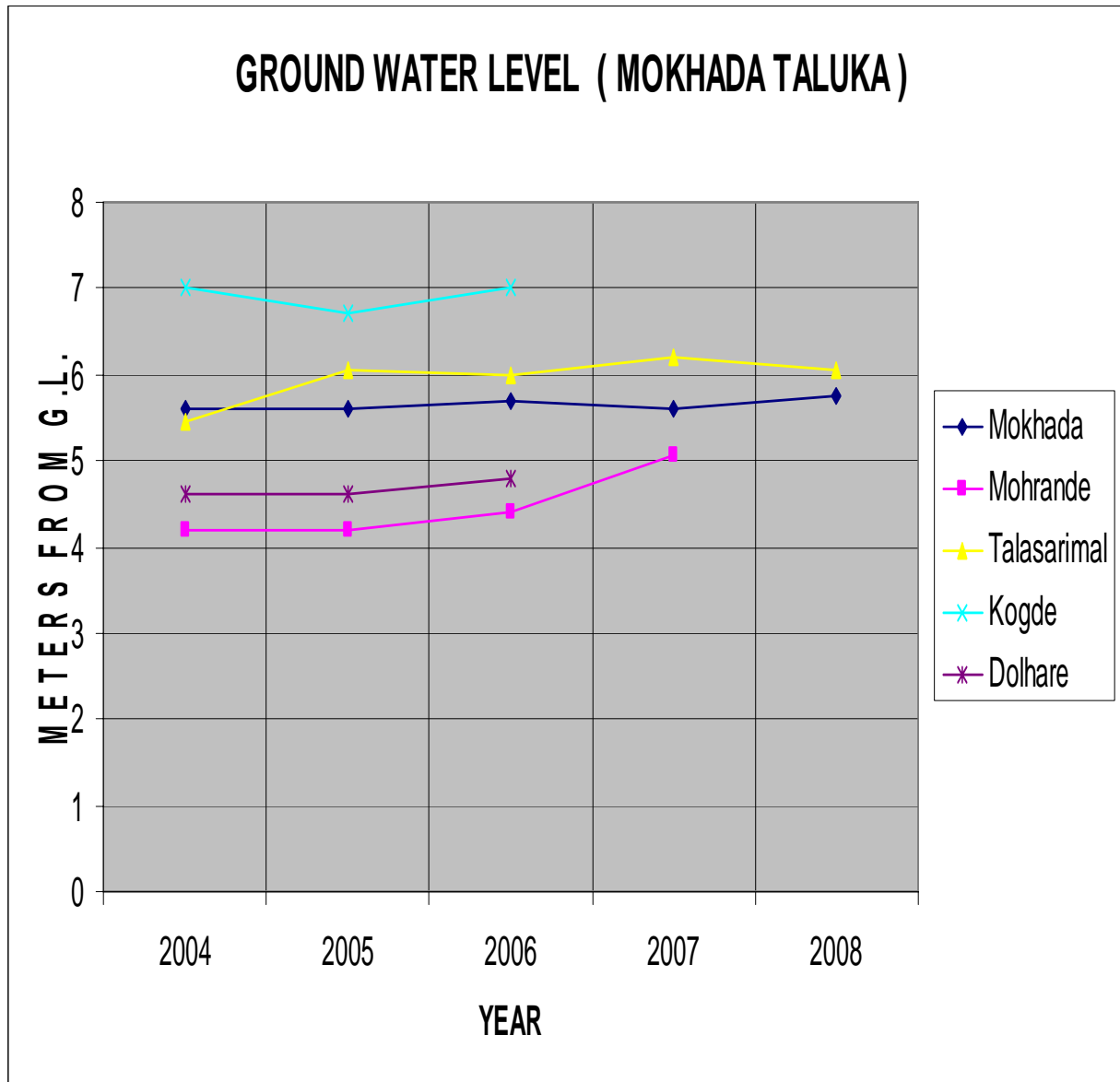
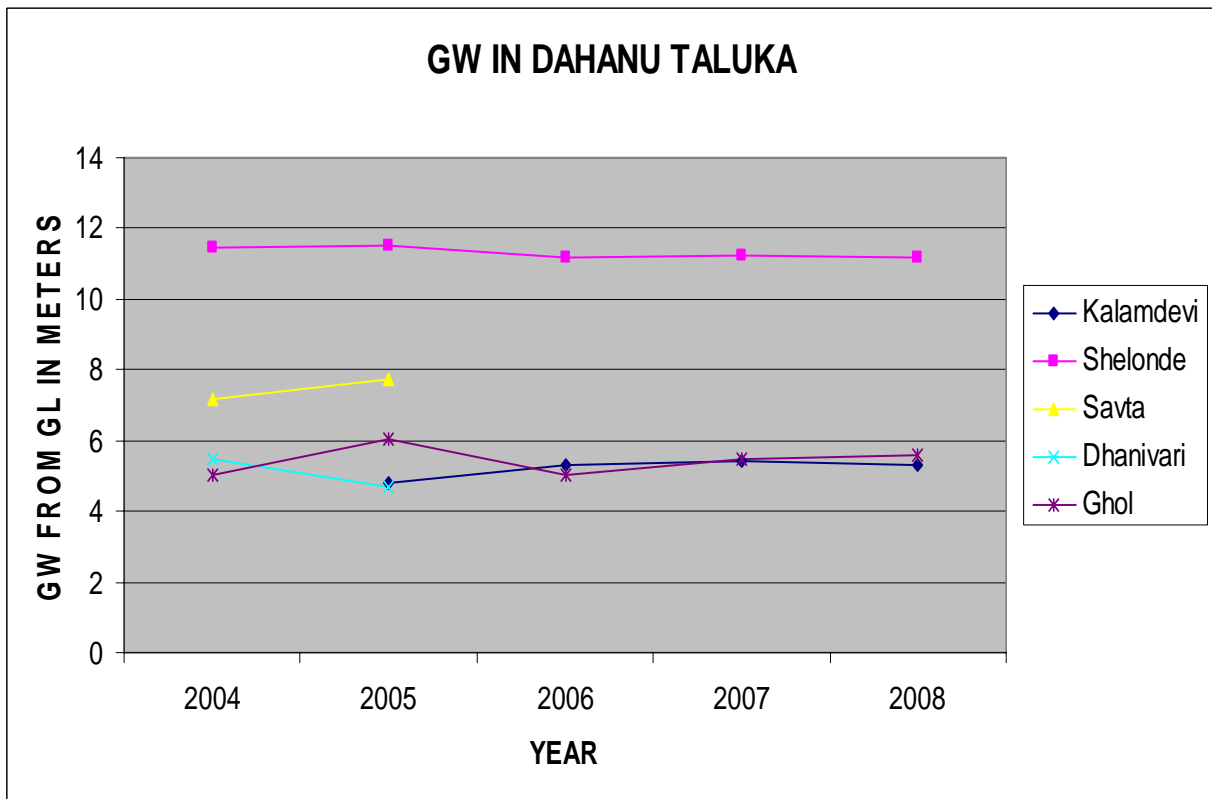
