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Hydrogeophysical Assessment for Groundwater Resources In Lower Vellar Watershed, Cuddalore District, Tamilnadu, India

K. Karthikeyan, S. Sivaprakasam, N. Nagarajan

Abstract: ***Seventeen Vertical Electrical Soundings were carried away in vellar river Bank of Bhuvanagiri and Chidambaram Taluk, Cuddalore District, Tamil Nadu to classify the development and management through Artificial Recharge zone in alluvium formation and identify the sub-surface lithological series. The most electrode division used is 100m by Schlumberger pattern. Geologically, sedimentary rocks are alluvium and tertiary formations. The resistivity reports were interpreted by using IPI2WIN software. The construe outcome shows 3 and 4 layer strata. It has been prepared pseudo section in comparison with the subsurface strata to validate the results.***

Keywords: Vellar River, Artificial Recharge, Vertical Electrical Resistivity.

I. INTRODUCTION

The escalating demands for groundwater, in various parts of Coastal areas are of huge ecological, financial, public, and civilizing consequence. Therefore, the achievement of appropriate monitoring and safety actions is primary for their protection and for assuring upcoming use of this resource (Antonio Satriani 2012).

At present, enormous awareness is created on modern geophysical methods for resolvehydro geological and environmental problems (D.W.Steeples 2001, V. Naudet, 2008).Electrical and electromagnetic geophysical methods have been broadly used in groundwater investigations because, geophysical survey as a veritable tool in groundwater exploration.

Still, groundwater exploration in hard rock areas are often more complicated, as sedimentary terrain must be situated closely successful. Vertical Electrical Sounding is a familiar technique to assess electrical resistivity; this technique has been used for hydrogeological survey of sedimentary basin (Kelly and stanislav 1993).

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***** Correspondence Author

Dr. K. Karthikeyan*, Associate Professor, Department of Civil Engineering, Faculty of Engineering and Technology, Annamalai University, Annamalai Nagar, Tamilnadu, India Email: srikrish.kkarthikeyan@gmail.com

Dr. S. Sivaprakasam, Associate Professor, Department of Civil Engineering, Faculty of Engineering and Technology, Annamalai University, Annamalai Nagar, Tamilnadu, India Email: sivacdm67@gmail.com

Dr. N. Nagarajan, Associate Professor, Department of Civil Engineering, Faculty of Engineering and Technology, Annamalai University, Annamalai Nagar, Tamilnadu, India Email: nnrajan.au@gmail.com

In general schlumberger array assumes importance and well used for groundwater survey due to the simplicity of the system, simple interpretation and rocky character of the allied instrumentation.

The method is commonly used in sedimentary and hard rock region (Urish and Frohlich, 1990,). In addition, the method has been developing effectively to solve groundwater evils by several researchers (Yadav et al., 2010).

The use of geophysical method collectively for groundwater resources mapping and water quality appraisal has augmented over the last few years (Karthikeyan et al., 2012).

The present Lower Vellar bank comes under the high ground water grasp type, an effort intended to understand subsurface Lithology and to identify the Artificial Recharge zone.

Objectives

- To delineate sub surface Lithology variation using Electrical resistivity method
- To identify the recharge zone

The Part of Lower Vellar River lies between the latitude 11^0 25´ and 11^0 31' and the longitude between 79^0 36' and 79^0 40' (Figure 1). Physiographically, the area has a mild gradient. Geologically it Comprises alluvium cover most of the Lower Vellar bank, subsequently by Mio Pliocene and cretaceous formations shown in Figure 2. Geomorphologically it is obscured by flood plain along the river courses and enduring area by alluvial and coastal plain. The normal rain fall of the district is 544.6mm.

Agriculture is the primary activity in the Lower Vellar bank. The surface and groundwater are used for both domestic and irrigational utility.

II. METHODOLOGY

In the present study, to know the subsurface Lithology and layer thickness of groundwater latent zone were carried out on different locations in seventeen vertical electrical soundings (VES).

The resistivity signal dimensions were collected by using SSR-MP-AT model resistivity meter.

A limit of 100m AB/2 spacing is used by Schlumberger configuration. The attain data were explored by using IPI 2WIN software.

