Volume : 2 | Issue : 4 | April 2013 • ISSN No 2277 - 8160

Research Paper | Engineering

A Study of Groundwater Fluctuation in Coastal Region, Valsad and Navsari District.

Aarti Avalkar	Research Scholar, M. E Civil (W.R.M) , Government Engineering College, Surat
Dr. S. M. Yadav	Prof. Civil Engineering Department, SVNIT, Surat
Sahita Waikhom	Asso. Prof. Civil Engineering Department, Government Engineering College, Surat.
Dr. P. R. Mehta	Retired Principal, SVNIT, Surat

ABSTRACT

The objective of this paper is to study the groundwater seasonal and annual fluctuation and trend of groundwater level and its effect on groundwater level due to rainfall in coastal region Valsad and Navsari District of Gujarat State. Water level data of last 20 years of 100 wells were collected. The yearly and as per distance from sea variation of average groundwater level fluctuation is shown in graph for premonsoon, postmonsoon and annual, also groundwater level vs rainfall vs graph are draw to study their co-relation. The result shows that groundwater level shows a seasonal pattern of fluctuation. The variation of decadal average water level trend is increasing and average water level with the distance from sea shore is decreasing for Valsad district. The variation of decadal average water level trend is decreasing and average water level with the distance from sea shore is decreasing for Navsari district. When co-relating average annual water level with average annual rainfall the water level is increasing with rainfall. When co-relating it with good rainfall year, the water level is high compare to good rainfall year for both districts.

KEYWORDS: Water table, Ground water, Fluctuation, Seasonal variations, coastal area.

I. INTRODUCTION

Valsad and Navsari district is located at the southernmost tip of Gujarat, near Gulf of Khambhat in the Arabian Sea. Water resources in any part of the world are subject to change due to meteorological and climatologically impact all the year long. Impact of these factors on water resources has been extensively studied. (Chen 2002). Groundwater is the primary source of water for human activities such as agriculture, industry and domestic drinking water especially in regions with limited annual precipitation (Todd, 1980). Ground water, the rest portion of water during percolating into the soil and after meeting the necessary soil moisture deficiency, occurs at various locations below the earth's surface depending on the physical properties of various formations that exist. Such as aquifer, unconfined aquifer, confined aquifer aquiclude, aquitard, aquifuge etc. Groundwater which is used for domestic and industrial water supply and irrigation is vital to local people and industry in semi-arid and arid areas like Valsad and Navsari District where groundwater is the main drinking water source. In the last few decades, tremendous increase in the demand for fresh water due to the rapid growth of population and the accelerated pace of industrialization. Ground water condition of an area are mainly depends on abstraction, recharge, soil properties, hydrological characteristic of aquifer, storage capacity etc. The increase of ground water can be achieved by infiltration of rainfall, recharge by seepage, surface flow etc. With the increasing use of ground water for agricultural, municipal, industrial needs, the annual extraction of groundwater are far in excess of net average recharge from natural sources (Mohmmad 2012). The groundwater level fluctuation is controlled by recharge and draft of groundwater and the diverse influences on groundwater levels include meteorology, tidal phenomena, urbanization, earthquakes and external loads Stress and strain in water level due to groundwater recharge, discharge and intensity of rainfall are reflected in groundwater level fluctuation with time. The lowering of groundwater levels has resulted in reduction in individual well yield, growth in well population, failure of bore wells, drying up of dug wells and increase in power consumption(Sukumar 2011). The pre and post monsoon water levels indicate the degree of saturation in aquifer. The extent of saturation in the aquifers is reflected in the status of static water levels. Rainfall is the main source of recharge and the aquifers get saturated by infiltration process. The recharging conditions also vary according to the topography. Variation in rainfall is reflecting in the full saturation of the aquifer in high and assured rainfall zone and partial saturation in the low rainfall zone/drought prone area. Patterns of rise and fall of water levels is directly related to the intensity, amount and duration of rainfall, seasonal fluctuation and water abstraction for different causes as there exists a variable time lag between two rainfall sessions or due to vagaries of monsoon. (Bhagyashri C. Maggirwar1 2011). The long term historical and meteorological data ,among all, temperature and rainfall can be used to assess the future surface water, ground water table and storage variations in order to have a better insight into the problem posed in the future.(Mohamad Aflatooni1* and Mehdi Mardaneh2 2011).