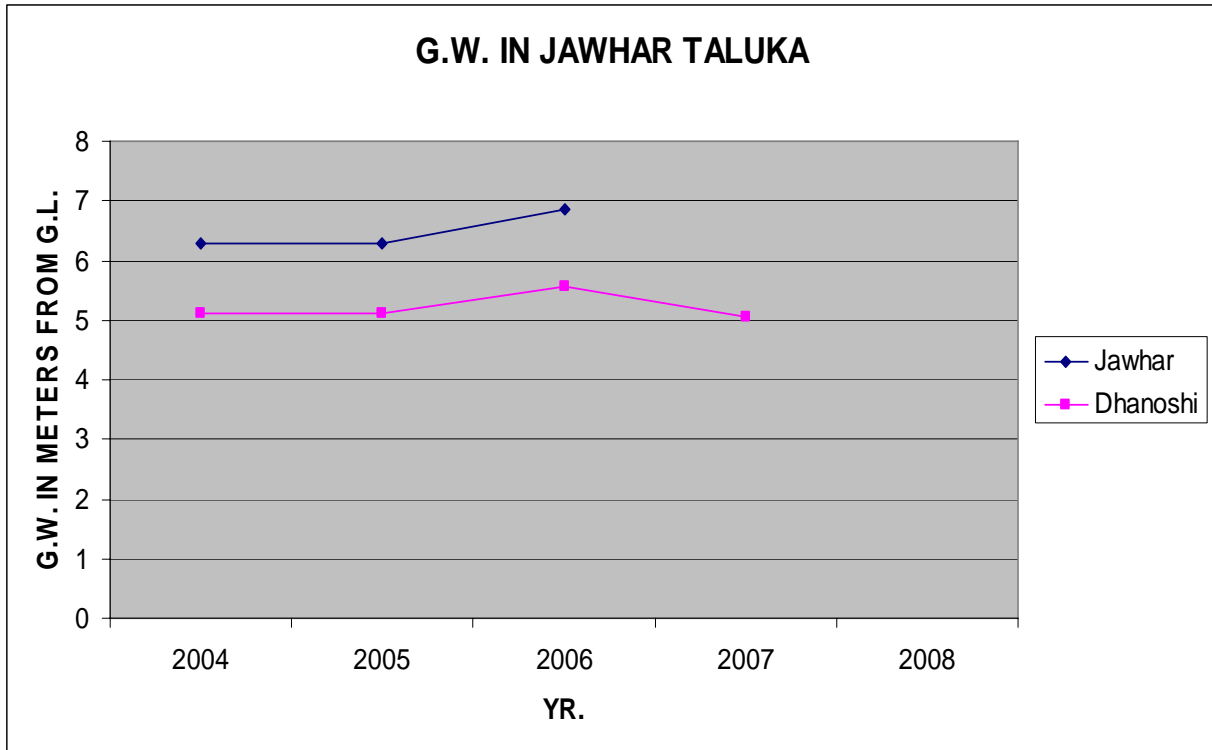
