International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-4, November 2019

Determination of Ground Water Stressed Regions of Visakhapatnam District using ArcMap

Srikanth Satish Kumar Darapu*, Hema Sumanth Bomma, Kode Venkata Sayi Sankeerth, Swathi Boosala

Abstract*: Water is essential for human life, which is vastly used for basic needs like drinking and other domestic, irrigational and industrial purposes etc. The main sources of water are classified as surface and sub-surface sources. The surface water resources are varied like rivers, ponds, lakes etc. but the sub-surface resources are only water bearing aquifers. Day by day the sub surface water is degrading due to many reasons like pollution, climate change etc. Therefore, studies on conservation of ground water is important. For the present study, data of ground water levels for eleven years (2007-2017) at 69 locations of various mandals (zones) in Visakhapatnam district (Andhra Pradesh, India) was obtained from the A.P. Ground Water and Water Audit Department, Visakhapatnam. By using ArcMap of ArcGIS and the spatial and temporal variations were mapped onto the base map of Visakhapatnam. The results indicated 'water stressed areas' in the study region. It was observed that the ground water levels dwindled drastically in the years 2016 and 2017. The results of the study highlighted the immediate necessity to scale up the ground water conservation measures and efficient design of the ground water resource systems in the area.

Keywords: Ground Water Conservation, ArcMap, Temporal Variation and Spatial Variation of Ground Water, Water Scarcity, Water Stress.

I. INTRODUCTION

The net usable groundwater in India is 398 billion cubic meters per year. Over 15% of the districts in India were overexploited in terms of ground water usage. In Andhra Pradesh, the ground water development was 37% in 2012; it increased to 44% in 2013. In Mizoram, it was just 3% and in Punjab, it was as high as 172% in the year 2012. India is facing the disaster of groundwater overuse, the reasons being decentralization of the ground water availability in India (owner of the land has a right to water underneath it), lack of conjunctive use etc. 68 districts of 10 states in India were affected by high arsenic contamination in ground water, 276 districts of 20 states were affected by high fluoride content, 387 districts of 21 states were affected by high nitrate content, and 297 districts of 24 states were affected by high iron content (Suhag 2016). These are some of the ill-effects of overexploitation of ground water (Goyal 2010).

Manuscript published on November 30, 2019.
* Correspondence Author
***Srikanth Satish Kumar Darapu**, Asst. Professor, Department of Civil Engineering, GIT, Gandhi Institute of Technology and Management (GITAM Deemed to be University), Visakhapatnam, A.P. – 530045,
Hema Sumanth Bomma, P.G student, School of Mechanical and Building Sciences, Vellore Institute of Technology (VIT) Chennai, Tamil Nadu - 600127, India
Kode Venkata Sayi Sankeerth, B.Tech. Student, Department of Civil Engineering, GIT, Gandhi Institute of Technology and Management (GITAM deemed to be University), Visakhapatnam, Andhra Pradesh - 530045, india.
Swathi Boosala, Asst. Professor, Department of Mechanical Engineering, Vignan's Institute of Engineering for Women (VIEW), Andhra Pradesh - 530046, A.P., India.

II. GROUND WATER SCENARIO IN VISAKHAPATNAM DISTRICT

The average annual rainfall of Visakhapatnam district is 1,116 mm. Major watersheds of the district are formed by Machkund, Tandava, Varaha, Sarada and Gosthani. The district has around 5,100 dug wells and 9,610 tube wells. There are 38 ground water monitoring wells. In 2013, the ground water development in Visakhapatnam district was 32% and it is rapidly increasing thereafter. The post monsoon ground water levels were declining in recent years. The water level fall in Visakhapatnam district in November 2016 was 42.6 m. The decennium mean-maximum fall for November (2006-2015) is 44.8 m, which is the highest of all the districts in the residual state of Andhra Pradesh and for January (2007-2016), it is 40.46 m which is the second highest (Rao 2013 and Sudhakar 2017). The annual ground water extraction in Visakhapatnam has been increasing rapidly in the last five years due to the increased speedy construction of human habitats like apartments, commercial complexes and other developmental activities. The ground water conservation measures taken were not up to the required scale. This had led to water stress in many areas of Visakhapatnam.

