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RESEARCH ARTICLE

Sustainability of Irrigation through Shallow Wells: A Case Study in Tamilnadu, India

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ABSTRACT

The importance of role of irrigation in developing countries is widely recognized for economic development and food security. It impacts growth of a nation and contribute to the wellbeing of the people. In India, since independence agriculture has been the primary source of income and a major sector employing vast majority of people till date. Shallow wells play a very important role in irrigating vast majority of area as it is affordable to even marginal farmers. Ground water levels have been greatly affected by increase in population, urbanization, growth of industries, consuming level of food and energy demands. It can directly impact the agricultural sector and hence impact economy. This paper analyses the sustainability of such wells through a case study demonstrating the use of statistical methods to derive useful information. The results indicate statistical methods can provide useful insights into the sustainability of shallow wells. Proper management strategies that can lead to sustainability have been suggested.

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Introduction

The importance of role of irrigation in developing countries is widely recognized for economic development and food security [1]. It impacts growth of a nation and contribute to the wellbeing of the people [2][3]. In India, since independence agriculture has been the primary source of income and a major sector employing vast majority of people till date [4]. Ground water levels have been greatly affected by increase in population, urbanization, growth of industries, consuming level of food and energy demands [5]. Shallow wells play a major part in irrigation sector and caters to majority of marginal farmers and farmers with small land holdings [6][7].

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Deep well irrigation is un economical as the cost of electricity is cannot be matched with returns. In the long run it is not going to a sustainable mode of irrigation [8][9]. Hence it is necessary to preserve and adopt proper irrigation practice to effectively manage shallow wells. This paper examines the procedure that can be adopted to analyze water level fluctuations statistically and arrive at useful information which can be used to adopt best management practice.

Materials and Methods

Shallow well irrigation is very common in the state of Tamilnadu and for the purpose of study historic water level data was collected from one of the shallow wells maintained by the public works department as shown in Table 1. This well is located in Thiruvallur district of Tamilnadu and the type of aquifer is phreatic. The total depth of the well is 8.75 m and the diameter of the well is 1.75 m.

Table 1. Details of Shallow well selected for study

Well No.	Location		Total Depth (m)	Well Diameter(m)	Type of Aquifer
	Latitude	Longitude			
OW 130348794534	13°03'53"	79°45'29"	8.75	1.75	Phreatic

The mean depth of water level measured from the year 2008 to 2018 is shown in Table 2. The water level measurements have been classified into four periods namely post monsoon, pre monsoon, southwest monsoon and northeast monsoon. The mean depth of water available for use is derived by subtracting the mean depth of water below ground level from the total depth of the well. The mean depth of water available for use is shown in Table 3.

Table 2. Mean depth of water below ground level

Year	Mean depth of water below ground level (m)			
	Post monsoon	Pre monsoon	Southwest monsoon	Northeast monsoon
2008	1.44	2.30	3.76	3.24
2009	2.49	4.78	5.52	3.59
2010	2.48	3.92	4.44	2.12
2011	2.32	2.83	3.58	3.37
2012	1.66	2.22	3.13	2.17
2013	2.38	3.23	3.95	1.25
2014	2.30	2.87	3.58	4.09
2015	2.21	5.59	3.77	2.49
2016	1.51	3.25	4.23	3.47
2017	3.38	4.30	4.51	2.00
2018	2.20	2.98	3.39	3.33

The water level fluctuations in the depth available for use have been analyzed with statistical tools. Frequency distribution charts along with the normal distribution curves have been plotted.

Table 3. Mean depth of water available for use

Year	Mean depth of water available for use (m)			
	Post monsoon	Pre monsoon	Southwest monsoon	Northeast monsoon
2008	7.31	6.45	4.99	5.51
2009	6.26	3.97	3.23	5.16
2010	6.27	4.83	4.31	6.63
2011	6.43	5.92	5.17	5.38
2012	7.09	6.53	5.62	6.58
2013	6.37	5.52	4.8	7.5
2014	6.45	5.88	5.17	4.66
2015	6.54	3.16	4.98	6.26
2016	7.24	5.5	4.52	5.28
2017	5.37	4.45	4.24	6.75
2018	6.55	5.77	5.36	5.42

Results and discussion

The descriptive statistics of the available ground water in terms of depth are given in Table 4.

