Ground Water Analyzation Using Query Optimization And Spatio-Temporal Data Mining Technology

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Abstract: The perspective of this paper to determines the data mining technology in spatio-temporal concept. Data mining is one of the main research areas to analyse data from the known set of data. The concept of ground water and rain water is very important to make growth of agricultural sectors. The association rule integration algorithm to implement using these two datasets. The ground water data is covered by country of India in the state of Tamilnadu. The query is to describe ground water level in maximum and minimum level in the pre monsoon and post monsoon in each year. The dataset used from the year of 1991 to 2016. The rainwater level compare with ground water in the year of 2011 to 2016.Using constraint checking to make different analyzation and comparisons report. The Predictions are used to give knowledge about the ground water level, rain fall details and maximum ground water level area.

Keywords: Association Rule, Maximum and Minumum, Pre and Post Monsoon, Relational calculus equation and Spatial Temporal Concept

1. INTRODUCTION

Data mining techniques were used to extraction of hidden predictive information from large databases. Spatial Temporal data mining manages data whose geometry changes over time. Applications that generate various type of data include surveillance applications, transportation systems, mobile communication systems, geographical and environmental systems so on. To classify spatial data as being either point data, line data or region data. In this paper utilisation spatial Temporal Technique to perform different analysation methodology using ground water and rain water dataset. In this paper utilisation spatial Temporal Technique to perform different analysation methodology using ground water and rain water dataset.

2. RELATED WORK

Groundwater, which is in aquifers below the surface of the Earth, is one of the Nation's most important natural resources. Here to discuss level of ground water post and pre monsoon level from 1991 to 2016.The data collection in the place Tamil nadu state 29 district ground water level except Chennai, Nilgiri and Cuddalore. The rain water data is used in this research from 2011 to 2015. Totally 756 entries were used in the database for ground water storage and 145 entries of rainfall details.

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The ground water levels from the number of observation wells of TWAD have been analyzed for post-monsoon and pre-monsoon since 1991, average ground water level in m below ground level for pre and post monsoon. http://www.twadboard.gov.in/twad/. The fields are used id, year, post and pre monsoon details.

Equations:

$$R_{11} = \pi_{a1,a2.....an}(\sigma_{\max(post)}(GW\_DB)) \quad -(1)$$

$$R_{12} = \pi_{a1,a2.....an}(\sigma_{\max(pre)}(GW\_DB)) \quad -(2)$$

$$R_{21} = \pi_{a1,a2.....an}(\sigma_{\min(post)}(GW\_DB)) \quad -(3)$$

$$R_{22} = \pi_{a1,a2.....an}(\sigma_{\min(pre)}(GW\_DB)) \quad -(4)$$

Where $a1, a2 \dots \dots \dots an$ selection attributes R_{11} R_{12} R_{21} and R_{22} are relational calculus results output of query optimization technique to implement post and pre_monsoon maximum and minimum groundwater level.

$$M_1 = \sum_{y=1}^{n} \sigma_{G(id)}(R_{11}) \quad -(5)$$

Where G(id) defines grouping of id i.e the location and count number of years occur for the maximum pre or post monsoon ground water level.

Where Y = 1 to n defines start from year 1991 to 2016.

The above eq(5) to grouping of id from the result set R_{11} output and also find percentage calculation using this result similarly to create all other grouping pattern using R_{12} R_{21} and R_{22}

$$M_2 = \sum_{y=1}^{n} \sigma_{G(id)}(R_{12}) \quad -(6)$$

$$N_1 = \sum_{y=1}^{n} \sigma_{G(id)}(R_{21}) \quad -(7)$$

$$N_2 = \sum_{y=1}^{n} \sigma_{G(id)}(R_{22}) \quad -(8)$$

Association rule:

Using association techniques to intersect and union of above result set.

$$X_1 = M_1 \cap M_2 \quad -(7)$$

$$X_2 = N_1 \cap N_2 \quad -(8)$$

$$F = X_1 U X_2 U R_F \quad -(9)$$

Where X_1 – the intersection result of maximum ground water level in pre and post monsoon. X_2 - the intersection result of minimum ground water level in pre and post monsoon. The final result F is used to union of all previous result set and rainfall details(R_F).