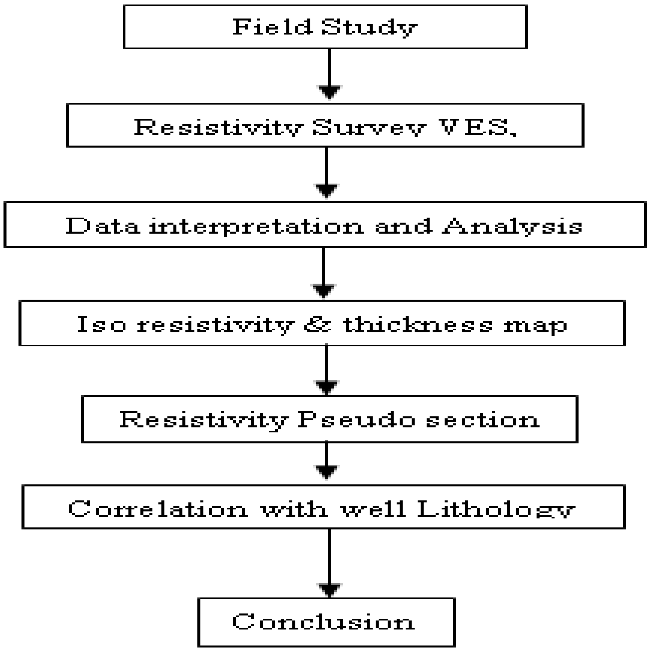


Figure 1 Flow chart showing the methodology

In the present study, IPI2win software has been used for interpreting the field data and curve matching techniques. From the apparent resistivity data, the interpreted resistivity curve obtained using the software is shown in the Figure 3. It is observed that 3 layer curves are conquered in the Lower Vellar bank, however, 4 layer curves also obtained from the interpretation. The resistivity and thickness of various layers is given in the Table 1.

III. RESULT AND DISCUSSION

The study helped to understand the sub surface Lithology and its groundwater latent regions in the Lower Vellar bank and its quality. The electrical resistivity technique applied in sedimentary terrain to understand groundwater potential and sub surface lithological studies is little bit difficult and complex in terms of data analysis and interpretation. The present study reveals the hydro geological condition of the area with reference to groundwater potential using electrical resistivity survey helped to identify the potential groundwater zones and for better understanding the subsurface lithological variation and shallow aquifer potential an attempt has been produced to practice pseudo section and suitable recharge structure of the Lower Vellar bank. It is observed that 3 layer curves are conquered in the bank, but 4 layer curves also obtained from the interpretation. In general resistivity and layer thickness are varied from 0.02 ohm m to 18424 ohm m and 0.4 m to 66.6 m respectively. The curve types obtained are A, H, and QH, KH, HK, KQ. The output of the infer data using IPI 2WIN is presented in the Figure 3. The investigate on illustrate that the resistivity and thickness for first layer varied from 1.45 ohm to 1517 ohm and the layer thickness varied from 0.75m to 9.6 m. The dry soil might be the cause for high resistivity values over coastal alluvium. The second layer thickness 0.5 ohm to 45.8 ohm and 0.4m to 12.10 m. The underlying formation resistivity is generally depends on the compaction and water diffusion level. This low resistivity value range could be the presence of saline water formation. The third layer resistivity and thickness value range from 0.74 ohm to 18424 ohm and 1.67 m to 66.6 m respectively. The fourth layer resistivity and thickness range from 0.02 ohm to 149 ohm. The third and fourth layer resistivity values are detected high in the dry sand and low in Lower Vellar bank due to sandy clay are salt water interface formation.

A. Pseudo section of electrical resistivity

For better understanding the subsurface lithological variation an attempt has been made to prepare pseudo section both side of river bank of the study area shown in the Figure 4.In the first zone resistivity value of < 5Ωm at 30 m depth which has saline water formation observed in near to the river boundary. The moderate resistivity > 20 to 30 Ωm observed at the depth varied from 5 to 10m in VES 3, 5 and 7 favorable for shallow groundwater development in the Lower Vellar bank. From this interpretation it shows clearly suitable place for Artificial Recharge zone Using Electrical Resistivity.

IV. CONCLUSION

The study helped to learn the sub-surface Lithology and groundwater latent zones and its quality in the Lower Vellar bank. The present study reveals the hydro geological conditions of the area with reference to ground water potential. The interpretation of true resistivity values and sub surface thickness has shown the potential of groundwater zones at various depths and location along the direction of Vellar River.

Electrical resistivity survey helped to identify the potential groundwater zones and suitable recharge structure for the Lower Vellar bank. There are four layer strata in maximum VES location in the Lower Vellar bank. The extremely low resistivity values are because of the presence of wet clay where as the high resistivity could be due to sand stone formation with ground water potential.

The resistivity pseudo cross section model is a more information techniques to analysis to sub surface variation at different depth levels in the Lower Vellar bank.

