Computation of Seawater Intrusion in Coastal Area

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***Abstract*—Sea water intrusion is one of the most serious environmental problems in many coastal regions all over the world. It affects the water quality, vegetation, soil conditions. It causes variation in pH, chloride contents, quality, colour, turbidity etc of the existing water. So the main difficulty we can see from the coastal regions is unavailability of drinking water. Sea water intrusion occurs naturally in most coastal aquifers which are caused by hydraulic connections and density difference between groundwater and sea water. The amount of dissolved salt in groundwater causes the variation in properties of the existing water by analysing the water samples by checking each properties in the lab we can find the amount of variations, and compare the values with standard index we can find the area is prone to sea water intrusion or not. Its objectives includes to understand the change in the water table and the water potential zone and Preparation of the various thematic maps or graphs for the representation of the problem.**

Keywords: seawater intrusion, coastal areas, index, parameters, Ground water

I.INTRODUCTION

Coastal aquifers are one of the most important water resources in the world. Sea water intrusion is one of the most serious environmental problems in many coastal regions. It affects the water quality, vegetation, soil conditions. So the main difficulty we can see from the coastal regions is unavailability of drinking water. In addition to that the natural discharge of freshwater to the sea as submarine groundwater discharge (SGD) which has an important role in the ecology of marine environments and the sustainable development. The dynamics of seawater and freshwater within coastal aquifers are highly sensitive to disturbances, and their inappropriate management may lead to the deterioration of water quality. In many coastal aquifers, seawater intrusion has become the major constraint imposed on groundwater utilization. Groundwater exploitation and climate variations create dynamic conditions, which can significantly increase the intrusion of seawater into the aquifer and may result in the Stalinization of wells. They may also reduce SGD and affect the water budget of marine systems. The excess seawater intrusion entirely changes the parameters of the water and destroys its quality, Hence it cannot be used for any purposes

II. LITERATURE REVIEW

The studies bring about the salient points of published literatures and other reported works.

1. P. Prusty, S. H. Farooq(2020)"Seawater intrusion in the coastal aquifers of India "Is a study of buried paleochannels is of scientific interest to understand hydrogeology. It use direct methods: geochemical methods, indirect methods: geophysical methods. It conclude that the seawater intrusion is more prominent on the east coast than the west coast of India.

2. C. P Kumar (2016)"Sea water intrusion in coastal aquifers" Hydrological aspects, control measures and modeling by Ghyben-Herzberg principle are used as objectives in this study. Physical, Analytical and numerical Models are used to analyze and it conclude that it provide better withdrawal of groundwater from networks so to reduce seawater intrusion.

3. Setyawan Purnama (2019),"Groundwater vulnerability from seawater intrusion in coastal area" It analyze groundwater vulnerability to the SWI using the method GALDIT by using Dupuit Gheyben-Herzberg method. It reaches the conclusion that the area which located closer to the shoreline had higher vulnerability to SWI.

4. Soumaya Hajji &Nabila Allouche (2021), "Assessment of seawater intrusion in coastal aquifer using hydrochemical facies" Is a study of detoriation of groundwater by sea intrusion. By testing physio-chemical properties from 37 wells and integrated in GIS. Conclude that high level of Na and Cl ions in groundwater indicate significant effect of sea water.

5. Mark Saadeh, Elie Wakim(2017), "Deterioration of Groundwater in Beirut" Due to Seawater Intrusion" TDS and pH were measured using individually calibrated portable test and principle dynamics, myriad methods may then be employed. It concluded that study emphasize the need for immediate implementation of (IWRM)

6. Min Wang, Mei Han, Hongkuan Hui,and Yunlong Li(2019), "Study on seawater intrusion in Laizhou bay coastal zone" Studied that seawater intrusion area was approaching inland time went on, and transverse distributionwas irregular. Regional, Data and Detection method are used for evaluating. Conclude that the groundwater chlorinity decreased with the increase of the distance with the coast.