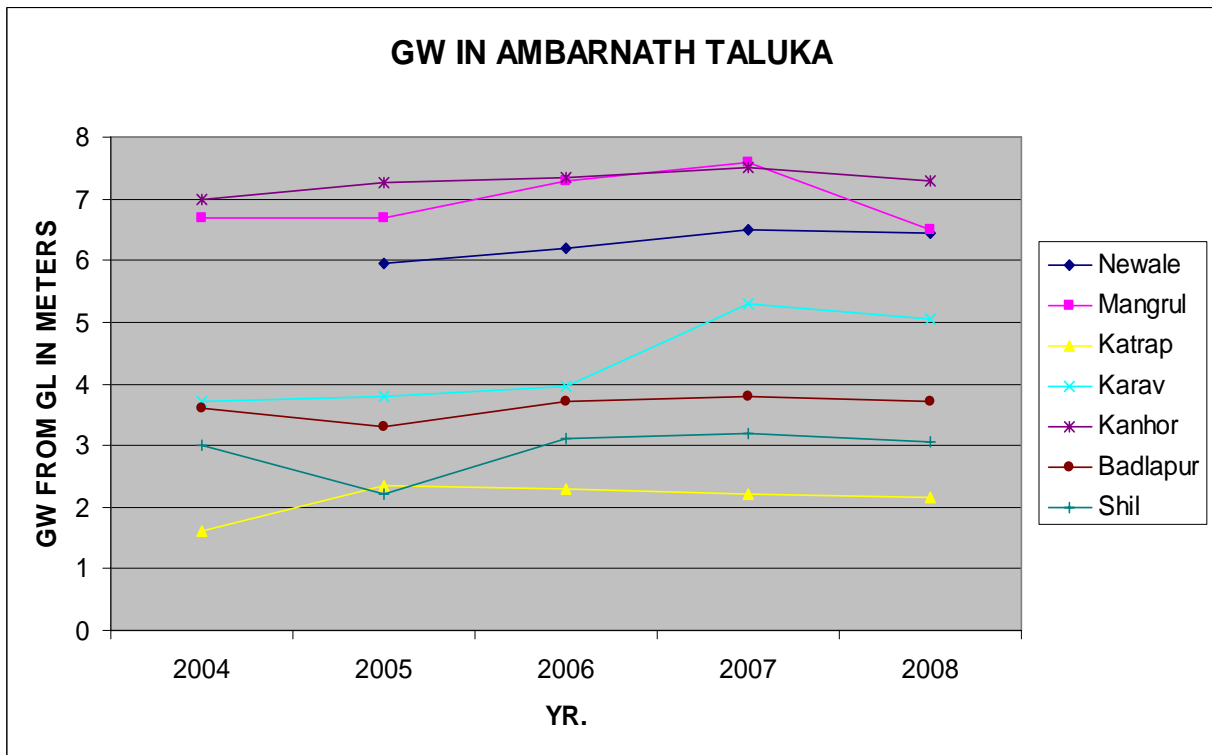
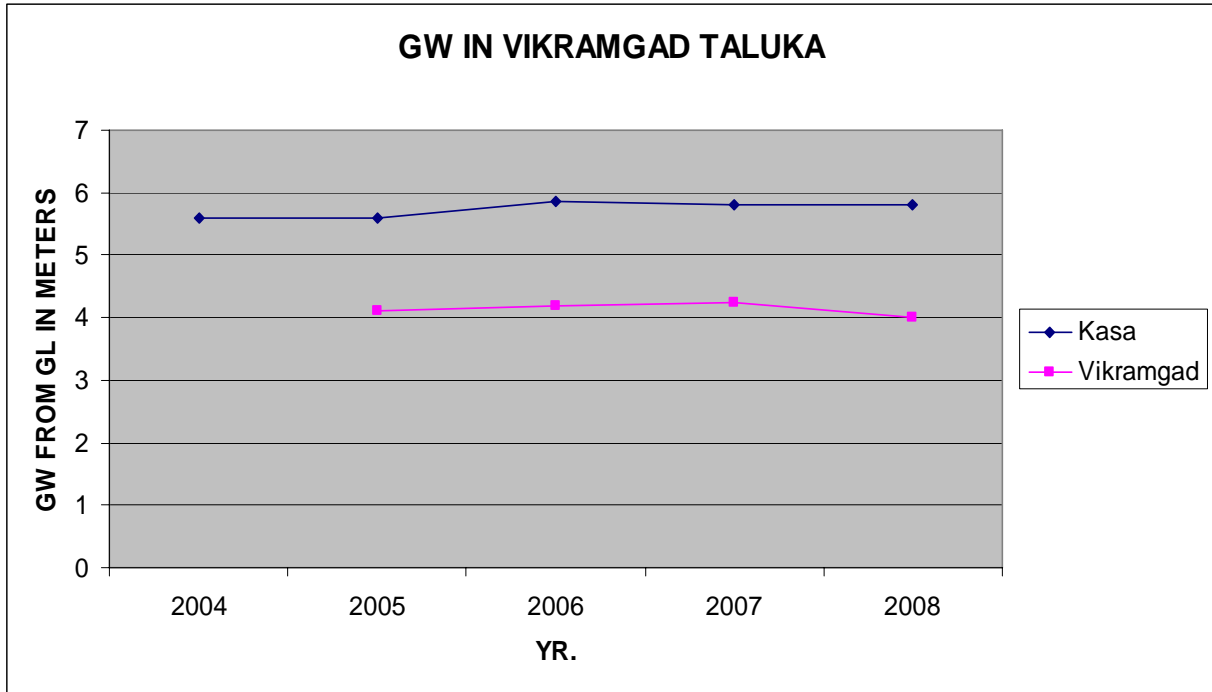


