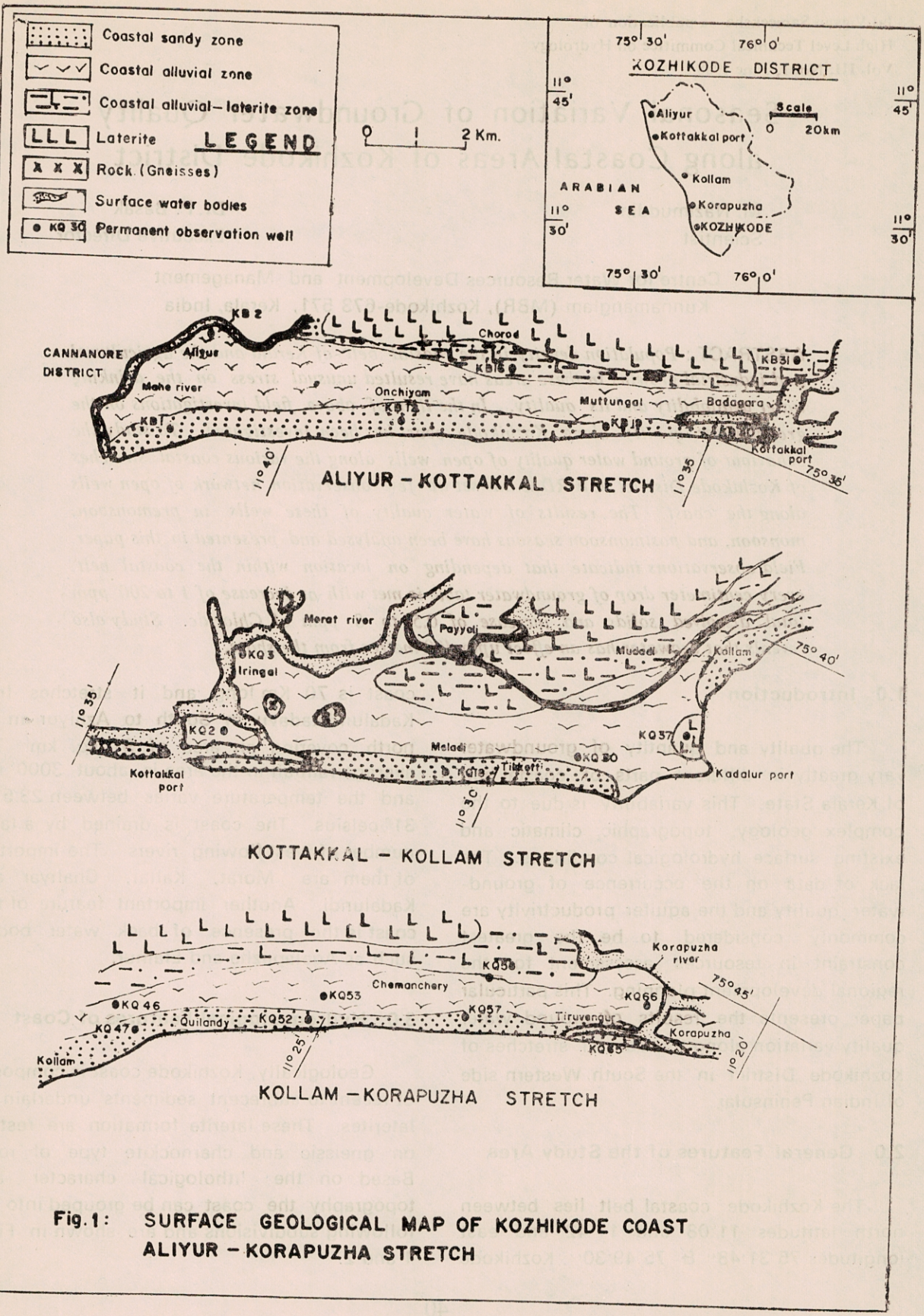
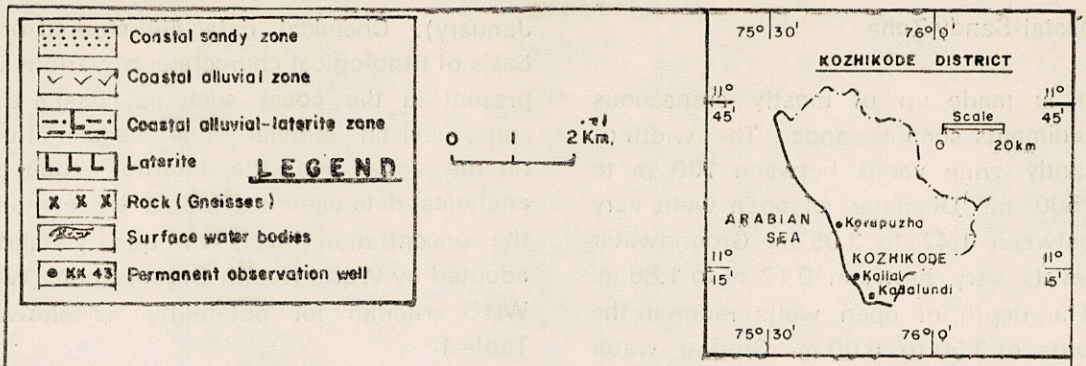
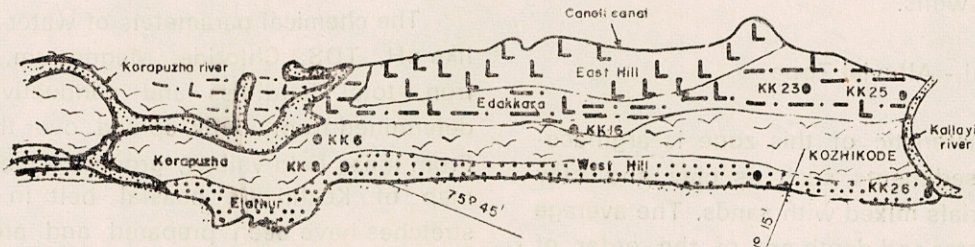
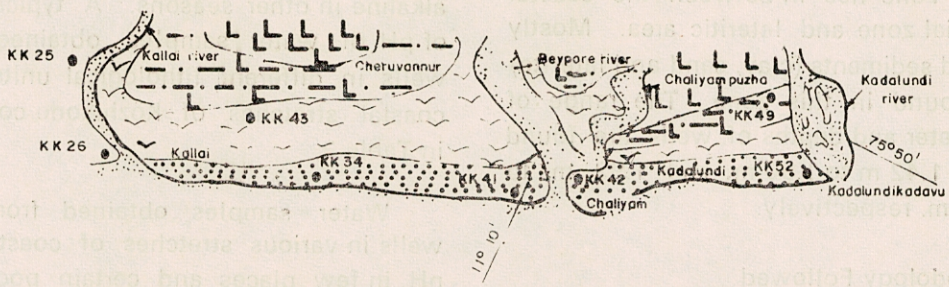