II. STUDY AREA

The study area of my work is Valsad District and Navsari District

1) VALSAD DISTRICT:-

Valsad district is located at the southernmost tip of Gujarat, near Gulf of Khambhat in the Arabian Sea. Valsad is located at 20.8 to 21.9 N latitude and 7 2.39 to 73.30.5 W longitude. Area of Valsad district is 2947.59 sq. kilometers. Total villages are 456. There are five talukas viz. Valsad, Dharmpur, Kaparada, Pardi, Umargaon. Average rainfall is 1500 to 2200 mm.Main rivers of district are Par, Daman Ganga, and Auranga.

2) NAVSARI DISTRICT:-

Navsari district is located at the southernmost tip of Gujarat, near Gulf of Khambhat in the Arabian Sea. Navsari is located at 72.43° to 73.00 ° East (Longitude) 20.07° to 21.00 ° North (Latitude) 40 ° Centigrade (Maximum) Avg. Area of Navsari district is 2657.56 sq. kilometers. There are four talukas viz. Navsari, Gandevi, Jalapore, Bansda. Rivers Kaveri, Mindhola, Purna, Kharera and AmbicaArea 2,196 sq. km District Headquarter Navsari Talukas. Total villages are 375. Average rainfall is 2000 mm.Main rivers of district are Ambika, Puna,Kaveri,Midola etc.

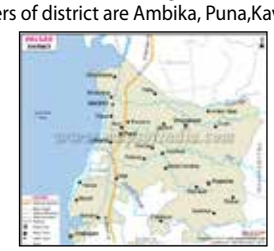




FIGURE 3.1 MAP OF VALSAD AND NAVSARI DISTRICT

III METHODOLOG

Water level data of last 20 years of premonsoon and postmonsoon from year 1991 to 2011 at interval of 5 years of 100 wells has been collected from GWRDC office Surat. From the collected data following procedure were done to study and analyses the groundwater fluctuation seasonal and annual and its co-relation with rainfall.

- Average water level has been find out using ms excel for premonsoon and postmonsoon.
- Average water level of well has been classified according to distance from sea for premonsoon and postmonsoon.
- Graph of average water level vs year has been prepared to study yearly water level fluctuation for premonsoon, postmonsoon and annual.
- Graph of average water level vs distance has been prepared to study distance wise water level fluctuation for premonsoon, postmonsoon and annual.
- From average annual rainfall and average annual water level, yearly variation in ground water fluctuation due to natural recharging has been studied by preparing graph.
- Using Surfer 3-D water surface level, contour map of average annual water level are prepared to study fluctuation in water level (Seasonal study).

IV RESULTS AND DISCUSSIONS

The results of water level fluctuation are taken in which average water level vs year, annual average water level vs year as per distance and correlation of water level with rainfall graph are drawn. Variations of average water level with year for pre monsoon and post monsoon season are studied. For Valsad district Fig 3.2 shows that for pre monsoon average water level is decreasing for all the wells and it is highest for May 1996. Fig 3.3 shows that for post monsoon average water level is increasing for all the wells and it is highest for Oct 2006. For all the wells which are away from sea shore, shows that (Fig 3.4) for pre monsoon average water level is decreasing and it is highest for 40 to 60 km. For all the wells which are away from sea shore, shows that (Fig 3.5) for post monsoon average water level is decreasing and it is highest for 30 to 40 km. For all the wells which are 0 to 60 km away from sea shore, shows that (Fig 3.6) for average water level is increasing as per distance and it is highest for 40 to 60 km. For all the wells Fig 3.7 shows average annual water level is increasing as passing of decade and it is highest for year 2006. Apart from studying variation of water level with time, effect of rainfall on the water level is also studied. Fig 3.8 shows the variation of water level with time and rainfall. Following are the common findings from the above study.

1. In year 1991 the average water level is less due to average rainfall is less.
2. In year 1996 the average water level is increasing as rainfall in that year is less due to effect of local recharge from river.
3. In year 2001 the rainfall is more so average water level is also increasing.
4. In year 2006 the rainfall is decreased but average water level is increasing due to good rainfall in previous year and also due to local recharge.
5. In year 2011 the rainfall is decreased so average water level is decreased.
6. From the above graph it is concluded the if rainfall is more average water level is increasing which shows the co relation of rainfall and average water level is good there is also effect of local recharge.