III. RESEARCH ON TEMPORAL AND SPATIAL VARIATIONS OF GROUND WATER LEVELS

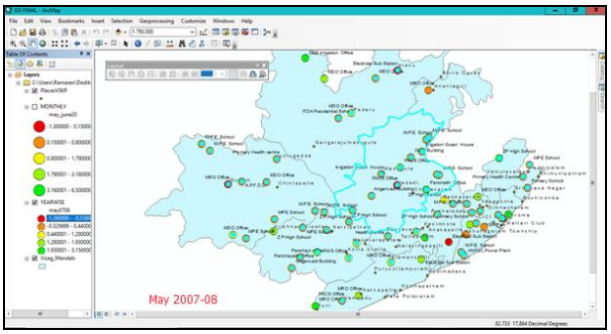
The depletion of ground water level had become faster during 1997-2007 than the previous decade in the study area (Goyal 2010). The ground water levels reduced in monsoon season due to excessive withdrawal for irrigation and the recharging of aquifers was at a slow rate. However, the groundwater level rises in the post monsoon season due to the groundwater resilience of the aquifers (Krishna et al. 2015). In

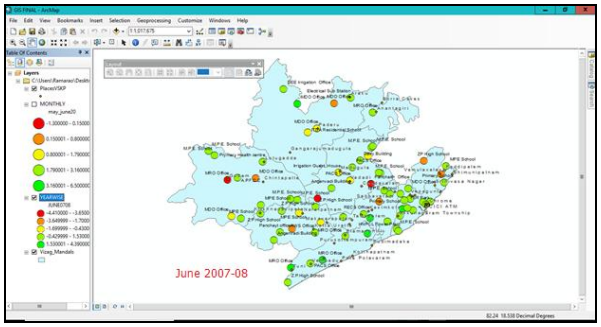
Haryana, continuous withdrawal of ground water along with low rainfall and variable geographic conditions resulted in the declination of ground water levels (Priyanka et al. 2016). The time series of groundwater levels were recurring with distinctive features of seasonal variations in the study area (Thakur et al. 2011). Development of water harvesting systems in the critical i.e. arid and hot regions and modernization of irrigation methods were essential to conserve ground water (Ahmadi et al. 2007). Autocorrelograms indicated the temporal dependence of seasonal water level fluctuations based on which forecasting can be carried out within a period of 3–21 months (Rakad A. Ta'any et al. 2009).

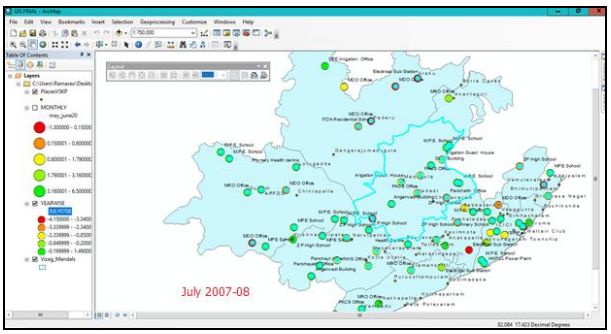
IV. METHODOLOGY

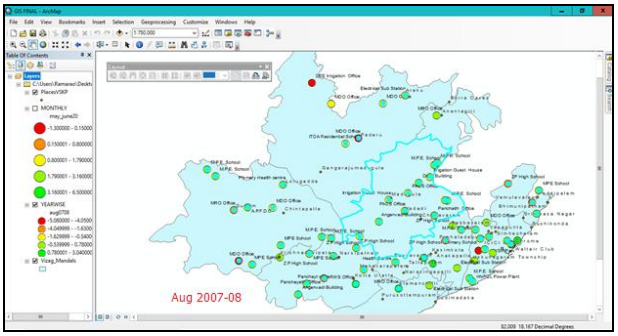
First, the base map of Visakhapatnam was imported into ArcMap. The monthly and water level differences at each of the 69 locations were calculated year by year for the entire duration of 2007-17. Each location was given a unique name. The data was converted to .CSV file and imported as the next layer. The 'water stress' intensity was given a color gradient, wherein areas marked in red indicate the most water stressed ones. Various maps thus obtained were exported for analysis purpose.