Fig. 1: SURFACE GEOLOGICAL MAP OF KOZHIKODE COAST ALIYUR – KORAPUZHA STRETCH





KORAPUZHA – KALLAI STRETCH



KALLAI – KADALUNDIKADAVU STRETCH

Fig. 2: SURFACE GEOLOGICAL MAP OF KOZHIKODE COAST KORAPUZHA – KADALUNDIKADAVU STRETCH

3.1 Coastal-Sandy Zone

It is made up of mostly arenaceous sediments such as sands. The width of sandy zone varies between 100 m. to 1500 m. Diameter of open wells vary between 1.47 to 3.05 m. Groundwater levels vary between 0.12 m to 1.86 m. The depth of open wells range in the order of 3.50 to 6.00 m. Ground water occurs under water table conditions and is suitable for open wells and filter point wells.

3.2 Coastal - Alluvial Zone

Characteristic of this zone is argillaceous sediments such as clay and clay materials mixed with sands. The average diameter and depth are of the order of 1.63 m. and 4.20 m. Perched water table conditions is common.

3.3 Coastal - Alluvial Laterite Zone

This zone lies in between the coastal alluvial zone and lateritic area. Mostly mixed sediments (clay, sand and laterite) are found in this zone. The range of diameter and depths of wells are found to be 1.42 m to 1.90 m. and 1.92 m. to 5.62 m. respectively.