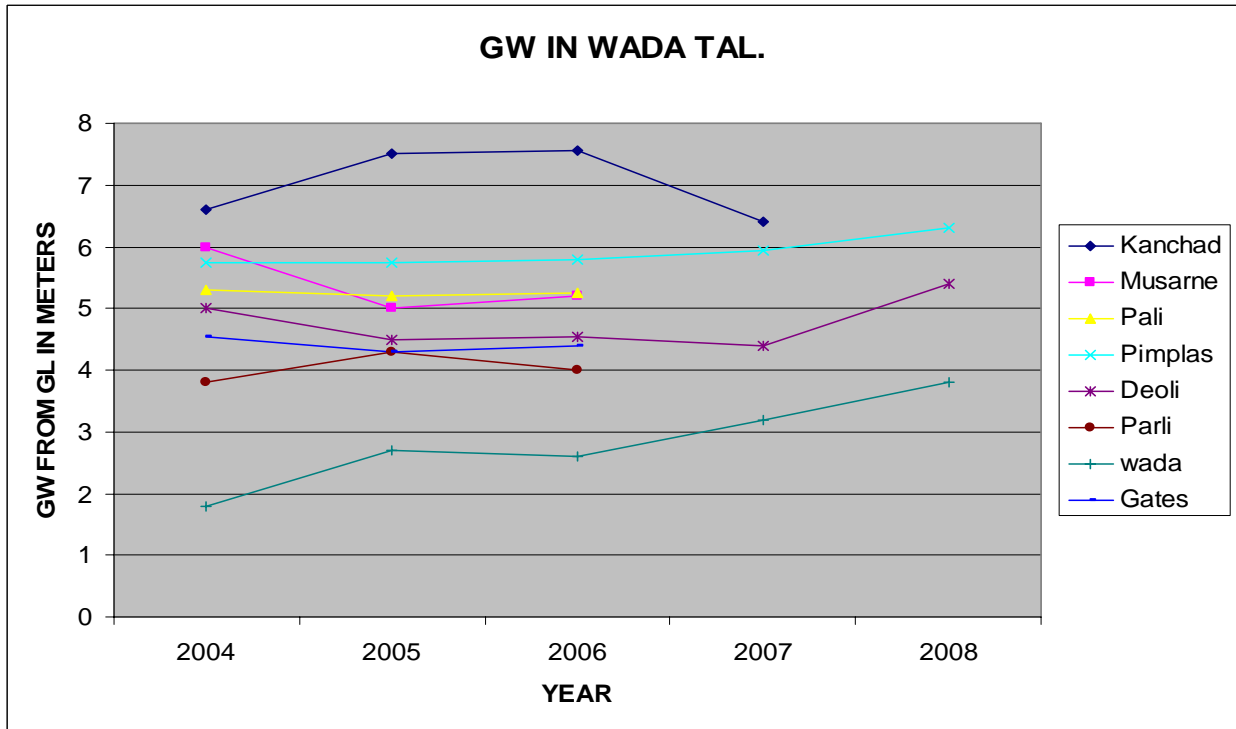
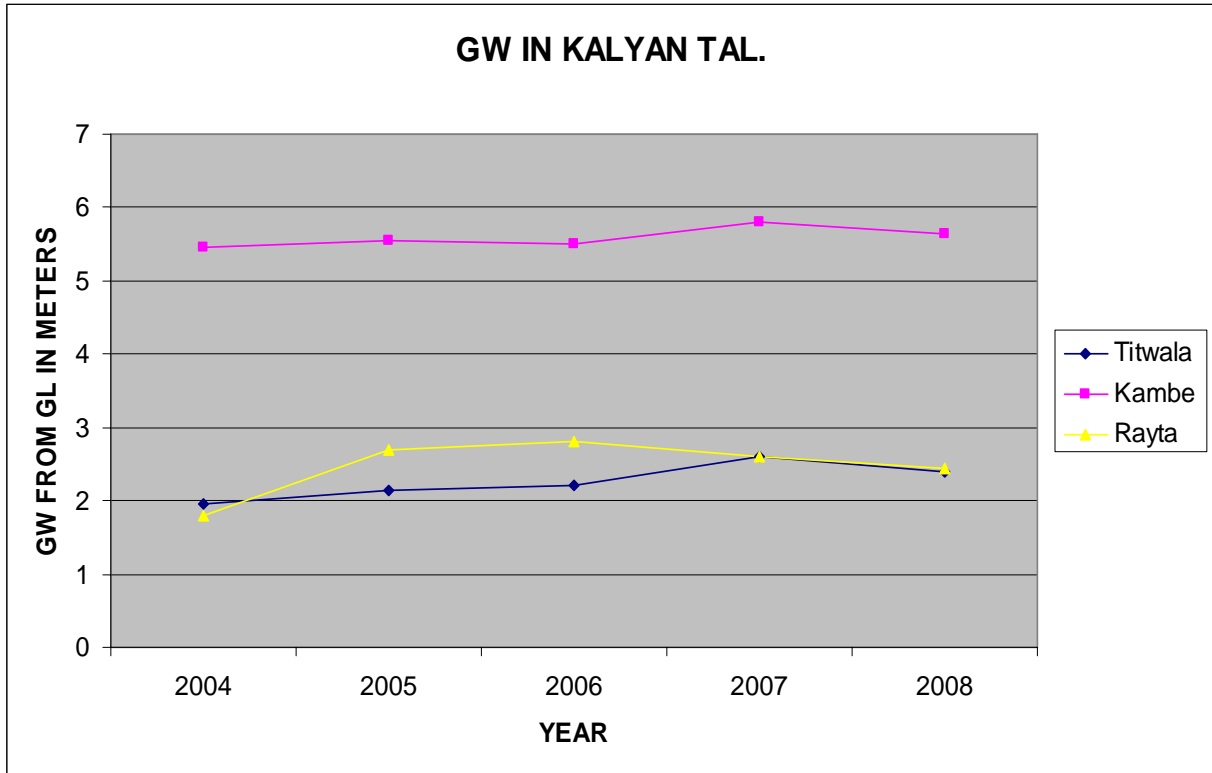
## ANNEXURE 9