Table 4. Descriptive statistics of available water level in four seasons

	N	Range	Min	Max	Mean	Std. Dev	Var.
Post Monsoon	11	1.94	5.37	7.31	6.53	0.54	0.295
Pre Monsoon	11	3.37	3.16	6.53	5.27	1.05	1.115
SW Monsoon	11	2.39	3.23	5.62	4.76	0.66	0.414
NW Monsoon	11	2.84	4.66	7.50	5.92	0.86	0.753
Valid N(list wise)	11						

The range is maximum with a value of 3.37 m during pre-monsoon with minimum depth of 3.16 m and maximum depth of 6.53 m. The standard deviation is 1.115. The range is minimum with a value of 1.94 m with a minimum depth of 5.37 m and maximum depth of 7.31 m. The standard deviation being 0.54355. This show that the dependability of ground water is more during post-monsoon period and least during pre-monsoon period. The values during southwest monsoon and northeast monsoon lying in between.

The frequency distribution of available water depths is shown in Figures 1 to 4.

During the post monsoon period the available water depth has gone below 5.5 m only once and the depth during most of the years were above 6.0 m as shown in Fig 1.

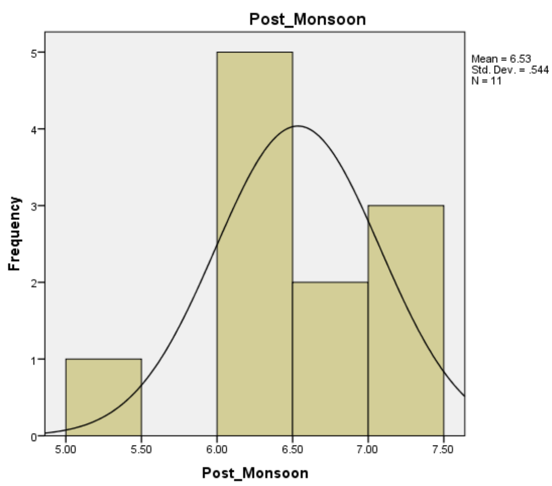

Figure 1. Frequency distribution of available water depth during Post monsoon

The frequency distribution of available water level depth during pre-monsoon is shown in Figure 2. During the pre-monsoon period, the available water level has gone below 5.00 m four times. Out of eleven years the water level depth was less than 6 m in 9 years. This clearly shows that dependability is less during pre-monsoon. The frequency distribution of available water level depth during southwest monsoon is shown in Figure 3. During the southwest monsoon, the available depth of water is more than 4.5 m in eight out of eleven years and shows more dependability. This is because the region receives moderate rainfall during southwest monsoon. Northeast monsoon period also shows a dependable availability of water as shown in the Figure 4.

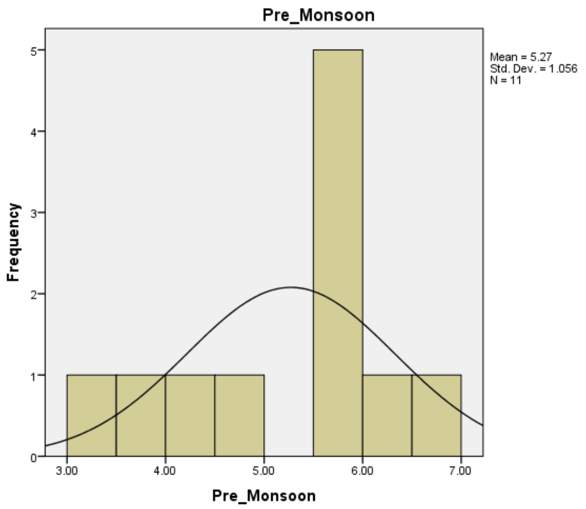

Fig. 2. Frequency distribution of available water depth during Pre-monsoon

The frequency table show that the available depth has always remained more than 4.5 m in all eleven years. The can be attributed to the fact that this region receives major amount of rainfall during northeast monsoon.

