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Research paper

Studies on Groundwater Problems in an Area Subjected to Sea Water Ingression and Seepage Into Groundwater in Karaikal District Using GIS

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Abstract

Fresh groundwater quality and accessibility in coastal zones is influenced via seawater interruption into coastal aquifers, and coastal water quality and biological community status might be altogether influenced by groundwater pollutants that are transported into coastal waters by submarine groundwater discharge (SGD). SGD and its pertinent evaluation as one associating part among the different principle local pathways of freshwater and tracer/poison contributions from land to sea and the coordinated framework working of both and as primary segments of the same coastal groundwater framework. An elective technique might be to control seawater interruption through fake groundwater revive, for example by adequately treated wastewater, which may impressively decrease long haul patterns of saltiness increment in pumped groundwater, notwithstanding for little simulated energize rates contrasted with pumping rates. Both the outside sources and the interior wellsprings of water seepage might be distinguished via doing infrared thermo-realistic assessments subsequent to directing water snugness tests, flooding tests or pressure driven tests as suitable. A contextual investigation was led to discover the examinations on groundwater issues in a region subjected to sea water ingression and seepage into groundwater in Karaikal

Keywords: *Ground water, Sea water, Water ingression, Seepage and GIS.*

1. Introduction

1.1. Water Resources Management

The water resources of the Union Territory still be undervalued and overused while not reference to current prices and future necessities, as indicated during this chapter. There's increasing pollution due to urbanization and industrialization the Union Territory. Though all the four are coastal areas, the water resources problems in every regions are completely different as a result of the pattern varies from region to region. the main target of the discussion during this chapter are going to be on the Pondicherry region as a result of it's the biggest of the constituent regions and is already facing serious issues of management.

1.2. Seepage

Seepage is most dangerous in groundwater. Most of the places seepage occurs due to leakage of defective drain pipes, Deteriorated waterproofing of floor slabs or bath-tub seals. Seepage of waste water or rain water through roof / external wall. Fig.1 shows the seepage.



Fig.1: Seepage

Fig.2 shows the Cauvery river delta plain which is located in Tamil Nadu.

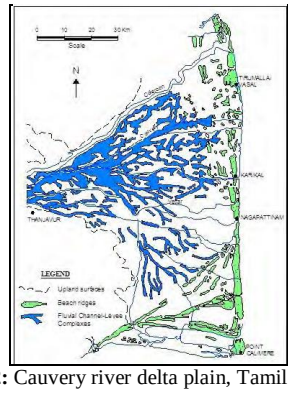


Fig.2: Cauvery river delta plain, Tamil Nadu

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More than 70 percent of the geographical area of Tamil Nadu State is underlain by crystalline formations comprising charnockites, granite gneisses, khondalites and mixed gneisses with intrusion of quartz veins, pegmatite's, dolerite dykes and senates etc.

1.3. Drainage System

Drainage is the natural or artificial removal of a surface's water and sub-surface water from an area. The inner drainage of most agricultural soils is right enough to save you intense water logging (anaerobic conditions that harm root increase), however many soils need artificial drainage to enhance manufacturing or to manage water supplies.

2. Methodology

Fig.3 shows the methodology of this study.

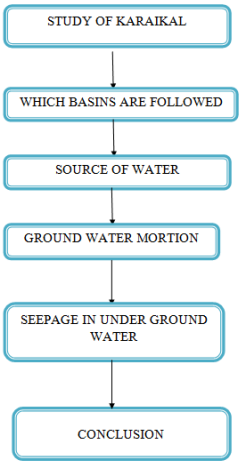


Fig.3: Methodology

3. Study Area of the Karaikal

About 150 km. further south from Pondicherry on the east coast lies the Karaikal region between $10^0$49' and $11^0$01' N latitudes and $79^0$37' and $79^0$53'E longitudes with an area of 161 sq. km. It consists of six communes (Panchayats), comprising100 villages.

3.1. Basin and Sub-Basin

The Karaikal region of U.T of Pondicherry is part of Cauvery basin. Table 1 shows the net area irrigated by (Ha).