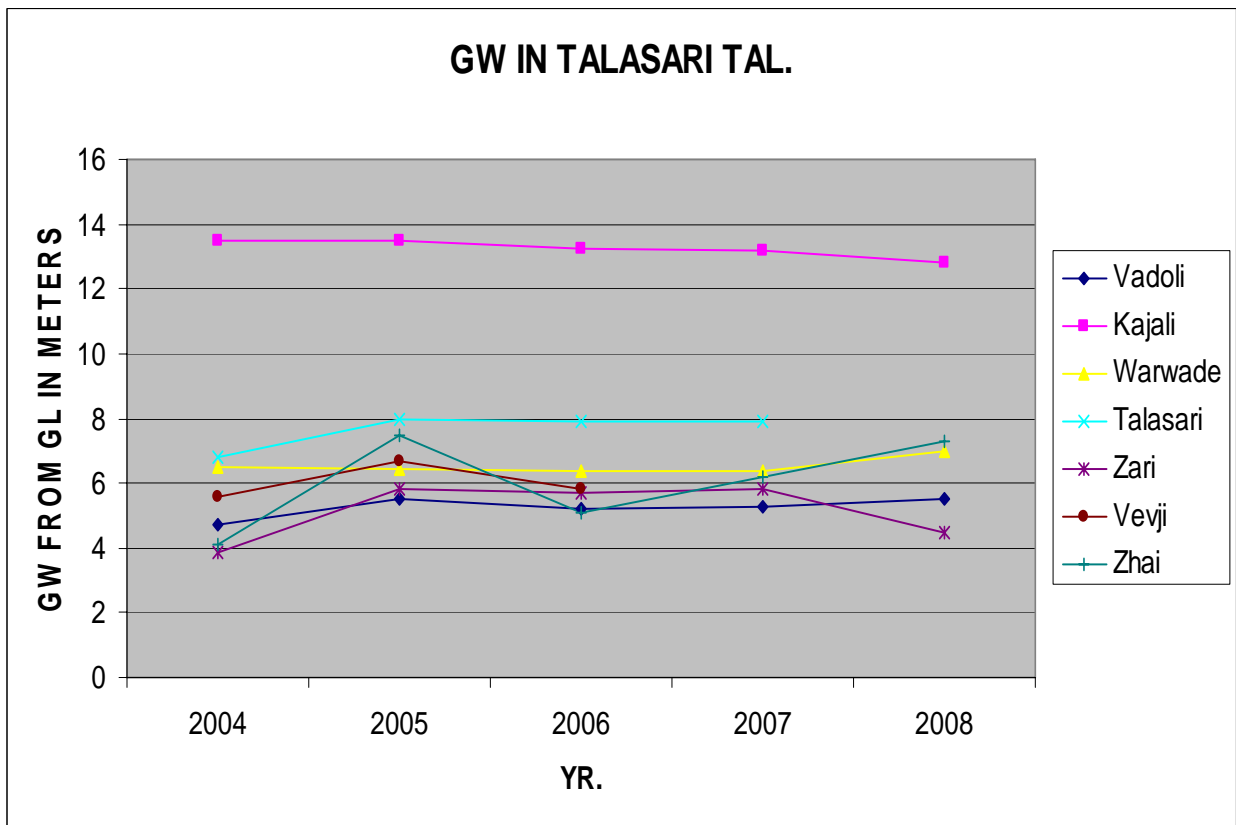
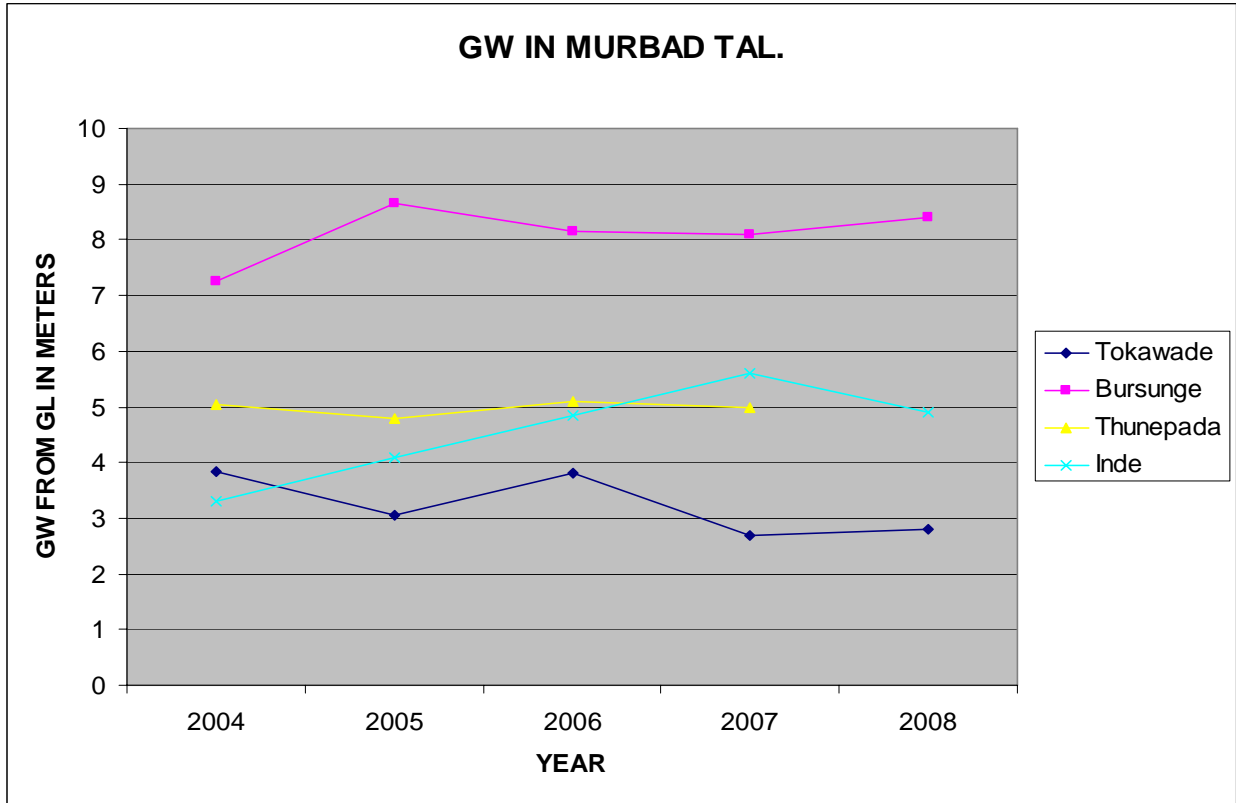
### GROUND WATER MEASUREMENTS FROM OB WELLS FOR THE MONTH OF MAY (2004 to 2008)