For Navsari district Fig 3.9 shows that for pre monsoon average water level is decreasing for all the wells and it is highest for May 1991. For all the wells Fig 3.10 shows that for post monsoon average water level is increasing and it is highest for Oct 1996. For all the wells Fig 3.11 shows that for pre monsoon average water level is decreasing as the distance is increasing and it is highest for 30 to 40 km. For all the wells Fig 3.12 shows that for post monsoon average water level is increasing as the distance is increasing and it is highest for 30 to 40 km. For all the wells which are 0 to 55 km away from sea shore, shows that (Fig 3.13) for average water level is decreasing and it is highest for 30 to 40 km. For all the wells Fig 3.14 shows average annual water level is decreasing as passing of decade and it is highest for year 1991. Apart from studying variation of water level with time, effect of rainfall on the water level is also studied. Fig 3.15 shows the variation of water level with time and rainfall. Following are the common findings from the above study.

1. In year 1991 the average water level is high but average rainfall is less due to local recharge or high rainfall in the previous year.
2. In year 1996 the average water level is decreasing as rainfall in that year is less
3. In year 2001 the rainfall is less so average water level is also decreasing.
4. In year 2006 the rainfall is increased so average water level is also decreasing.
5. In year 2011 the rainfall is decreased so average water level is also decreased.
6. From the above graph it is concluded that if rainfall is more average water level is increasing which shows the co relation of rainfall and average water level is good.

The map of 3D surface water level and contour map developed for annual average water level for Valsad district and Navsari district is as shown in figure 3.16 to 3.19.

Discussions

Following are the discussion from the above result for Valsad and Navsari Region.

VALSAD DISTRICT

Following are the common findings from the above study for Valsad Region.

1) The variation of water level is maximum for the wells situated in 40 to 60 km zone for premonsoon season and 40 to 60 km for postmonsoon.
2) The variation of water level is minimum for the wells situated in 30 to40 km zone for premonsoon season and 30 to 49 km for postmonsoon.
3) The variation of decadal average water level trend is increasing.
4) The variation of decadal average water level with the distance from sea shore is decreasing.
5) With passage of time increase in the five yearly rainfall the water level is increasing.
6) When Co relating average annual water level with average annual rainfall the water level is increasing with good rainfall.

NAVSARI DISTRICT

Following are the common findings from the above study for Navsari Region.

1) The variation of water level is maximum for the wells situated in 40 to 50 km zone for premonsoon season and 50 to 55 km for postmonsoon.
2) The variation of water level is minimum for the wells situated in 0 to10 km zone for premonsoon season and 0 to 10 km for postmonsoon.
3) The variation of decadal average water level trend is decreasing.
4) The variation of decadal average water level with the dis-

tance from sea shore is decreasing.
5) With passage of time increase in the five yearly rainfall the water level is decreasing.
6) When Co relating average annual water level with average annual rainfall the water level is increasing with good rainfall.

Comparison between Valsad and Navsari District.
1) With passage of time increase water level is increasing for Valsad district and decreasing for Navsari district.
2) With increase in distance water level is increasing for Valsad district and decreasing for Navsari district.
3) Co relation of rainfall with average water level is good.

V. Conclusion.
Valsad District: The groundwater level shows a seasonal pattern of fluctuation The variation of decadal average water level trend is increasing and average water level with the distance from sea shore is decreasing. When Co relating average annual water level with average annual rainfall the water level is increasing with rainfall. When co-relating it with good rainfall year, the water level is high compare to good rainfall year.

Navsari District: The groundwater level shows a seasonal pattern of fluctuation. The variation of decadal average water level trend is decreasing and average water level with the distance from sea shore is decreasing. When Co relating average annual water level with average annual rainfall the water level is increasing with rainfall. When co-relating it with good rainfall year, the water level is high compare to good rainfall year.

Valsad District

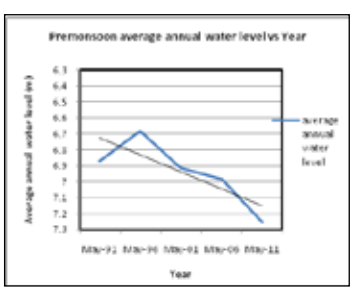


Figure 3.2 Average annual water level vs Year graph.

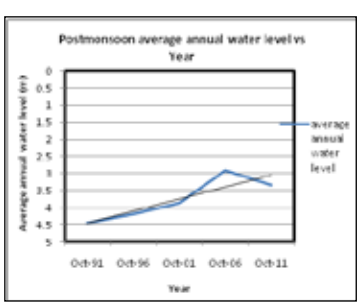


Figure 3.3 Average annual water level vs Year graph.