Table 1: Net area irrigated

S.No.	Net area irrigated by (Ha)	
1	Canals	5988
2	Tanks	-
3	Tube wells	80
4	Ordinary wells	-
5	Other sources*	13
6	Total Area Irrigated (Net)	6081
7	Area irrigated more than once	642
8	Total Gross Area irrigated	6723

(Source: Directorate of Economics and Statistics, Puducherry)

The characteristic resources, water are unarguably the most fundamental and valuable. Life started in water and life is sustained with water. Ninety seven percent of the world's water is found in seas. Just 2.5% of the world's water is non-saline crisp water. There are organisms, for example, anaerobes, which can get by without oxygen. Yet, no living being can make due for any time allotment without water. It is an all inclusive dissolvable and as a dissolvable it gives the ionic adjust and supplements, which bolster all types of life. In India lakes, waterways and ground water are utilized for the local and agriculture purposes. The major sources of water of water are rainfall, surface water including waterways, lakes and groundwater including wells bore wells and so on. As of late, the development of industry, innovation, populace and water utilize has expanded the worry upon both our territory and water resources.

3.2. Ground Water

Pondicherry is invested with significant groundwater resources. The utilizable groundwater resources (at 85per penny of the gross energize potential) is surveyed at 151 MCM.Table 2 demonstrates the ground water region.

Table 2: Ground water area

S.No	Classification	Area (Ha)
1	Forests	-
2	Barren & Uncultivable Lands	-
3	Land put to non agricultural uses	4747
4	Cultivable Waste	2456
5	Permanent Pastures & other grazing lands	-
6	Groves not included in the area sown	188
7	Current Fallows	548
8	Other Fallow Lands	1584
9	Net Area sown	6489
	Total	**16012**

(Source: Directorate of Economics and Statistics, Puducherry)

4. Source of Water

4.1. Surface Water

Two major rivers are flow in Pondicherry region such as Gingee River and Ponnaiyar (Penniyar) river. About 140 small and two big tanks are in the region. These tanks are interlinked and act as water storage for agricultural purposes as well as to recharge the groundwater. Groundwater occurs in all of the geological formations ranging in age from the Archaeans to latest, which can be widely categorized into two hydrogeological units viz., (i) Fissured and fractured crystalline formations and (ii) Porous sedimentary formations. Table 3 demonstrates the tanks within the Pondicherry area.

Table 3: Tanks in the Pondicherry Region

Tanks in the Pondicherry Region

Sl.No	Commune/ Municipality	System tanks	Non- system tanks	Total number of tanks	Command area in hectares
1.	Pondicherry	2	0	2	230.8
2.	Ozhukarai	0	2	2	589.8
3.	Villianur	4	11	15	1399.2
4.	Mannadipet	19	8	27	1291.7
5.	Nettapakkam	11	4	15	976.0
6.	Bahour	22	0	22	1784.2
7.	Ariankuppam	1	0	1	320.9
	Total	**59**	**25**	**84**	**6592.6**

Source: Dhan Foundation (2002).

Table 4 shows the ponds in Pondicherry region.

Table 4: Ponds in Pondicherry region

Ponds in Pondicherry Region

Sl. No.	Name of the taluk	No. of ponds
1.	Bahour sub-taluk	173
2.	Pondicherry taluk	174
3.	Villianur sub-taluk	151
	Total	498

Source: Dhan Foundation (2002).

Fig.4 shows the Cauvery basins elevation.

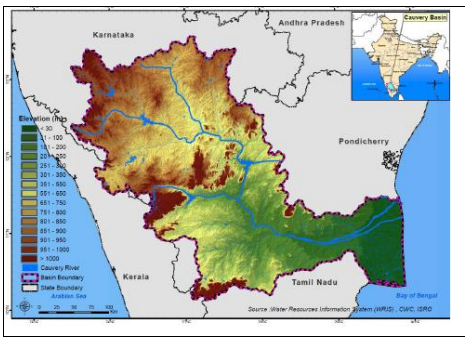


Fig.4: Cauvery Basins Elevation

5. Ground Water Problems

5.1. Seepage of Ground Water

Seepage as the hydrological procedure of groundwater rising at the surface and groundwater sapping as the geomorphologic procedure of disintegration by undermining which is activated by seepage, despite the fact that not all disintegration by seepage of groundwater brings about undermining. A channel is an assemblage of flowing water, i.e., a dynamic fluvial feature. We conjecture that a neighborhood groundwater source, e.g., as consequence of privately invaded precipitation, brings about less groundwater flow theft contrasted with groundwater that first voyages some separation before seepage to the surface, since seepage from an adjacent source is less impacted by the topographic slope in charge of flow robbery. Since flow robbery is an essential instrument in the arrangement of valleys by groundwater seepage, we expect extraordinary and particular morphological improvement for valleys framed by seepage from a nearby source contrasted with those created by distally encouraged frameworks. Fig.5 shows the Studies on GW problems in an area subjected to sea water ingression and seepage in to GW in karaikal