## ANNEXURE 11

The **Analytic Hierarchy Process (AHP)** is a structured technique for helping people deal with complex decisions. Rather than prescribing a "correct" decision, the AHP helps people to determine one. The strength of the AHP approach lies in its ability to structure complex, multi-attribute, multi-person and multi-period problem hierarchically. In addition, it can also handle both qualitative (through representing qualitative attributes in terms of quantitative values) and quantitative attributes. The AHP is a method that can be used to establish measures in both the physical and social domains. The Analytic Hierarchy process have wide range of applications include, Technology alternatives selection, Priority setting, Alternative (policy) generation, Selection of the best policy alternative, Determination of requirements; Resource allocation, Prediction, Measuring performance, designing a system, planning, Conflict resolution, Optimization as a forward projection-backward idealization process, Systems with feedback, Relation to fuzzy sets.

### Ranking of domestic water supply technologies

No. of technology alternatives = 5

The Technology alternatives considered for comparison are as follows:-

1. Dug well
2. Well + pump
3. Bore well + hand pump
4. Bore well + electric pump motor set
5. Jack well + pump house

Attributes	Well	Well + Pump	Bore well Hand pump	Bore well pump	Jack well + pump
Population	1000	1000	600	800	2000
Construction cost (Rs.)	600000	650000	55000	70000	2500000
Maintenance cost	0	2500	500	1000	4000
Time of const.( days )	90	120	5	7	180

Total No. of most important attributes characterizing the alternatives =12

No. of most important qualitative attributes characterizing the alternatives =8

No. of most important quantitative attributes characterizing the alternatives=4

The Quantitative attributes are as follows:-

Population served

Construction cost

Maintenance cost

Time required

The Qualitative attributes:-

Water quality

Sustainability

Human effort required

Location

Electricity

Assurance

Technical skills

Employment opportunity

The total comparison matrix of 12 attributes is=

1.0000	0.2000	0.3333	2.0000	3.0000	0.1429	2.0000	3.0000	0.3333	0.2000	3.0000	5.0000
5.0000	1.0000	2.0000	8.0000	9.0000	1.0000	8.0000	9.0000	2.0000	1.0000	3.0000	9.0000
9.0000	3.0000	0.5000	1.0000	4.0000	5.0000	0.5000	4.0000	5.0000	1.0000	0.5000	2.0000
5.0000	0.5000	0.1250	0.2500	1.0000	1.0000	0.1250	1.0000	1.0000	0.2500	0.1250	0.5000
1.0000	0.3333	0.1111	0.2000	1.0000	1.0000	0.1250	1.0000	1.0000	0.2500	0.1250	0.5000
1.0000	7.0000	1.0000	2.0000	8.0000	8.0000	1.0000	8.0000	8.0000	2.0000	1.0000	4.0000
8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000

0.5000	0.1250	0.2500	1.0000	1.0000	0.1250	1.0000	1.0000	0.2500	0.1250	0.5000
1.0000										
0.3333	0.1111	0.2000	1.0000	1.0000	0.1250	1.0000	1.0000	0.2500	0.1250	0.5000
1.0000										
3.0000	0.5000	1.0000	4.0000	4.0000	0.5000	4.0000	4.0000	1.0000	0.5000	2.0000
4.0000										
5.0000	1.0000	2.0000	8.0000	8.0000	1.0000	8.0000	8.0000	2.0000	1.0000	4.0000
8.0000										
0.3333	0.3333	0.5000	2.0000	2.0000	0.2500	2.0000	2.0000	0.5000	0.2500	1.0000
0.5000										
0.2000	0.1111	0.2000	1.0000	1.0000	0.1250	1.0000	1.0000	0.2500	0.1250	2.0000
1.0000										

The maximum eigen value is=12.4258

Consistency Index (CI) =0.0387115 (ci<0.1 is preferred)

The priority vector is= 0.0571 0.1930 0.1033 0.0233 0.0219 0.1999 0.0233  
0.0219 0.0977 0.1907 0.0416 0.0263

Now Alternatives comparison for each Qualitative attribute

The alternatives Comparison matrix w.r.t attribute water quality

The comparison matrix is:

1.0000	1.0000	0.1429	0.1429	0.2000
1.0000	1.0000	0.1429	0.1429	0.2000
7.0000	7.0000	1.0000	1.0000	1.0000
7.0000	7.0000	1.0000	1.0000	1.0000
5.0000	5.0000	1.0000	1.0000	1.0000

Priority vector 0.0480 0.0480 0.3141 0.3141 0.2758

Lamda max = 5.018154, CI = 0.004538



The alternatives Comparison matrix w.r.t attribute sustainability

The comparison matrix is:

1.0000	0.5000	1.0000	1.0000	1.0000
2.0000	1.0000	4.0000	3.0000	3.0000
1.0000	0.2500	1.0000	8.0000	1.0000
1.0000	0.3333	0.1250	1.0000	5.0000
1.0000	0.3333	1.0000	0.2000	1.0000

Priority vector

0.1257 0.3699 0.2642 0.1415 0.0987

Lamda max = 6.483786, ci = 0.070947

The alternatives Comparison matrix w.r.t attribute human efforts

The comparison matrix is:

1.0000	5.0000	3.0000	5.0000	5.0000
0.2000	1.0000	0.5000	1.0000	1.0000
0.3333	2.0000	1.0000	2.0000	2.0000
0.2000	1.0000	0.5000	1.0000	1.0000
0.2000	1.0000	0.5000	1.0000	1.0000

Priority vector

0.5129 0.0988 0.1907 0.0988 0.0988

Lamda max = 5.003994, ci = 0.000998

The alternatives Comparison matrix w.r.t attribute location

The comparison matrix is:

1.0000	1.0000	1.0000	0.5000	0.1429
1.0000	1.0000	1.0000	0.5000	0.1429
1.0000	1.0000	1.0000	0.5000	0.1429
2.0000	2.0000	2.0000	1.0000	0.3333
7.0000	7.0000	7.0000	3.0000	1.0000