7. A .A. Javed, M. S. Hussain, M. M. Sheriff(2013), "Optimal control of seawater intrusion in coastal aquifers" Aims to Optimize control of seawater. Uses method based on combination of saline near shore land and recharge of aquifer of surface ponds. Conclude that the resulting in least cost and salt concentration in aquifer

III. OBJECTIVES OF WORK

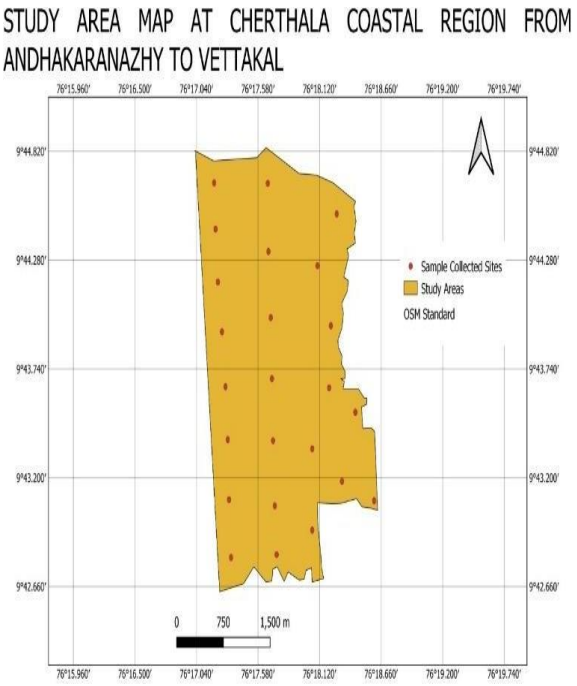
- To understand various parameters which getsaffected by sea water intrusion
- Identify the parameters includes ph, acidity,alkalinity, hardness, turbidity etc
- To understand the change in the water table and thewater potential zone.

IV. METHODLOGY

This test is to be carried out in coastal areas of Alappuzha district. Samples needed for the project are collected from places in and near Cherthala Taluk. Firstly we need to collect samples form that places, usually we are taking samples from the wells. Then after collecting samples we are testing that samples in the laboratory for evaluating the pH, acidity, alkalinity, turbidity, hardness for identifying the quality of the water samples. After getting the datas of various samples, we are plotting graphs related to each parameter and analyse the places whether it is prone to sea water intrusion or not. After analyzing we are providing suitable remedial measures to avoid the excess Seawater intrusion.

V. MATERIALS USED

1. Sample Details



Map. 1 : Showing the area from which the sample is collected.

(Note: Samples are numbered from top to bottom. That is sample 1-8 in the first column comes 1st then sample 9-15 then sample 16-21 and remaining are marked as 22,23&24)

Sample No.	Samples collected from	Place	Ward	Panchayat
1	Joseph T, puthenpurackal	Andhakaranazhy	19	Pattanakaad
2	Vishvan Nair, Pathilchira	Andhakaranazhy	19	Pattanakaad
3	Jhony scaria,Mundakathil	Andhakaranazhy	17	Pattanakaad
4	Mathew K, Kadavath	Andhakaranazhy	17	Pattanakaad
5	Benedict philp,Vazhayil	Ottamacheriy il	1	Pattanakaad
6	Daniel chacko, Veliyakunnel	Ottamacheriy il	1	Pattanakaad

7	Philp Zacharia, Palaparambil	Thyckal	14	Pattanakaad
8	Joseph M, Veliyakulangara	Thyckal	12	Pattanakaad
9	Wilson chacko, Thalaparampil	Andhakaranazhy	1	Pattanakaad
10	Dominic Cherian, Thavalaparamp il	Andhakaranazhy	18	Pattanakaad
11	Edison Regi, Palathara	Vettakal	16	Pattanakaad
12	Eldho Manuel, koyithra	Arassupuram	16	Pattanakaad
13	Lijo Varkey, Kottarathil	Arassupuram	2	Pattanakaad
14	David Samuel, Kalapurackal	Thyckal	13	Pattanakaad
15	Jacob mathew, Thyparampil	Thyckal	13	Pattanakaad
16	Antony Varghese, Mangalacheriy il	Thyckal	11	Pattanakaad
17	Saju K, Kadamaat	Andhakaranazhy	1	Pattanakaad
18	Udayakumar, Puthenchira	Andhakaranazhy	18	Pattanakaad
19	Common Panchayath well	Maniyampuzhy	13	Pattanakaad
20	Thresia Jose, Kumbalacheriyil	Vettakal	14	Pattanakaad
21	Emmanuel, Edavazhikal	Kanattusheriyil	15	Pattanakaad
22	Common panchayath well	Kanattusheriyil	15	Pattanakaad
23	Nagarajj, Pathinanjil chira	Kandamanga lam	5	Pattanakaad
24	Tom Chacko,Pidikayil	Thyckal	7	Pattanakaad