4.0 Methodology Followed

The general ground water quality in Kozhikode coast were studied from a net work of 36 open wells whose locations are given in Fig. 3. These wells were chosen on the basis of one well for 4 to 5 sq. kms. Factors like proximity to the sea and various surface water bodies, accessibility of the areas, potential pollution sites etc., were considered, while fixing the net work of observation wells. Water samples of these wells were collected in pre-monsoon (April-May), monsoon (July-August) and post - monsoon (December-January). Chemical data are studied on the basis of lithological characters of various units present in the coast such as coastal sandy zone, coastal alluvial zone, coastal alluvial-laterite zone and the laterite zone. The analytical data were interpreted by comparing the concentration levels with quality standards adopted by World Health Organisation (WHO). WHO criterian for potablility is shown in Table-1.

5.0 Results and Discussions

The chemical parameters of water samples like pH, TDS, Chloride, Magnesium, Calcium, Iron, total hardness and conductivity were determined from wells spread over the coast. From these field values, ground water quality map of Kozhikode coastal belt in different stretches have been prepared and are shown in Figs 4 and 5. These studies lead to the following conciusions :

Generally, ground water quality in the Kozhikode coast are found to be potable during premonsoon season. The water becomes alkaline in other seasons. A typical variation of pH of water samples obtained from the wells in different lithological units of various coastal stretches of Kozhikode coast is given in Table 2.

Water samples obtained from the dug wells in various stretches of coast show low pH, in few places and certain pockets show high pH condition. The details of location of wells showing low pH and high pH values are given in Table 3. Perched water table condition of the wells located in coastal alluvial zone and well adjacent to coir retting industry may be the cause of low pH.

Well water that has a hardness of less than 50 ppm. is considered soft. A typical variation of hardness of well waters in different geological horizons of the coastal stretches of Kozhikode in various seasons are given in Table 4.