Priority vector

0.0843 0.0843 0.0843 0.1741 0.5729

Lamda max = 5.002854, ci = 0.000713

The alternatives Comparison matrix w.r.t attributes energy consumption

The comparison matrix is: 1.0000 3.0000 1.0000 3.0000 5.0000

0.3333 1.0000 0.3333 1.0000 2.0000

1.0000 3.0000 1.0000 3.0000 8.0000

0.3333 1.0000 0.3333 1.0000 3.0000

0.2000 0.5000 0.1250 0.3333 1.0000

priority vector

0.3368 0.1158 0.3683 0.1263 0.0529

lamdamax = 5.034630, ci = 0.008657

The alternatives Comparison matrix w.r.t attributes water assurance

The comparison matrix is:

1.0000 1.0000 3.0000 3.0000 9.0000

1.0000 1.0000 3.0000 3.0000 9.0000

0.3333 0.3333 1.0000 1.0000 3.0000

0.3333 0.3333 1.0000 1.0000 3.0000

0.1111 0.1111 0.3333 0.3333 1.0000

Priority vector

0.3600 0.3600 0.1200 0.1200 0.0400

Lamda max = 5.000000, ci = 0.000000

The alternatives Comparison matrix w.r.t attribute technical skills

The comparison matrix is:

1.0000 2.0000 5.0000 6.0000 8.0000

0.5000 1.0000 3.0000 3.0000 4.0000

0.2000 0.3333 1.0000 1.0000 2.0000

0.1667 0.3333 1.0000 1.0000 1.0000

0.1250 0.2500 0.5000 1.0000 1.0000

Priority vector

0.4977 0.2586 0.0979 0.0820 0.0638

lamdamax = 5.037377, ci = 0.009344

The alternatives Comparison matrix w.r.t attribute employment

The comparison matrix is:

1.0000 1.0000 0.2500 0.5000 2.0000  
 1.0000 1.0000 5.0000 0.5000 2.0000  
 4.0000 0.2000 1.0000 0.1111 0.3333  
 2.0000 2.0000 9.0000 1.0000 3.0000  
 0.5000 0.5000 3.0000 0.3333 1.0000

Priority vector

0.1305 0.2206 0.1212 0.4027 0.1251

Lamda max = 6.383824, ci = 0.345956

Quantitative calculation :-

Attributes	Well	Well + Pump	Borewell Handpump	Borewell pump	Jackwell + pump
Population	1000	1000	600	800	2000
Construction cost( Rs.)	600000	650000	55000	70000	2500000
Maintenance cost	0	2500	500	1000	4000
Time of const.( days )	90	120	5	7	180

The Total Priority matrix of 4 quantitative attributes w.r.t 5 technologies

0.2857 0.2857 0 0.1429 1.0000  
 0.7771 0.7566 1.0000 0.9939 0  
 1.0000 0.3750 0.8750 0.7500 0  
 0.5143 0.3429 1.0000 0.9886 0

Combined quantitative and qualitative attributes

QUALITATIVE ATTRIBUTES MATRIX IS:

0.0480 0.0480 0.3141 0.3141 0.2758

0.1257	0.3699	0.2642	0.1415	0.0987
0.5129	0.0988	0.1907	0.0988	0.0988
0.0843	0.0843	0.0843	0.1741	0.5729
0.3368	0.1158	0.3683	0.1263	0.0529
0.3600	0.3600	0.1200	0.1200	0.0400
0.4977	0.2586	0.0979	0.0820	0.0638
0.1305	0.2206	0.1212	0.4027	0.1251

QUANTITATIVE ATTRIBUTES MATRIX IS:

0.2857	0.2857	0	0.1429	1.0000
0.7771	0.7566	1.0000	0.9939	0
1.0000	0.3750	0.8750	0.7500	0
0.5143	0.3429	1.0000	0.9886	0

TOTAL ATTRIBUTES MATRIX IS:

0.0480	0.0480	0.3141	0.3141	0.2758
0.1257	0.3699	0.2642	0.1415	0.0987
0.5129	0.0988	0.1907	0.0988	0.0988
0.0843	0.0843	0.0843	0.1741	0.5729
0.3368	0.1158	0.3683	0.1263	0.0529
0.3600	0.3600	0.1200	0.1200	0.0400
0.4977	0.2586	0.0979	0.0820	0.0638
0.1305	0.2206	0.1212	0.4027	0.1251
0.2857	0.2857	0	0.1429	1.0000
0.7771	0.7566	1.0000	0.9939	0
1.0000	0.3750	0.8750	0.7500	0
0.5143	0.3429	1.0000	0.9886	0

OVERALL WEIGHTS LINKED TO THE LAST LEVEL:

0.0571 0.1930 0.1033 0.0233 0.0219 0.1999 0.0233 0.0219 0.0977 0.1907  
0.0416 0.0263

RANKING OF ALTERNATIVES:

Dug well	0.4070
Well + pump	0.3685
Bore well + hand pump	0.3810
Bore well + electric pump motor set	0.3577
Jack well + pump house	0.1694.

FINAL RANKINGS:-

1. Dug well
2. Bore well + hand pump
3. Well + pump
4. Bore well + electric pump motor set
5. Jack well + pump house