Fig.a: shows the collected 25 samples

2. Reagents Required For Testing

- Reagents used for testing acidity are,
  a. .02N Standard NAOH solution
  b. Methyl Orange indicator
  c. Phenolphthalein indicator
  d. .1Normal Sodium Thiosulphate
- Reagents required for testing alkalinityare,

a. Standard Sulphuric acid
b. Methyl Orange indicator
c. Phenolphthalein indicator

- Reagents used for testing hardness are asfollows,

a. Ammonia Buffer Solution
b. ErichromeBlack T
c. Standard EDTA Titrant .01M

VI. TESTS TO BE CONDUCTED

Following are the tests to be conducted to check the changein parameters. It includes

1. pH Test
2. Acidity Test
3. Alkalinity Test
4. Hardness Test
5. Turbidity Test

1. pH TEST

Clean the electrode using distilled water and dry it using tissue paper. Calibrate the equipment with known buffer solution. Dip the combined electrode in the solution to determine its ph value. pH of drinking water should be in the range 6.5-8.5

Fig. a :Shows the ph test

2. ACIDITY TEST

Pipette 500ml of the sample into a Erlenmeyer flask. Add one drop of 0.1N sodium thiosulphate solution if residual chlorine is present. Add two drops of methyl orange indicator. Titrate the sample against O.2N NaoH solution. Note the volume of titrant at the end point when the color changes from orange red to yellow. Add 3 drops of phenolphthalein indicators to the above & continue titration till an appearance of faint pink colour. Note the volume of titrant. Acidity for potable water should be less than 50mg/l

Fig. b :shows the Acidity test

3. *ALKALINITY TEST*

Pipette 50ml of sample into Erlenmeyer flask. Add 1 drops of sodium thiosulphate if residual chlorine is present. Add two drops of phenolphthalein indicator (if PH is above 8.3 colour of solution becomes pink).Titrate the sample against standard acid taken in the burette till the colour just disappears. Add two drops of methyl orange indicator the colour turns to yellow. Again titrate against acid till the yellow colour changes to orange yellow or orange red. Note down the volume of the titrate used from the initial reading. Alkalinity of potable water should be less than200mg/l

Fig. c:Shows the Alkalinity Test

4. HARDNESS

Take a sample which will acquire less than 15 ml EDTD titrant.Dilute 25 ml of the sample about 50 ml by adding distilled water (v). In case of samples of low hardness take a larger sample volume.Add 1 or 2 ml of buffer solution to being the ph 10 + or -. 01Add 1 or 2 drops of indicator solution if ca or mg hardness is present, the solution turn wine red.Titrate against EDTA titrant till the sample turn blue.Note the volume of the titrant. Hardness of potable water is less than 60mg/l

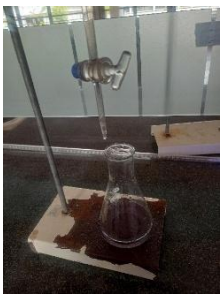


Fig. d:Shows the Hardness Test

5. TURBIDITY

Transfer the sample to the test. Open the lid of the sample compartment of the instrument calibrated as above and insert the test tube into the sample compartment. Close the lid. Note the reading and read out as turbidity of sample in NTU. Turbidity value of potable water is less than 5 NTU