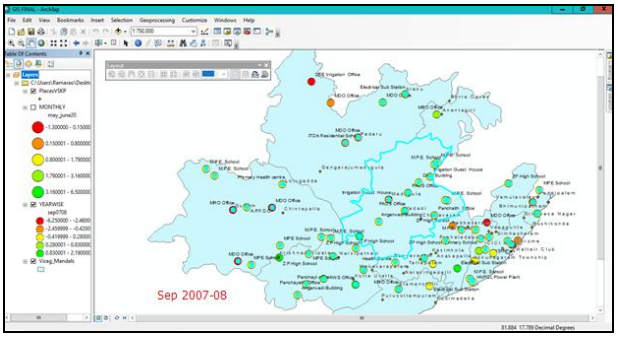
V. MONTH SPECIFIC SPATIAL AND TEMPORAL VARIATIONS OF GROUND WATER LEVELS

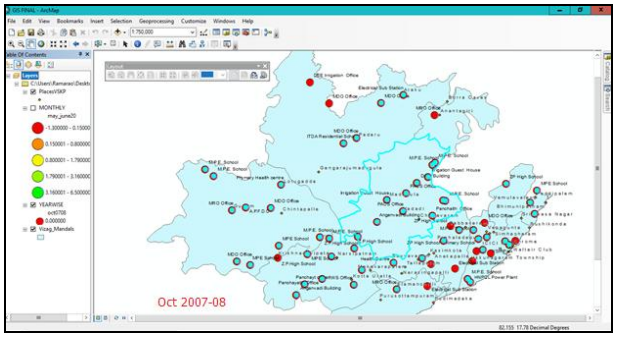


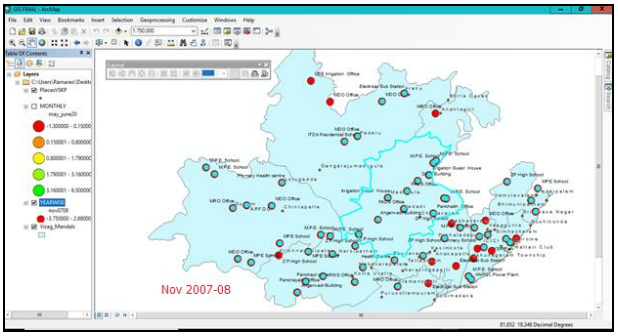


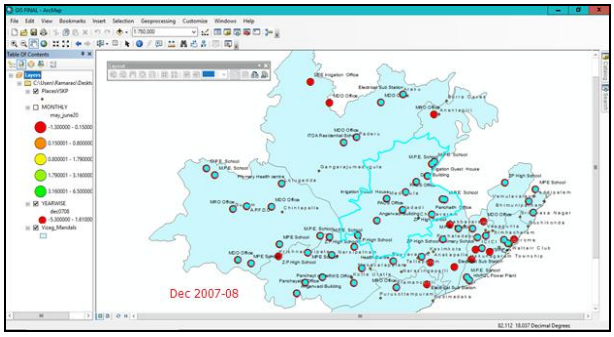






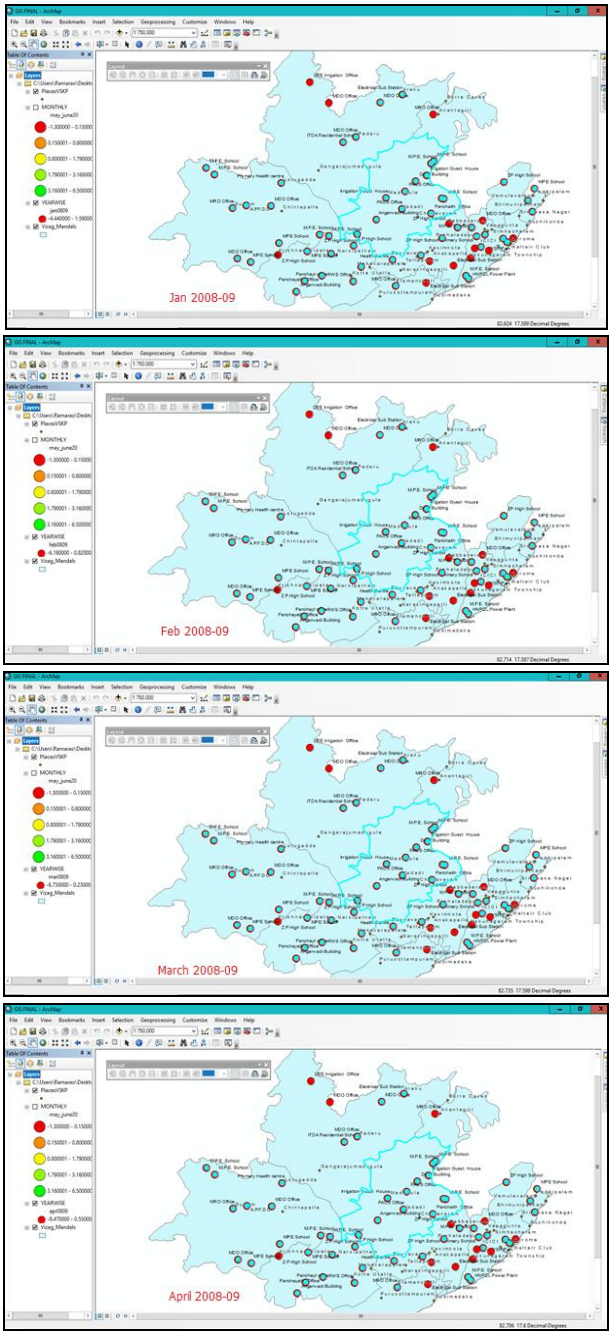






Retrieval Number: D4442118419/2019©BEIESP
DOI:10.35940/ijrte.D4442.118419
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication



VI. RESULTS AND DISCUSSIONS

The results were indicated in the ArcMap images in the form of vibrant colored dots. Red color indicates 'extreme water stress' in a specific area for a specific duration. Dark green indicates better amelioration in ground water levels. By comparing the month wise water level variations of 2007 and 2008, it was found that water levels in the post-monsoon of 2008 had considerably reduced when compared to that of 2007. Water stress was significantly more in May 2008-09 when compared to that of 2007-08. Similar analysis was carried out until 2017 and useful inferences were drawn. It was found out that there was a declining trend in the ground water levels in Visakhapatnam district from 2007-2017. Most of the water stressed areas were found to be, Irrigation Guest house-2, M.P.E school-10, Ground water department building , M.R.O office-4, Z.P.H school-4, Electrical substation-3, Primary health centre-2, Health centre-2, ITDA residential building as indicated in the exported maps by red dots.

VII. CONCLUSION

From the ArcMap analysis, 2017, 2016, 2015 respectively were found to be the most water stressed years indicating the unsustainable practices in the region and calls for immediate action for conservation of ground water on a large scale. The ground water resources personnel, irrigation and water resources engineers and city planners may use this information for the strategic development and sustainable use of ground water resources in Visakhapatnam region.

ACKNOWLEDGMENT

The authors would like to thank the A.P. Ground Water and Water Audit Department, Visakhapatnam for providing data for the research.