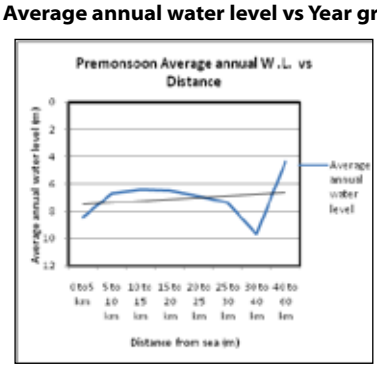
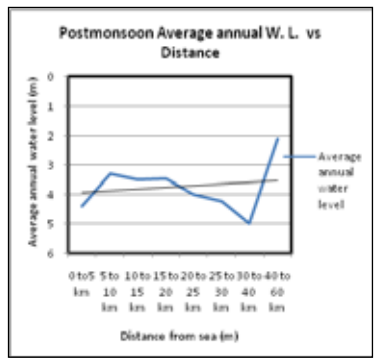


Figure 3.4 Average annual water level vs Distance Figure



3.5 Average annual water level vs Distance from sea for pre monsoon graph. from sea for post monsoon graph.

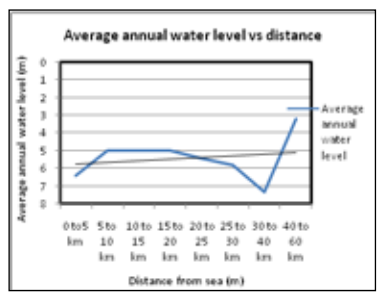


Figure 3.6 Average annual water level vs Distance from sea graph

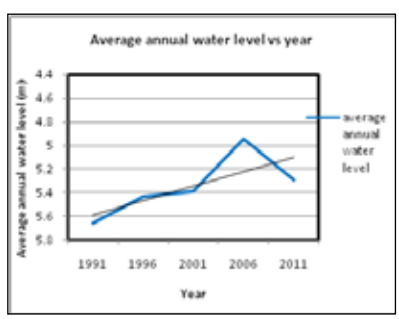


Figure 3.7 Average annual water level vs Year graph

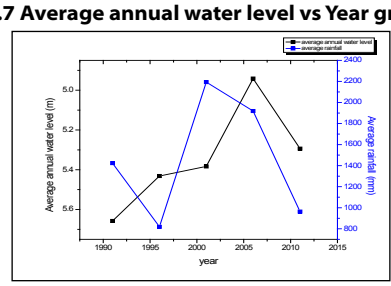


Figure 3.8 Average annual water level vs Year vs average rainfall graph

NAVSARI DISTRICT

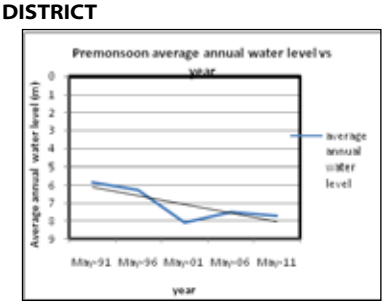


Figure 3.9 Average annual water level vs Premonsoon Year