VII. OBSERVATIONS

Following are the observations obtained while testing the samples,

- **PH-ACIDIC/ALKALINE-ACIDITY-ALKALINITY-HARDNESS-TURBIDITY**

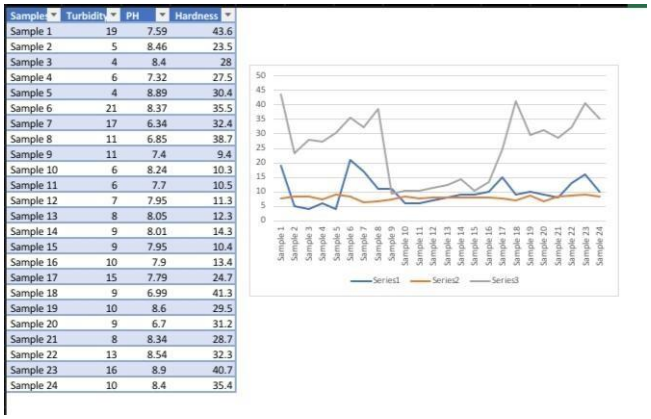
Sl No	pH value	Acidic/Alkaline	Acidity (mg/l)	Alkalinity (mg/l)	Hardness (mg/l)	Turbidity (NTU)
1	7.59	Acidic	134	0	43.6	19
2	8.46	Alkaline	0	206	23.5	5
3	8.00	Alkaline	0	222	28.00	4
4	7.32	Acidic	110	0	27. 5	6
5	8.89	Alkaline	0	228	30.4	4
6	8.37	Alkaline	0	94	35.5	21
7	6.34	Acidic	190	0	32.4	17
8	6.85	Acidic	170	0	38.7	11
9	7.4	Acidic	130	0	9.4	11
10	8.24	Acidic	118	0	10.3	6
11	7.7	Acidic	154	0	10.5	6
12	7.95	Acidic	198	0	11.3	7
13	8.05	Acidic	174	0	12.3	8
14	8.01	Acidic	170	0	14.3	9
15	7.95	Acidic	158	0	10.4	9
16	7.9	Acidic	135	0	13.7	10
17	7.79	Acidic	170	0	24.7	15
18	6.99	Acidic	228	0	41.3	9
19	8.60	Alkaline	0	118	29.5	10
20	6.7	Acidic	180	0	31.2	9
21	8.34	Alkaline	0	136	28.7	8
22	8.54	Alkaline	0	224	32.3	13
23	8.9	Alkaline	0	214	40.7	16
24	8.4	Alkaline	0	238	35.4	10

VIII. RESULTS

Value ranges for Potable water are:

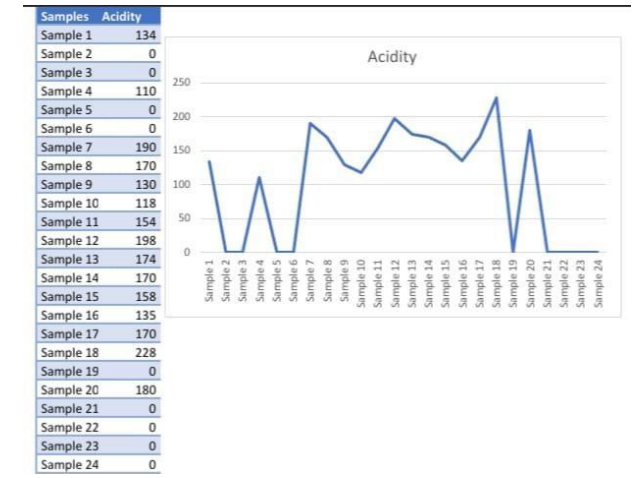
- The pH of most drinking-water lies within the range 6.5–8.5
- Turbidity (NTU):<5
- Acidity(mg/L):<50
- Alkalinity (as CaCO3) (mg/L):<200
- Hardness:<60

That means the samples 3&5 are within the limit for the conditions of turbidity. All samples are within the limits of hardness. Ph for the samples 5,19,22,23 are not in the limit, their for cannot be used for drinking purpose. As per alkalinity test samples 6, 19,21 are portable and no samples are portable according to acidity test. Hence it proves that the area which is along the coastal area faces more difficulties due to seawater intrusion.