REFERENCES

1. "District Wise Pre and Post monsoon average groundwater levels for the years 2014 and 2017 (Meters below ground level)." 2018, Core Dashboard, CM Office Real-Time Executive Dashboard, IT, E&C Dept., Govt. of Andhra Pradesh.
2. Dhirendra Kumar Singh and Anil Kumar Singh, "Groundwater Situation in India: Problems and Perspective.", International Journal of Water Resources Development, Volume 18, Issue 4, 2002, pp. 563-580, DOI: 10.1080/0790062022000017400
3. G. B. Rao, "Ground Water Brochure, Visakhapatnam District, Andhra Pradesh", (AAP-2012-13), Central Ground Water Board, Ministry of Water Resources, Government of India, 2013.
4. G. Krishna, A. K. Lohani, M. S. Rao, S. Kumar, and K. S. Takshi, "Spatiotemporal Variability Analysis of Groundwater Level for Water Resources Development and Management in Northern Punjab, India." J Environ Anal Toxicol, Volume 5, Issue 4, 2015, pp. 1-6, DOI: 10.4172/2161-0525.1000279
5. G.S. Thakur, T. Thomas, "Analysis of Ground Water Levels for the Detection of Trend in Sagar District, Madhya Pradesh.", Journal of the Geological Society of India, Volume 77, Issue 4, 2011, pp. 303-308, https://doi.org/10.1007/s12594-011-0038-z.
6. P. Madhnure, P. Sudhakar, "Ground Water Year Book, Andhra Pradesh, 2015-2016.", Central Ground Water Board, Ministry of Water Resources, River Development & Ganga Rejuvenation, Government of India, 2016.
7. P. Sudhakar, M. B. Reddy, Y. Satyakumar, "Ground Water Yearbook of Andhra Pradesh State (2016-17).", Central Ground Water Board, Ministry of Water Resources, Govt. of India, 2017.
8. Priyanka, G. Krishan, L. M. Sharma, B. K. Yadav, N. C. Ghosh, "Analysis of Water Level Fluctuations and TDS Variations in the Groundwater at Mewat (Nuh) District, Haryana (India)." Current World Environment, Volume 11, Issue 2, 2016, pp. 388-398, DOI: http://dx.doi.org/10.12944/CWE.11.2.06.
9. R. Suhag, "Overview of Ground Water in India.", PRS Legislative Research, 2016.
10. Rakad A. Ta'any, Alaeddin B. Tahboub, Ghazi Saffarini, "Geostatistical Analysis of Spatiotemporal Variability of Groundwater Level Fluctuations in Amman–Zarqa Basin, Jordan: A Case Study." Journal of Environmental Geology, Volume 57, Issue 3, 2009, pp. 525-535, https://doi.org/10.1007/s00254-008-1322-0.
11. S. H. Ahmadi, A. Sedghamiz, "Geostatistical Analysis of Spatial and Temporal Variations of Groundwater Level. Environmental Monitoring and Assessment." Environmental Monitoring and Assessment, Volume 1, Issue 3, 2007, pp. 277-294.
12. S. K. Goyal, B. S. Chaudhary, O. Singh, G. K. Sethi, P. K. Thakur, "Variability Analysis of Ground Water Levels – A GIS-based case study." Journal of the Indian Society of Remote Sensing, Volume 38, Issue 2, 2010, pp. 355–364.

AUTHORS' PROFILE

Er. Darapu Srikanth Satish Kumar Darapu is working as Assistant Professor at the Dept. of Civil Engineering, GIT, Gandhi Institute of Technology and Management (GITAM deemed to be University), Visakhapatnam.
https://vspgitcivil.gitam.edu/faculty/profile/1156

Hema Sumanth Bomma is pursuing his master's degree from the School of Mechanical and Building Sciences, Vellore Institute of Technology (VIT), Chennai.

Kode Venkata Sayi Sankeerth is pursuing his bachelor's degree, Department of Civil Engineering, GIT, Gandhi Institute of Technology and Management (GITAM deemed to be University), Visakhapatnam.

Swathi Boosala is working as Assistant Professor at the Dept. of Mechanical Engineering, Vignan's Institute of Engineering for Women (VIEW), Visakhapatnam.