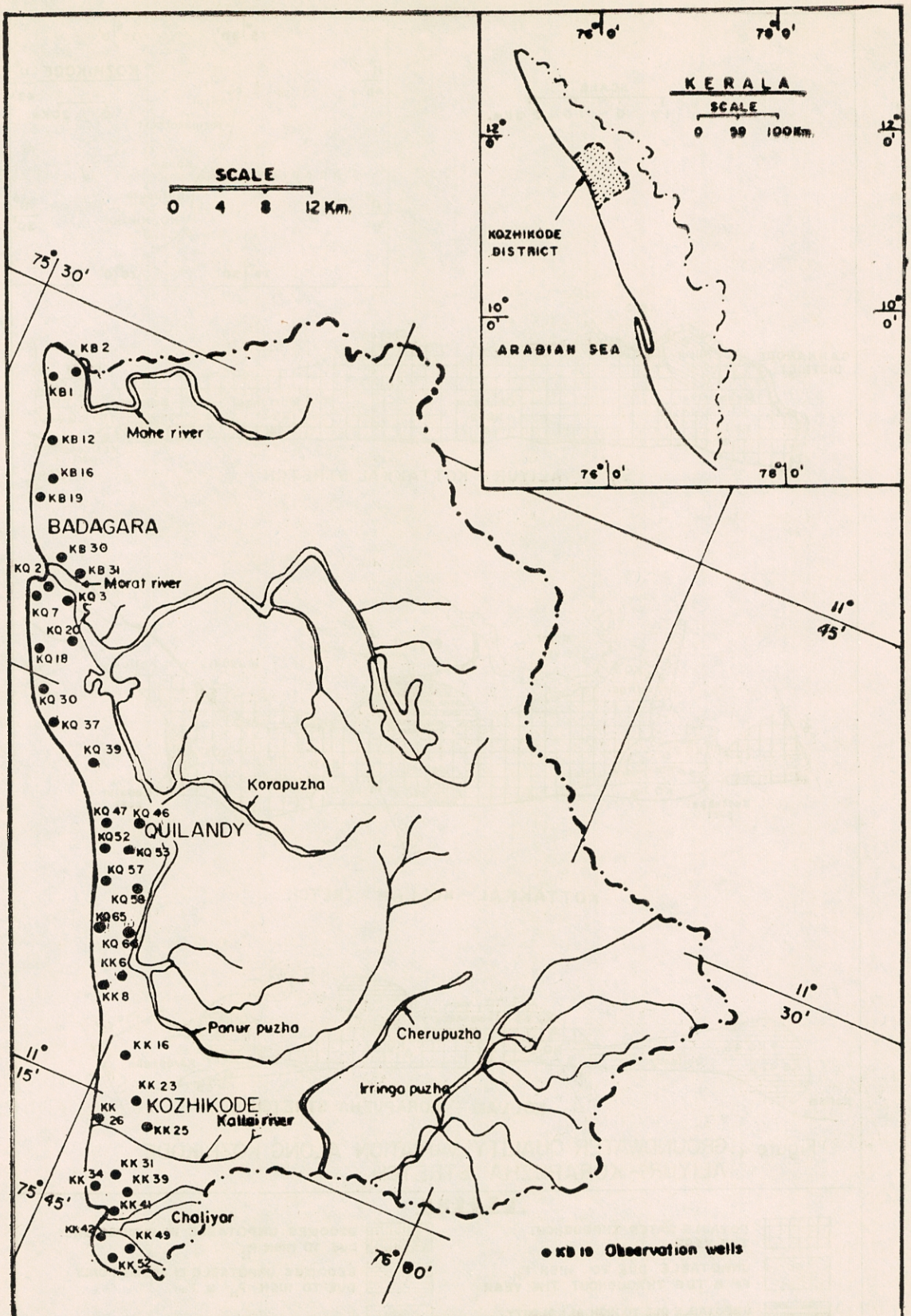


Fig. 3: NET WORK OF OBSERVATION WELLS IN KOZHIKODE COAST

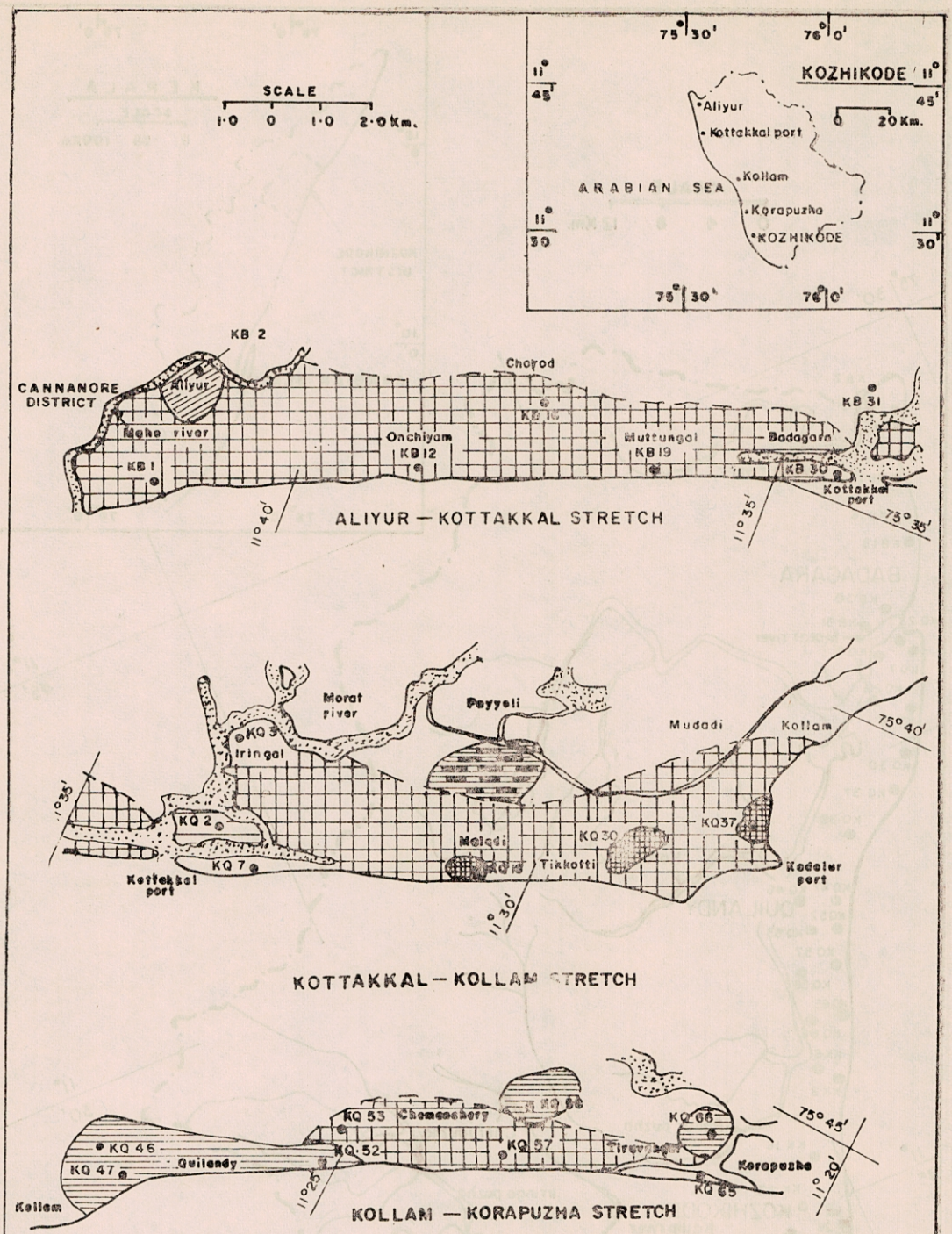


Figure 4: GROUNDWATER QUALITY VARIATION ALONG KOZHIKODE ALIYUR — KORAPUZHA STRETCH

LEGEND

- POTABLE WATER THROUGHOUT THE YEAR
- UNPOTABLE DUE TO HIGH P_H Fe & TDS THROUGHOUT THE YEAR
- UNPOTABLE DUE TO HIGH ALKALINITY (P_H > 8·5) ALL OVER THE YEAR
- BECOMES UNPOTABLE IN SUMMER ONLY DUE TO HIGH P_H
- BECOMES UNPOTABLE IN SUMMER ONLY DUE TO HIGH P_H & Fe
- RIVERS & BACK WATERS