To perform association rule

Algorithm-1:

Step 1: Using Database to fetch ground water data.

Step 2: To find Maximum Ground water level for all the years.

-To find post_monsoon Maximum Level

-To find pre_monsoon maximum level

Using eq(1) and eq(2)

Step 3: To find Minimum Ground water level for all the years.

-To find post_monsoon maximum level.

-To find pre_monsoon minimum level.

Using eq(3) and eq(4)

Step 4: Calculate percentage of appearance of each location from the overall years in group by command i.e 26 years. Using eq(5),eq(6),eq(7) and eq(8).

Step 5: Using association rule intersect and union to find final result. The eq(9) to produce final result of the summary.

3. RESEARCH ANALYSIS

A. Maximum Ground_Water Level in Post_Monsoon

Here to consider maximum ground water level and its percentage calculation based on the number of years occur each location.

select YEAR(g.year) as YEAR,id as ID,post as POST_MONSOON from GWater_detail as g where post=(select max(post) from GWater_detail where YEAR(year)=YEAR(g.year) and post<>999) order by year.

Table 1 describes the highest ground water level in post_monsoon. To display the location id, year and post_monsoon ground water level details.

Table 1. Maximum GW Post_Monsoon

year	id	Post_Monsoon
1992	2	22
1993	2	14.6
1994	2	16.1
1995	2	12.4
1996	2	18.5
1997	8	12
1998	17	10.8
1999	12	12.4
2000	2	12.1
2001	2	14.4
2002	2	16.6
2003	17	32.4
2004	17	26.5
2005	25	22.2
2006	25	7.2
2007	2	12.7
2008	9	15.4
2009	2	13
2010	3	14
2011	9	16
2012	2	9.9
2013	2	14.3
2014	1	21.2
2015	1	23.6
2016	1	23.1

Based on above query the output comes from maximum ground water level in post_monsoon in the area and number of Years.

Table 2. Percentage of Maximum GW Post_Monsoon

Maximum GW Level Post_Monsoon			
Id	Location	No.Of Year	%
1	Ariyalur	3	13
2	Coimbatore	12	50
8	Karur	1	4
9	Krishnagiri	2	8
12	Namakkal	1	4
17	Salem	3	13
25	Tiruppur	2	8

Table 2 describes the highest ground water level in post_monsoon. To display the location, year and post_monsoon ground water level details.

The Fig. 1 shows pie chart for table 2 data. The ground water highest level is Coimbatore district compare than other places. The next level is Ariyalur and Salem district.

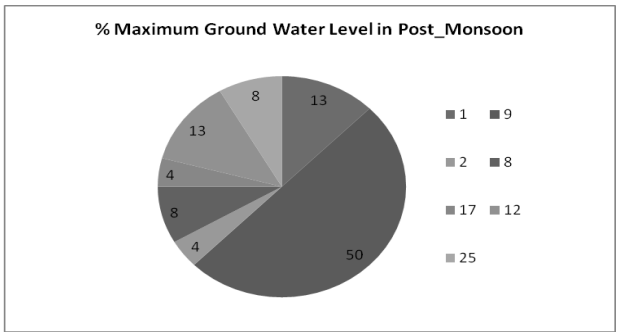

Fig. 1 Percentage of Maximum GW Level in Post_Monsoon

B. Maximum Ground_Water Level in Pre_Monsoon

Select YEAR(g.year) as YEAR,id as ID,pre as PRE_MONSOON from GWater_detail as g where pre=(select max(pre) from GWater_detail where YEAR(year) =YEAR(g.year) and pre<>999) order by year

Table 3 describes the highest ground water level in pre_monsoon. To display the location, year and pre_monsoon ground water level details.