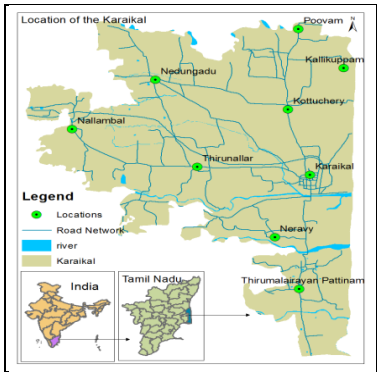


Fig.5: Studies on GW problems in an area subjected to sea Water ingression and seepage in to GW in karaikal

Fig.6 shows the methodology flow chart.

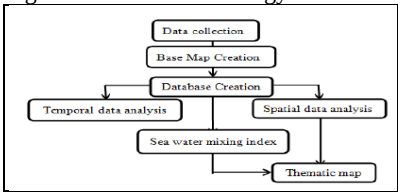


Fig.6: Methodology flow chart

Fig.7 shows the location map.

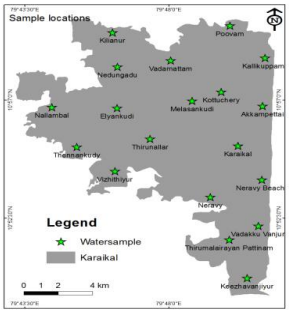


Fig.7: Location map

5.2. Seawater Mixing Index (Smi)

As an effective tool for quantitative estimation of the relative level of seawater blending in certain water, in this paper we propose a parameter called 'Seawater Mixing Index (SMI)'.On the off chance that the ascertained SMI value is >1, the water might be considered to clearly record the impact of seawater mixing. Fig.8 shows the cumulative probability (%).

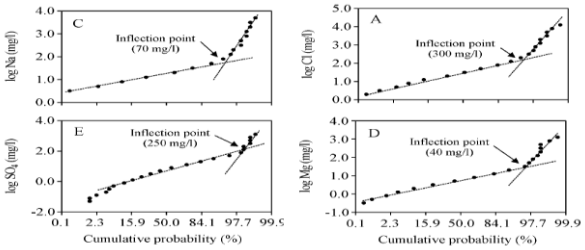


Fig.8: Cumulative probability (%)

Table 5 shows the Water sample analysis and sea water mixing index of Karaikal district

Table 5: Water sample analysis and sea water mixing index of Karaikal district

Sample number	Village name	EC	TDS	Na	Mg	Cl	SO_4	SMI
1	Karaikal	565	325	1920	12.3	42	21.3	8.60
2	Thirumalairayan Pattinam	768	296	62	15.6	1260	10.2	2.69
3	Neravy	1020	525	350	23.6	120	16.5	1.81
4	Nallambal	4523	2900	1820	48.6	1310	52.3	10.61
5	Nedungadu	1230	1500	1500	49.6	720	53.1	8.08
6	Kallikuppam	952	562	59	5.2	41	1.6	0.34
7	Poovam	1200	950	120	12.6	63	4.5	0.67
8	Thirunallar	3210	1800	1200	32.1	1010	51.3	7.28
9	Kottuchery	1150	952	650	16.5	520	42.3	3.90
10	Keezhavanjiyur	942	420	57	6.5	29	2.3	0.31
11	Thennankudy	2030	3020	1300	45.6	1120	36.4	7.94
12	Vizhithiyur	3410	2500	1250	39.8	1030	39.4	7.55
13	Kilianur	1600	1200	920	42.5	850	26.4	5.74
14	Elyankudi	3650	2750	1350	49.5	1300	50.3	8.51
15	Vadamattam	1930	965	850	23.5	910	42.3	5.53
16	Melasankudi	1100	820	450	29.8	640	42.3	3.25
17	Neravy Beach	750	285	75	7.6	35	1.7	0.41
18	Akkampettai	840	230	62	10.2	46	3.5	0.37
19	VadakkuVanjur	650	320	65	12.6	50	2.4	0.40

Fig.9 shows the water sample analysis for calcium

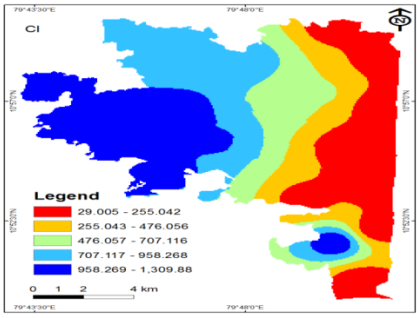


Fig 9: Water sample analysis for calcium

Fig.10 shows the water sample analysis of EC values.