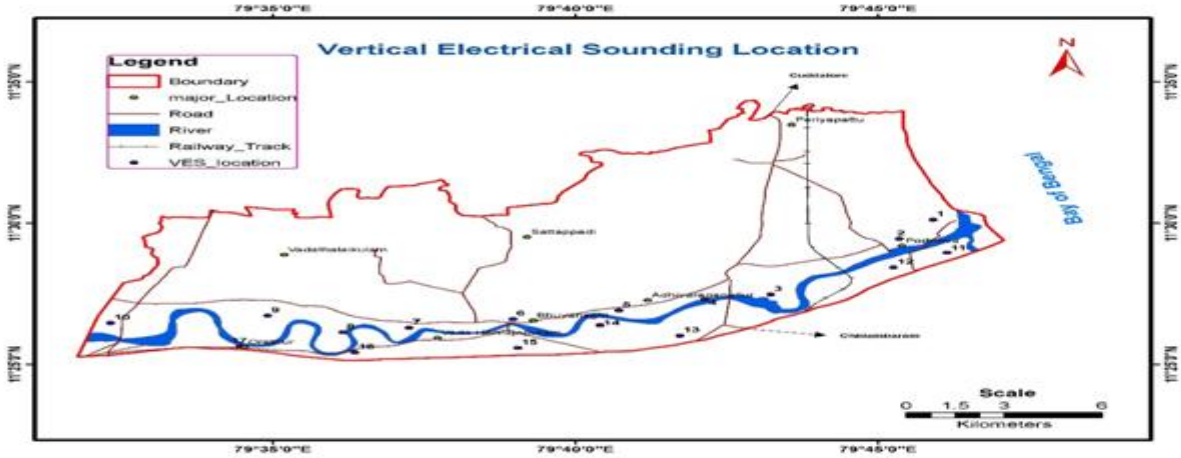


Figure 2 VES Location Map

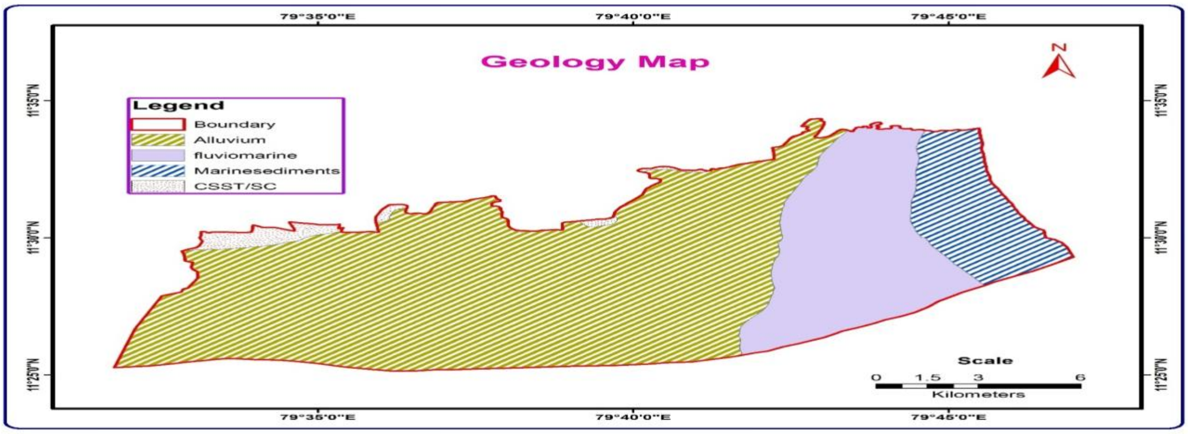
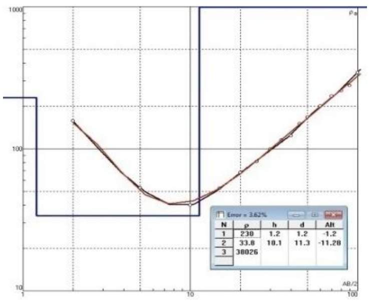
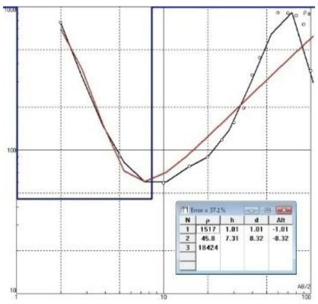


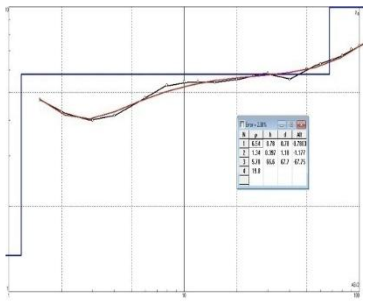
Figure 3 Geology Map of the Lower Vellar bank