Table 3. Maximum GW Pre_Monsoon

Maximum GW Level Pre_Monsoon		
year	**id**	**Pre_Monsoon**
1991	25	23.4
1992	2	26.6
1993	25	20.7
1994	2	16.2
1995	17	14.6
1996	12	36.6
1997	25	16
1998	25	16.2
1999	12	14
2000	2	13.5
2001	2	16.3
2002	17	30
2003	17	35.6
2004	2	32.2
2005	27	22.1
2006	2	12.7
2007	2	15
2007	9	15
2008	9	14.7
2009	2	16.1
2010	15	20.1
2011	1	19
2012	15	22.1
2013	15	25.4
2014	9	29.8
2015	1	26.6
2016	1	28.7

Table 4. Percentage of Maximum GW Pre_Monsoon

Maximum GW Pre_Monsoon			
Id	**Location**	**No.Of Years**	%
1	Ariyalur	3	11
2	Coimbatore	8	30
9	Krishnagiri	3	11
12	Namakkal	2	7
15	Pudukottai	3	11
17	Salem	3	11
25	Tiruppur	4	15
27	Vellore	1	4

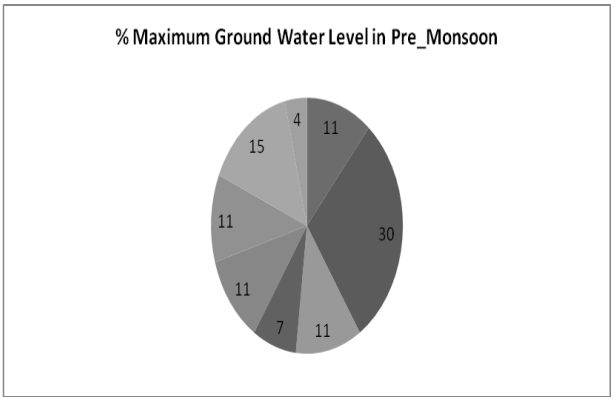

Fig. 2 Percentage of Maximum GW Level in Pre_Monsoon

The Fig. 2 shows pie chart for table 4 data. The ground water highest level is Coimbatore district compare than other places.

The next level is Trippur and equal level of ground water level is Ariyalur, Krishnagiri, Pudukottai andSalem district.

C. Minimum Ground_Water Level in Post_Monsoon

select YEAR(g.year) as YEAR,id as ID,post as POST_MONSOON from GWater_detail as g where post=(select min(post) from GWater_detail where YEAR(year)=YEAR(g.year) and post<>999) order by year

Table 5 describes the minimum ground water level in post_monsoon. To display the location id, year and post_monsoon ground water level details.

Table 5. Minimum GW Post_Monsoon

Minimum GW Post_Monsoon		
year	**id**	**Post_Monsoon**
1992	11	2.2
1993	11	1.9
1994	11	1.2
1995	11	1.5
1996	11	2
1997	14	1.1
1998	11	1.1
1999	11	1.2
2000	11	1
2001	11	1.2
2002	11	0.9
2003	11	3.1
2004	11	2.3
2005	11	2.5
2006	26	1.1
2007	14	2
2007	11	2
2008	26	1.8
2008	28	1.8
2009	11	1.1
2010	28	1
2011	28	1.2
2012	28	1.1
2013	28	2.5
2014	11	4.2
2015	11	4
2016	23	2.7

Table 6. Percentage of Minimum GW Post_Monsoon

Minimum GW Post_Monsoon			
Id	**Location**	**No.Of Year**	**%**
11	Pudukottai	17	65.38
14	Perambalur	2	7.69
26	Tiruvannamalai	2	7.69
28	Villupuram	5	19.23
23	Thoothukudi	1	3.85

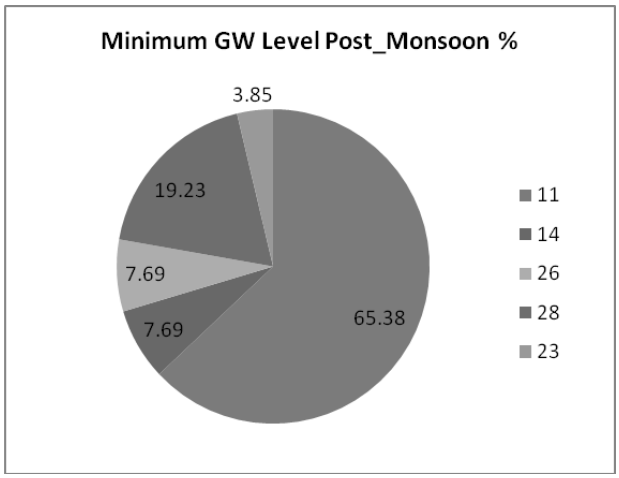

Fig. 3 Percentage of Minimum GW Level in Post_Monsoon

The Fig.3 shows lower level ground water measurement area. The highest number of year is pudukottai district compare than other places. The next level is Villupuram and equal level of ground water level is Perambalur and Tiruvannamalai. Thoothukudi district is only once out of whole year comparison.