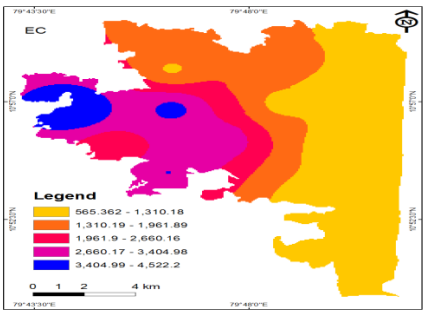


Fig 10: Water sample analysis EC values

Fig.11 shows the magnesium value in study area.

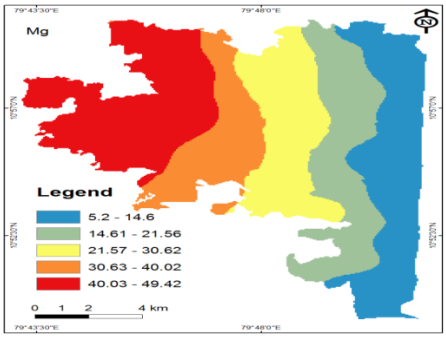


Fig.11: Magnesium values in study area

Fig.12 shows the sodium values in study area.

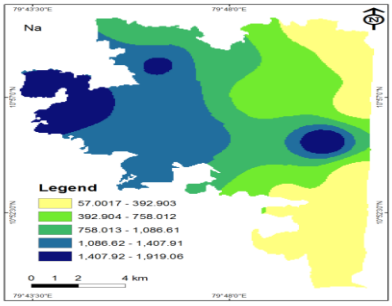


Fig.12: Sodium values in study area

Fig.13 shows the analysis results of SO_4 values.

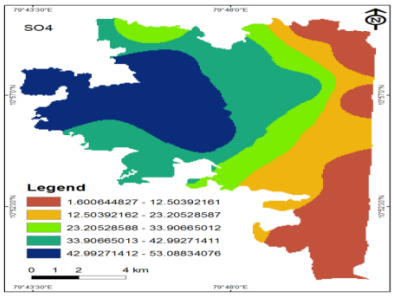


Fig.13: Analysis results of SO_4 values

Fig.14 shows the TDS values of karaikal.

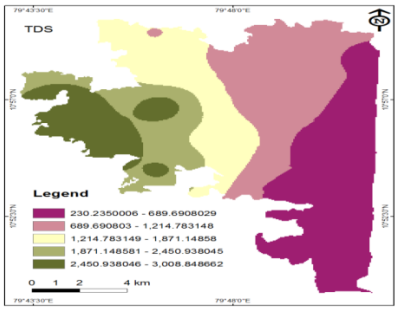


Fig.14: TDS values for Karaikal

Fig.15 shows the sea water mixing index (SMI) for study area.

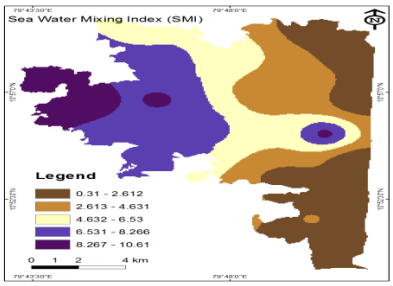


Fig.15: Sea water mixing index (SMI) for study area

Fig.16 shows the cross plot between SMI vs Cl

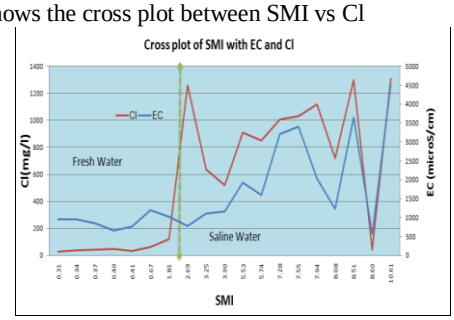


Fig.16: Cross plot between SMI vs Cl

6. Conclusion

From the analysis results for efficient and controlled development of groundwater resources groundwater mapping is essential. The main reason for saltwater intrusion is higher amount of groundwater withdrawals and freshwater drainage along the coasts. Karaikal dist used modeling approach to integrate the physio – chemical factors of groundwater potential using spatial map of Karaikal district using GIS. Additional work is required to understand the morphological details of valleys formed by groundwater seepage. In particular, we expect important effects on valley shapes to result from layered substrates with alternations in material credibility.

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