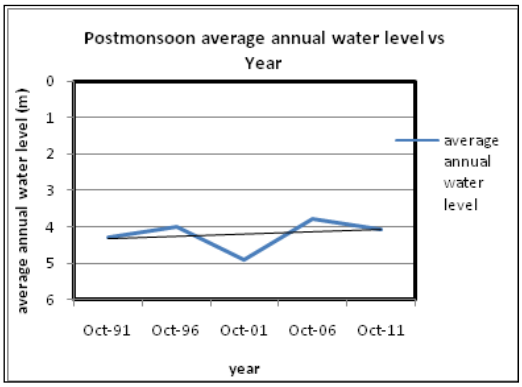


Figure 3.10 Average annual water level vs Pre monsoon Year graph graph

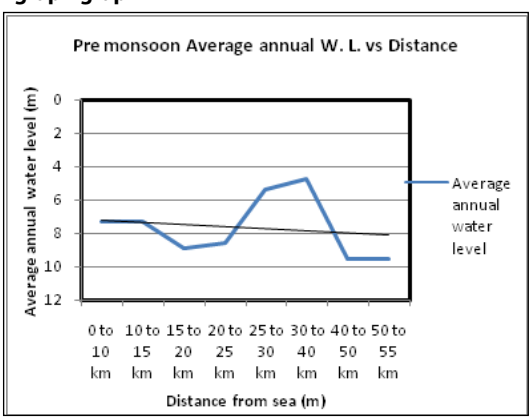


Figure 3.11 Average annual water level vs Distance from sea

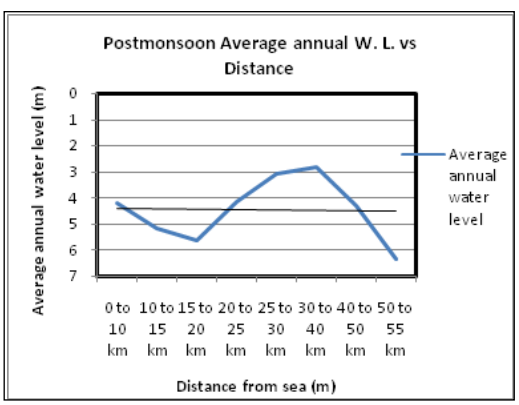


Figure 3.12 Average annual water level vs Distance from sea graph

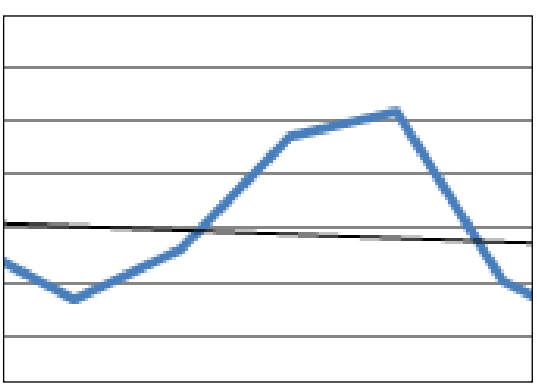


Figure 3.13 Average annual water level vs Distance graph

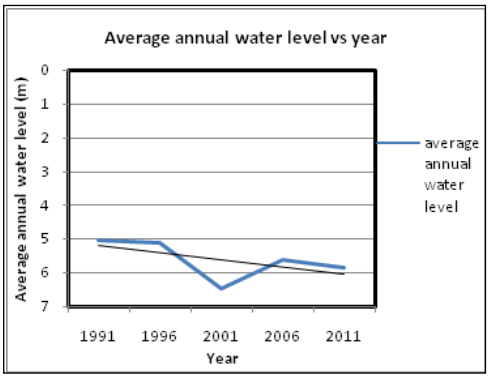


Figure 3.14 Average annual water level vs Year graph

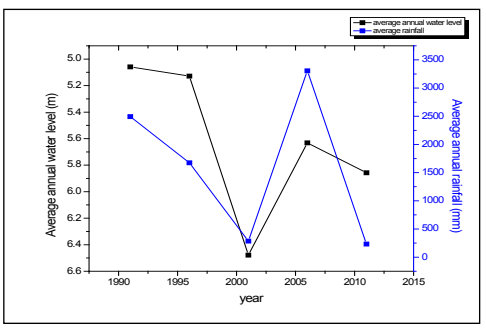


Figure 3.15 Average annual water level vs Year vs average rainfall graph.