D. Minimum Ground_Water Level in Pre_Monsoon

Select YEAR(g.year) as YEAR,id as ID,pre as PRE_MONSOON from GWater_detail as g where pre=(select min(pre) from GWater_detail where YEAR(year)=YEAR(g.year) and pre<>999) order by year

Table 7. Minimum GW Pre_Monsoon

Minimum GW Pre_Monsoon		
year	**id**	**Pre_Monsoon**
1991	11	5
1992	11	3.6
1993	11	4.3
1993	21	4.3
1994	11	3.3
1995	11	3.6
1996	11	4.1
1997	11	3.5
1998	11	2.1
1999	11	2.2
2000	11	2.1
2001	11	2.7
2002	11	2.4
2003	11	4.8
2004	11	3.3
2005	11	4.2
2006	11	4.1
2007	11	3.8
2008	29	3.8
2008	4	3.8
2009	11	2.1
2010	24	4.6
2011	14	4.8
2012	10	4
2013	11	6
2014	11	6.5
2015	7	5.1
2016	24	3.7

Table 8. Percentage of Minimum GW Pre_Monsoon

Minimum GW Pre_Monsoon			
Id	**Location**	**No.Of Year**	**%**
11	Pudukkottai	20	76.92
21	Thiruvarur	1	3.85
29	Virudhunagar	1	3.85
4	Dindugal	1	3.85
24	Thirunelveli	2	7.69
14	Perambalur	1	3.85
10	Madurai	1	3.85
7	Kanniyakumari	1	3.85

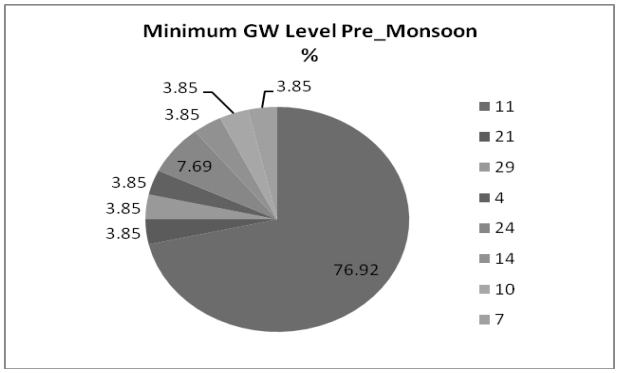

Fig. 4 Percentage of Minimum GW Level in Post_Monsoon

The Fig. 4 shows lower level ground water measurement area. The highest number of year is pudukottai district compare than other places. The next level is Thirunelveli and remaining all other places are only one year in that comparison summary.

E. Association Rule Integrity Mining Technique:

Using association rule intersect and union technique to implement the maximum and minimum ground water level. The eq(5) and eq(6) to intersect find the common value. The result to utilize eq(7) output.

Select distinct id from GWater_detail as g where pre=(select max(pre) from GWater_detail where YEAR(year)=YEAR(g.year) and pre<>999) intersect select distinct id from GWater_detail as g where post=(select max(post) from GWater_detail where YEAR(year)=YEAR(g.year) and post<>999);

Table 9. Intersect output of Maximum GW Post_Monsoon and Pre_Monsoon

Sl.No	**Id**
1	1
2	2
3	12
4	17
5	25

The Table 9 describes the Intersect output collection of five different location.