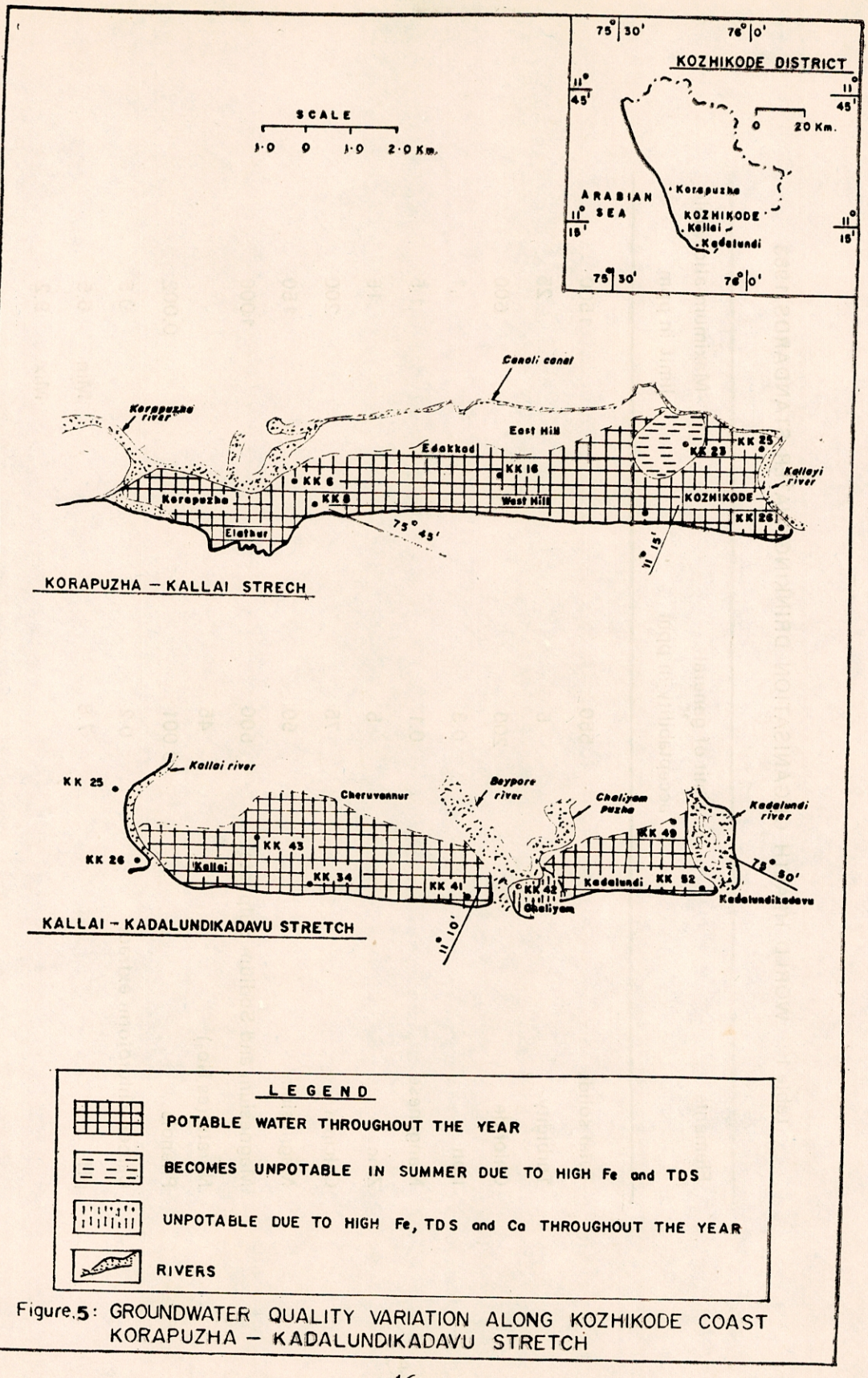


Figure 5: GROUNDWATER QUALITY VARIATION ALONG KOZHIKODE COAST KORAPUZHA – KADALUNDIKADAVU STRETCH

Table 1 : WORLD HEALTH ORGANISATION DRINKING WATER STANDARDS 1983

Elements	Limit of general acceptability in ppm	Maximum allowable limit in ppm
Total solids	550	1500
Turbidity	5	25
Chloride	200	600
Iron	0.3	1
Manganese	0.1	1.5
Zinc	5	15
Calcium	75	200
Magnesium	50	150
Magnesium and Sodium Sulphate	500	1000
Nitrate (as No_3)	45	
Phenols	0.001	0.002
Carbon-chloroform extract	0.2	0.5
pH	7.8	Min. 6.5
		Mix. 9.2

TABLE 2 : pH VARIATION OF WELL WATER IN VARIOUS STRETCHES ALONG KOZHIKODE COAST

Name of the Coastal Stretches	Geological Horizons								
	Coastal Sandy Zone			Coastal Alluvial Zone			Coastal Alluvial Laterite Zone		
	Premon-soon	Mon-soon	Post-monsoon	Premon-soon	Mon-soon	Post-monsoon	Premon-soon	Mon-soon	Post-monsoon
Aliyur-Kottakkal	6.58	7.76	7.10	—	—	—	6.20	7.61	6.88
Kottakkal-Kollam	6.42	7.64	6.97	6.05	7.46	6.90	7.75	7.86	7.45
Kollam-Korapuzha	6.52	7.23	7.10	6.20	7.50	7.63	—	—	—
Korapuzha-Kallai	6.93	7.52	7.23	7.20	6.69	6.95	7.55	7.86	7.56
Kallai-Kadalundikadvu	6.96	7.30	7.16	7.20	7.50	7.05	—	—	—

TABLE 3 : LOCATION AND THE GEOLOGICAL HORIZONS OF LOW pH AND HIGH pH WELLS ALONG THE COAST

Name of the Stretch	Well No.	Location	Name of the Horizon	High/Low pH
Aliyur-Kottakkal	KB 30	Purakkara	Coastal sandy zone	Low pH, less than 6
Kollam-Korapuzha	KQ 52	Edakulam beach	Coastal sandy zone	Low pH, less than 7
Kallai-Kadalundikadavu	KK 34	Naduvattom	Coastal sandy zone	High pH, less than 8
Aliyur-Kortakkal	KB 02	Aliyur	Coastal alluvial zone	Low pH, less than 4
Kottakkal-Kollam	KQ 30	Tikkoti	Coastal alluvial zone	Low pH, less than 6
Kollam-Korapuzha	KQ 46	Kollam	Coastal alluvial zone	Low pH, less than 6
Kollam-Korapuzha	KQ 53	Edakulam	Coastal alluvial zone	Low pH, less thon 6
Kallai-Kadalundikadavu	KK 39	Beypore	Coastal alluvial zone	Low pH, less than 6
Kottakkal-Kollam	KQ 20	Payyoli	Coastal alluvial zone	Low pH, less than 6
Aliyur-Kottakkal	KQ 37	Kadalur beach	Laterite formation	Low pH, less than 6