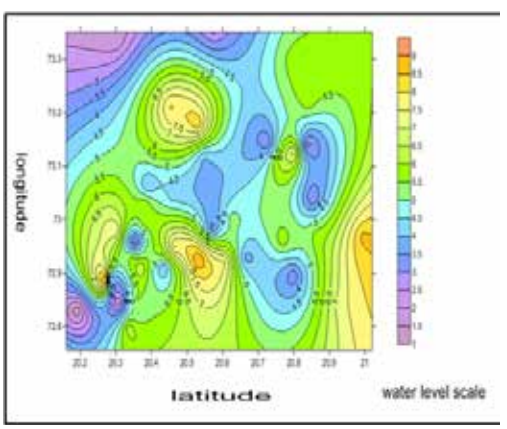


Figure 3.16 Contour map of average water level of Valsad

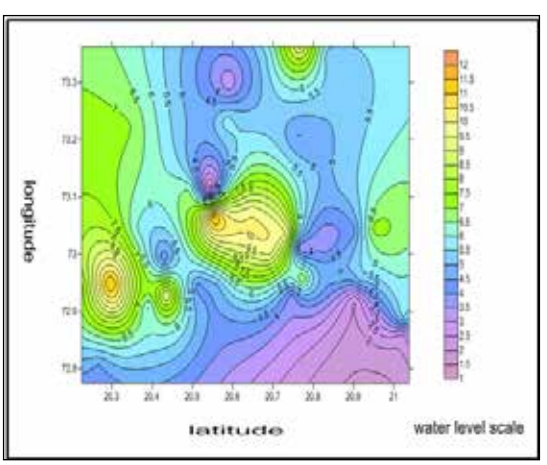


Figure 3.17 Contour map of water level of Navsari District District

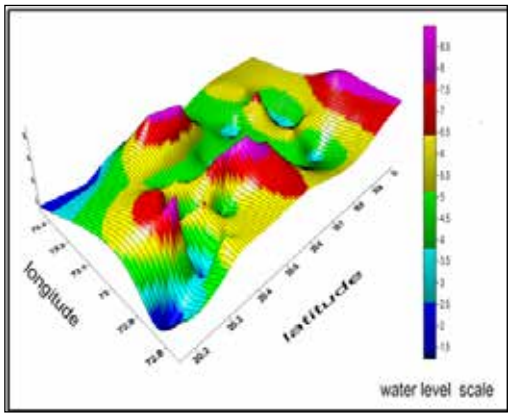


Figure 3.18 3 D water level surface of Valsad District

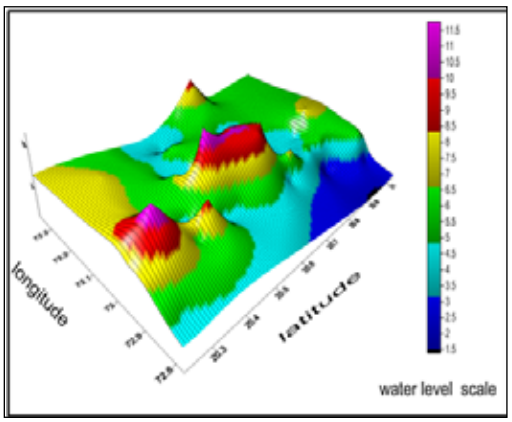


Figure 3.19 3 D water level surface of Navsari district

REFERENCES

1. Alejandro Dussaillanta_, Pablo Galdamesb, Chi-Le Sunb "Water level fluctuations in a coastal lagoon: El Yali Ramsar wetland, Chile" Desalination 247 (2009) 203–215. 2. Awni T Batayneh 1, Hani A . Qassaa 2 "Changes in quality of ground water with seasonal fluctuations: An example from Shor Safi area, Southern Dead Sea coastal aquifer, Jordan. Journal of environmental sciences Vol 18, No 2, pp.263-269,2006 3. Bhagyashri C. Maggirwar1 and Bhavana N. Umrikar 2* "Influence of various factors on the fluctuation of groundwater level in hard rock terrain and its importance in the assessment of groundwater" Journal of Geology and Mining Research Vol. 3(11) pp. 305-317, November 2011. 4. Chen ZS, Osadetz MK "Prediction of average annual groundwater levels from climate variables: An empirical model". J. Hydrol., 260: 102-117. (2002). 5. Emmanuel E., Joseph O., Fanfan P. and Winiarski T. "Trend analysis of the groundwater salinity of the Cul-Desac aquifer in Haiti". Vaulx-en-Velin France.2005. 6. Mohamad Aflatooni1* and Mehdi Mardaneh2 "Time series analysis of ground water table fluctuations due to temperature and rainfall change in Shiraz plain" International Journal of Water Resources and Environmental Engineering Vol. 3(9), pp. 176-188, 8 October, 2011. 7. Mohammad Ahmeduzzaman, Shantanu Kar, Abdullah Asad "A Study on Ground Water Fluctuation at Barind Area, Rajshahi', International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 2, Issue 6, November- December 2012, pp.1465-1470. 8. Sukumar.S 1 , Sankar.K 2 "Statistical Study on Pre & Post Monsoon Variation of Groundwater Level in Theni District, Tamil Nadu – India", INTERNATIONAL JOURNAL OF ENVIRONMENTAL SCIENCES Volume 1, No 5, 2011. 9. Suzana M. Gico Montenegro1, Abelardo A. de A. Montenegro2, Jaime J. S. P. Cabral1,Giancarlo Cavalcanti1 "Intensive exploitation and groundwater salinity in Recife coastal plain (Brazil): monitoring and management perspectives" Proceeding 1st SWIM-SWICA Joint Saltwater Intrusion Conference, Cagliari-Chia Laguna, Italy - September 24-29, 2006. 10. Todd, D., (1980). Groundwater hydrology. Second edition. John Wiley and sons.