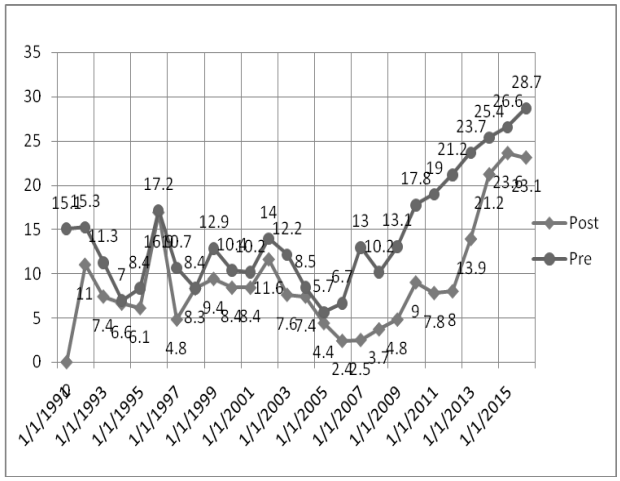

Fig. 5 Ariyalur [id=1] District Pre and Post_Monsoon Ground Water Level [1991_2016]

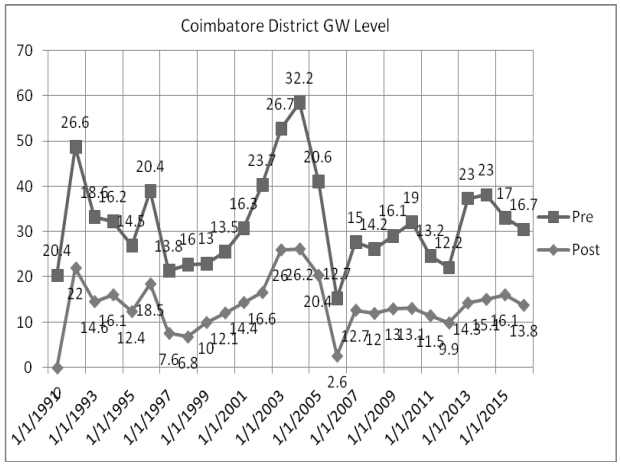

Fig. 6 Coimbatore[id=2] District Pre and Post_Monsoon Ground Water Level [1991_2016]

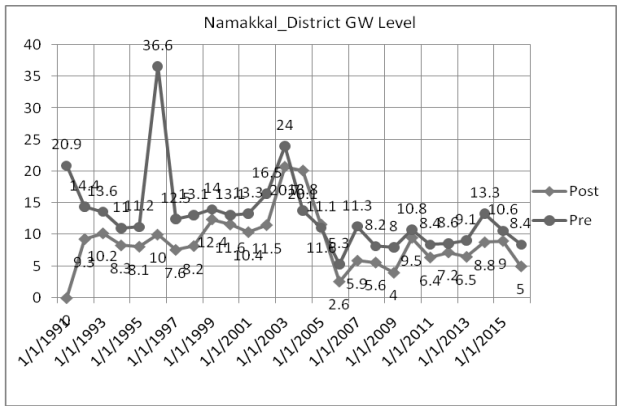

Fig. 7 Namakkal [id=12] District Pre and Post_Monsoon Ground Water Level [1991_2016]

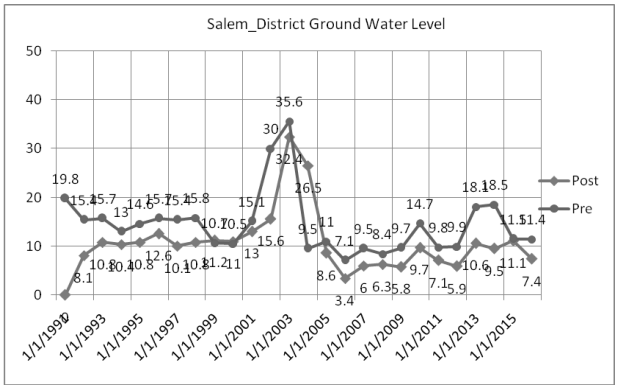

Fig. 8 Salem[id=17] District Pre and Post_Monsoon Ground Water Level [1991_2016]