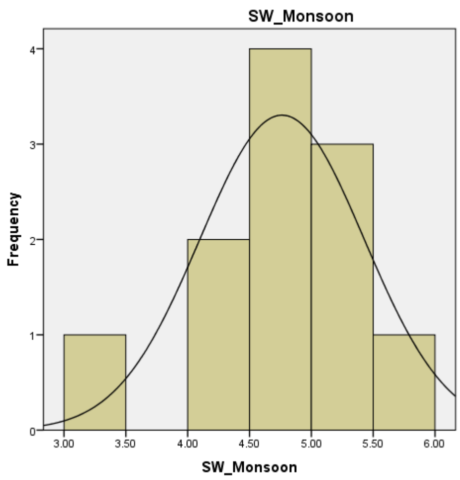

Fig. 3. Frequency distribution of available water depth during Southwest monsoon

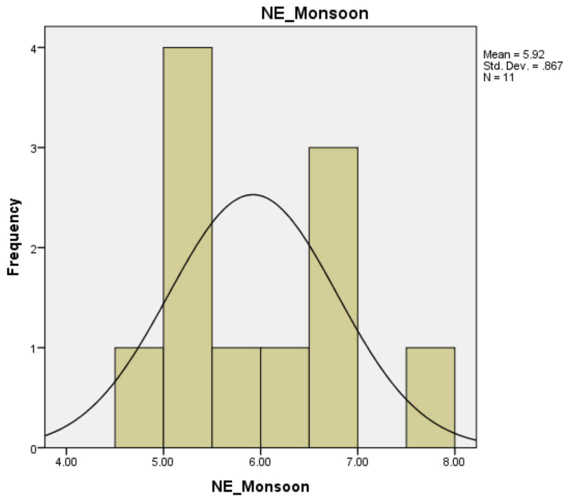

Fig 4. Frequency distribution of available water depth during Northeast monsoon

Conclusion

The statistical methods deployed provides very useful insights in to the variations in the depth of water available for use. It is also clearly demonstrated that seasonal variations need to be considered while analysing hydrological data. Cropping pattern plays a major role as it determines the crop water requirements. The type of crops that is cultivated during various seasons must be in tune with the availability of water in various seasons. Sustainability can only be achieved if there is proper understanding of the hydrological process of ground water fluctuations and adaptation of proper management practice in terms of appropriate cropping pattern. Rain water harvesting could play a vital role in maintaining adequate water levels for irrigation. Statistical methods prove to be a very useful tool in understanding the groundwater dynamics of shallow wells.

References

Bhatia, R., Briscoe, J., Malik, R.P.S., Miller, L., Misra, S., Palainisami, K., and Harshadeep, N., 2006. Water in the economy of Tamil Nadu, India: more flexible water allocation policies offer a possible way out of waterinduced economic stagnation and will be good for the environment and the poor. *Water Policy,* 8: 1–13.

Kant, N., Singh, P.K., and Kumar, B., 2018. Hydrogeochemical characterization and groundwater quality of Jamshedpur urban agglomeration in Precambrian terrain, Eastern India. *Journal of the Geological Society of India*, 92(1): 67-75.

Khan, R., and Jhariya, D.C., 2017. Groundwater quality assessment for drinking purpose in Raipur City, Chhattisgarh using water quality index and geographic information system. *Journal of the Geological Society of India*, 90(1): 69-76.

Patil, K., 2015. An Implication of Groundwater Institutions on Reducing Negative Externality, Enhancing Economic Efficiency and Welfare in Karnataka. *Indian*

Journal of Agricultural Economics, 70(902-2016-68382): 292-306.

Łabędzki, L., 2016. Actions and measures for mitigation drought and water scarcity in agriculture. *Journal of Water and Land Development*, 29(1): 3-10.

Nerker, R.K., Vaibhav, S., and Rajendra, B., 2013. The Sustainable Growth and Development of Indian Agriculture. *Asia Pacific Journal of Marketing & Management Review,* 2(6): 117-119.

http://indianresearchjournals.com/pdf/APJMMR/2013/June/14.pdf.

Sathyamoorthy, N.K., Jagannathan, R., and Ramaraj, A.P., 2016. Rainfall Profile of Cauvery Delta Zone of Tamil Nadu. *Current World Environment*, 11(2): 524-530.

Sonekar B.L., 2017. Problem of water stress in Indian agriculture. *Journal of Rural Development,* 1(1): 15-23.

Venkatachalam, L., and Narayana, M.A., 2012. Estimated economic value of irrigation water through contingent valuation method: Results from Bhavani River Basin, Tami Nadu. *Indian Journal of Agricultural Economics,* 70(3): 33-349.