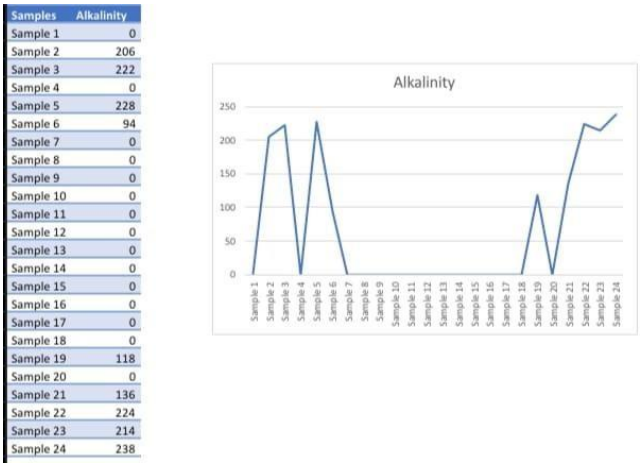
Samples	Turbidity	PH	Hardness
Sample 1	19	7.59	43.6
Sample 2	5	8.46	23.5
Sample 3	4	8.4	28
Sample 4	6	7.32	27.5
Sample 5	4	8.89	30.4
Sample 6	21	8.37	35.5
Sample 7	17	6.34	32.4
Sample 8	11	6.85	38.7
Sample 9	11	7.4	9.4
Sample 10	6	8.24	10.3
Sample 11	6	7.7	10.5
Sample 12	7	7.95	11.3
Sample 13	8	8.05	12.3
Sample 14	9	8.01	14.3
Sample 15	9	7.95	10.4
Sample 16	10	7.9	13.4
Sample 17	15	7.79	24.7
Sample 18	9	6.99	41.3
Sample 19	10	8.6	29.5
Sample 20	9	6.7	31.2
Sample 21	8	8.34	28.7
Sample 22	13	8.54	32.3
Sample 23	16	8.9	40.7
Sample 24	10	8.4	35.4

Graph. a: shows the details of the results getting after the test and Graph showing the details



Samples	Acidity
Sample 1	134
Sample 2	0
Sample 3	0
Sample 4	110
Sample 5	0
Sample 6	0
Sample 7	190
Sample 8	170
Sample 9	130
Sample 10	118
Sample 11	154
Sample 12	198
Sample 13	174
Sample 14	170
Sample 15	158
Sample 16	135
Sample 17	170
Sample 18	228
Sample 19	0
Sample 20	180
Sample 21	0
Sample 22	0
Sample 23	0
Sample 24	0

Graph.b: shows the results obtained from testing the samples for acidity



Samples	Alkalinity
Sample 1	0
Sample 2	206
Sample 3	222
Sample 4	0
Sample 5	228
Sample 6	94
Sample 7	0
Sample 8	0
Sample 9	0
Sample 10	0
Sample 11	0
Sample 12	0
Sample 13	0
Sample 14	0
Sample 15	0
Sample 16	0
Sample 17	0
Sample 18	0
Sample 19	118
Sample 20	0
Sample 21	136
Sample 22	224
Sample 23	214
Sample 24	238

Graph.c: shows the results obtained from testing the samples for alkalinity

IX. CONCLUSIONS

Saline water intrusion is controlled by maintaining the appropriate balance between water being extracted and the quantity of water recharging into aquifers. Regular monitoring of saline water interface is essential in calculating the accurate management technique. Six methods are normally recognized as methods for controllingor preventing saline water ingression.

- Keeping basin water level high
- Creating a fresh water ridge near sea
- Creating pumping trough or extraction barriertrough
- Developing artificial subsurface barriers
- Adopting rainwater harvesting technology andartificial recharging structures

X. ADVANTAGES

- Method is very simple
- Cost effective
- Doesn't require theoretical knowledge
    - Doesn't require skilled persons

XII.DISADVANTAGES

- Doesn't provide an accurate result
- There is a chance of occurrence of manual errors
- Time required for testing the samples are too large
- This method cannot be used alone for analysing seawater intrusion in an area.
- Need skilled persons for analysing the graph and suggest appropriate remedial measure

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