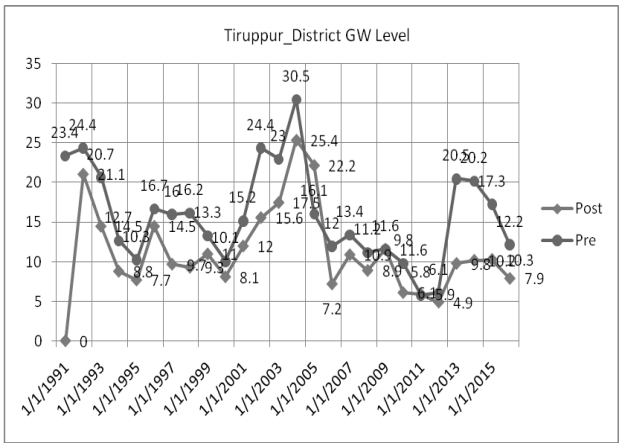

Fig. 9 Tiruppur[id=25] District Pre and Post_Monsoon Ground Water Level [1991_2016]

Select distinct id from GWater_detail as g where pre=(select min(pre) from GWater_detail where YEAR(year)=YEAR(g.year) and pre<>999) intersect select distinct id from GWater_detail as g where post=(select min(post) from GWater_detail where YEAR(year)=YEAR(g.year) and post<>999);

Table 10. Intersect output of Minimum GW Post_Monsoon and Pre_Monsoon

Sl.No	Id
1	11
2	14

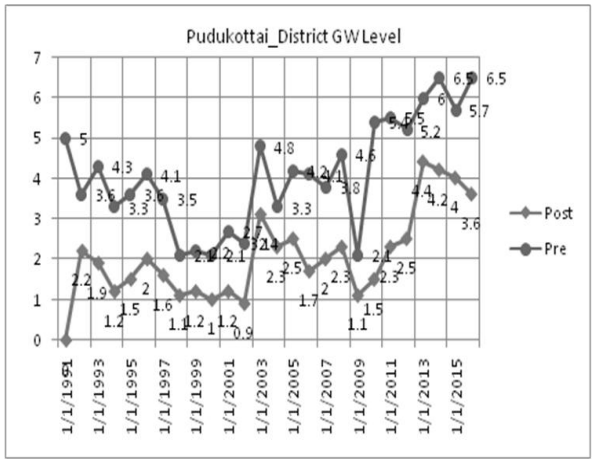

Fig. 10 Pudukottai[id=11] District Pre and Post_Monsoon Ground Water Level [1991_2016]

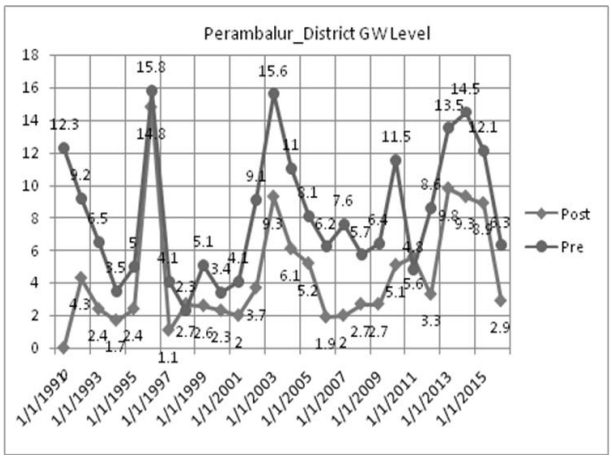

Fig. 11 Perambalur[id=14] District Pre and Post_Monsoon Ground Water Level [1991_2016]

Table 11. *Average Difference between Post and Pre Monsoon from 1991 to 2016 Location Selection of table 9 and table 10.*

id	Post	Pre	Difference
2	14.16	18.04	3.88
17	10.66	14.12	3.46
25	11.18	15.33	4.15
1	10.4	15.51	5.11
12	8.95	12.49	3.54
11	2.29	4.28	1.99
14	4.73	8.13	3.4

The Fig 13 shows details about average ground water level in the past 26 year summary report. The Coimbatore district GW depth level is higher than others but the GW level increases for pre monsoon level to post monsoon level. It also approximately 3.88m increases. The Ariyalur district GW level increases 5.11m.The Pudukottai district GW depth level minimum compare than other places.