Table 4 : TYPICAL VARIATION OF HARDNESS OF WELL WATERS IN DIFFERENT GEOLOGICAL HORIZONS OF THE COASTAL STRETCHES IN VARIOUS SEASONS

Name of the Costal Stretches			Total hardness in ppm. Premonsoon	Postmonsoon	Monsoon
COASTAL SANDY ZONE					
	Well No.	**Location**			
	KB 01	Azhiyur Puzhithala	228	194	104
	KQ 07	Kottekkal	190	64	85
	KB 19	Kuriadi Beach	210	138	84
	KR 26	Koteiroad, Kallai	418	230	248
	KK 08	Puthiyappa	305	189	179
	KQ 65	Kannankaduv	350	170	138
COASTAL ALLUVIAL ZONE					
	Well No.	**Location**			
	KB 02	Azhiyur	2760	20	13
	KQ 66	Korapuzha	208	164	174
	KK 31	Meenchanda	105	110	72
	KK 41	Beypore	156	110	70
COASTAL ALLUVIAL-LATERITE ZONE					
	Well No.	**Location**			
	KQ 03	Iringal	300	270	140
	KK 25	East Kallai	390	180	160
	KB 31	Puthupanam	220	96	46
	KK 23	Mavoor Road (KSRTC Bus stand)	390	180	166

Results indicate that certain pockets in Kozhikode coastal stretches contain hard water. These wells are concentrated in Azhiyur, Kadalundi, East Kallai, Iringal and Korapuzha. Lime Shells are found in Calicut backwaters as stratified deposits. Because of the concentration of lime industries as mentioned above, the ground water deposits are clogged with $CaCo_3$ and thereby likely to affect adversely the yield as well as water quality.

The iron concentration of well waters in various coastal stretches vary between 0.20 ppm. to 0.80 ppm in different seasons. General variation of Fe concentration in wells located in various lithological units of the coast is given below :

Lithological Units	Premonsoon in ppm	Postmonsoon in ppm	Monsoon in ppm
Coastal sandy zone	0.30 to 0.43	0.25 to 0.55	0.25 to 0.55
Coastal alluvial zone	0.40 to 0.80	0.30 to 0.60	0.20 to 0.45
Coastal alluvial-laterite zone	0.30 to 0.50	0.30 to 0.60	0.30 to 0.40

Ground water is found to contain excessive iron (more than 1 ppm) at Beypore Port, Edakulam beach and near KSRTC Bus Stand of Calicut City.

Chemical analysis data and field investigations reveal that there are pockets saline water intrusion. They are

(i) Aliyur in Aliyur-Kottakal coastal stretch
(ii) Chaliyam in Kallai - Kadalundikadavu stretch

Field observations indicate, that depending on location within the coastal belt of District, every centimeter drop of ground water is met with an increase of 1 to 20 ppm of total dissolved solids and increase of 0.5 to 8 ppm of Chloride. Earlier studies (Basak and Nazimuddin, 1987) on Coastal wells of Kozhikode District reveal that the seawater has an effect upto 400 metres zone from the shore. This implies that during summer, groundwater use by the well owners have to be restricted to minimise the fall of the lowering water table with specific reference to this 400 metre zone. As a long term measure, recharging the coastal aquifers to maintain, the optimum groundwater level in summer has to be thought of.

The field investigations and chemical data on water samples from dugwells located at Aliyur (KB_2) near to Mahi river, Payyoli near to Morat river and Chaliyam near Beypore port indicate that ground water remain unpotable through out the year. This unpotability is mainly due to high pH, Fe and TDS. Ground water in places like Tikkoti beach, Meladi and Kadallur become alkaline in summer, whereas places around Tiruvangur and Korapuzha, the wells become alkaline as well as ferric ($Fe > 1$ ppm) during summer. Bariing the pockets mentioned above ground water along the Kozhikode coastal belt is found to remain potable through out the year.

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