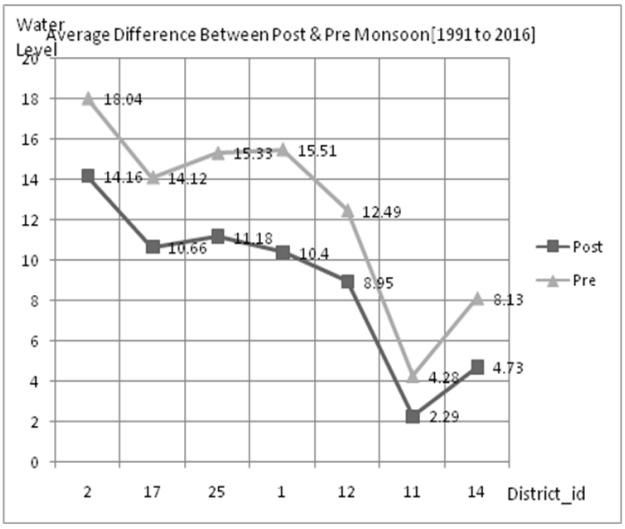

Fig. 12 Average Difference between GW Level Pre and Post_Monsoon [1991_2016]

Rainfall Detail Using Integrity Technique:

Using the integrate technique combine both ground water and rainfall details from 2011 to 2015 data. The integration apply only for the eq(9) that is intersect result of X_1 and X_2 with rainfall data R_1

Table 12. Integration Result of Rain and GW Level [2011 to 2015]

id	rainfall (mm)	Rain fall (in m)	Post (m)	Pre (m)	Diff
2	906.3	0.906	13.380	17.680	4.300
1	803.18	0.803	14.900	23.180	8.280
17	976.82	0.977	8.840	13.560	4.720
12	672.28	0.672	7.580	10.000	2.420
25	586.66	0.587	7.580	10.000	2.420
11	1268.88	1.269	3.480	5.780	2.300
14	793.62	0.794	7.380	10.700	3.320

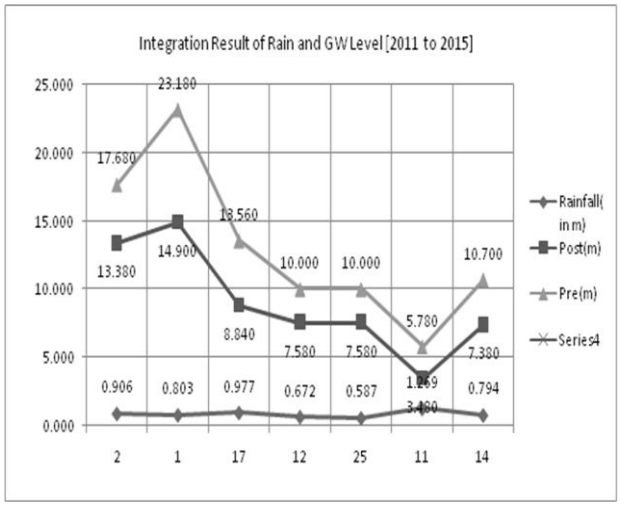

Fig. 13 Integration Result of Rain and GW Level [2011 to 2015] chart

The above Fig.13 and Table 12 describe the details of integration of average rainfall and GW level from 2011 to 2015 for different location based on intersect and union result output. The highest rainfall is 1.269m the location of pudukottai but the GW level increases minimum compare than other areas. The location of ariyalur district GW increases more than other places 8.280m.

4. CONCLUSION

Ground and rain water using spatio Temporal Datamining Technology covers Overall 754 data with 29 different location in 26 years to filter 7 location using different analysation pattern. The final conclusion of this research GW level is very depth in the area of Coimbatore district for 26 years comparison result but past five years result report Ariyalur district is highest. The pudukottai district GW level depth is very less compare than other area. Using integration technique of rainfall with GW level highest rainfall is pudukottai district but water level increase minimum only that is 2.3m. The Perambalur district GW increase 3.320m but the rainfall is 0.794m. In future result to analyse the difficulty of GW level with different prediction.

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