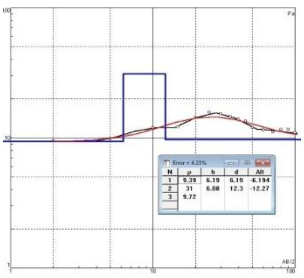
VES 1 - Light House



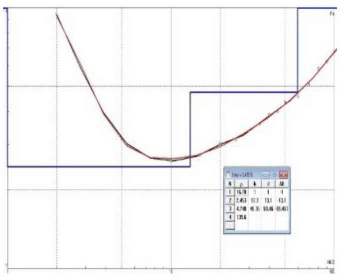
VES 2 - Pudhukuppam



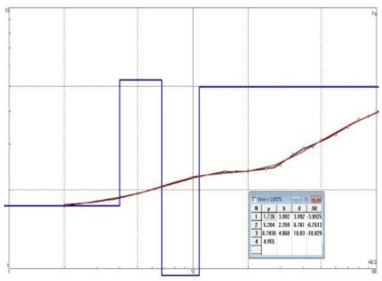
VES 3 - Thithampalayam



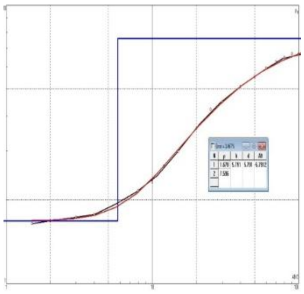
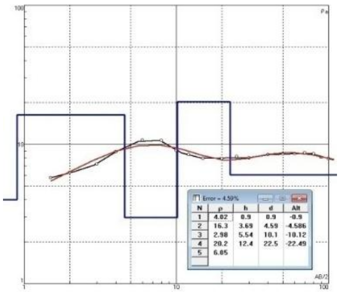
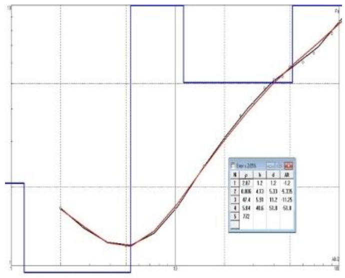
VES 4 - B.Mutlur



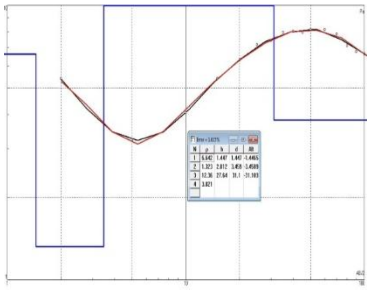
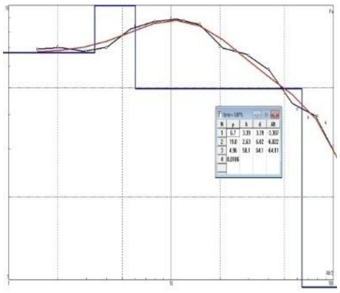
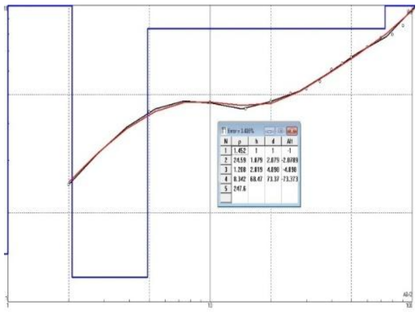
VES 5 - TN Pattinam



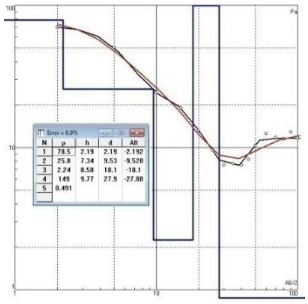
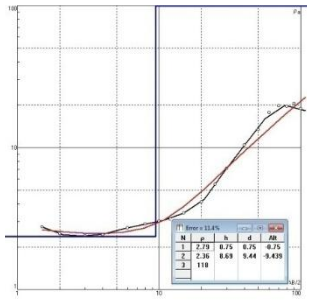
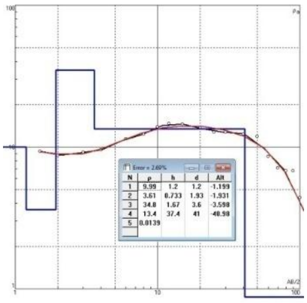
VES 6 - Bhuvanagiri

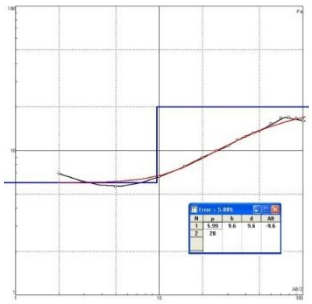
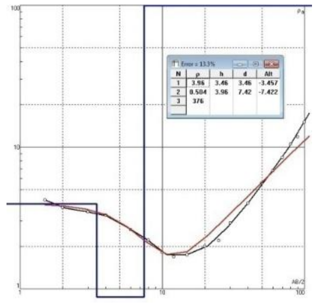
VES 7 - Adhivaraganatham **VES 8 - Nallathattu** **VES 9 - Siyappadi**

VES 10 - Anaivari **VES 11 - Ponanthittu** **VES 12 - Manambadi**

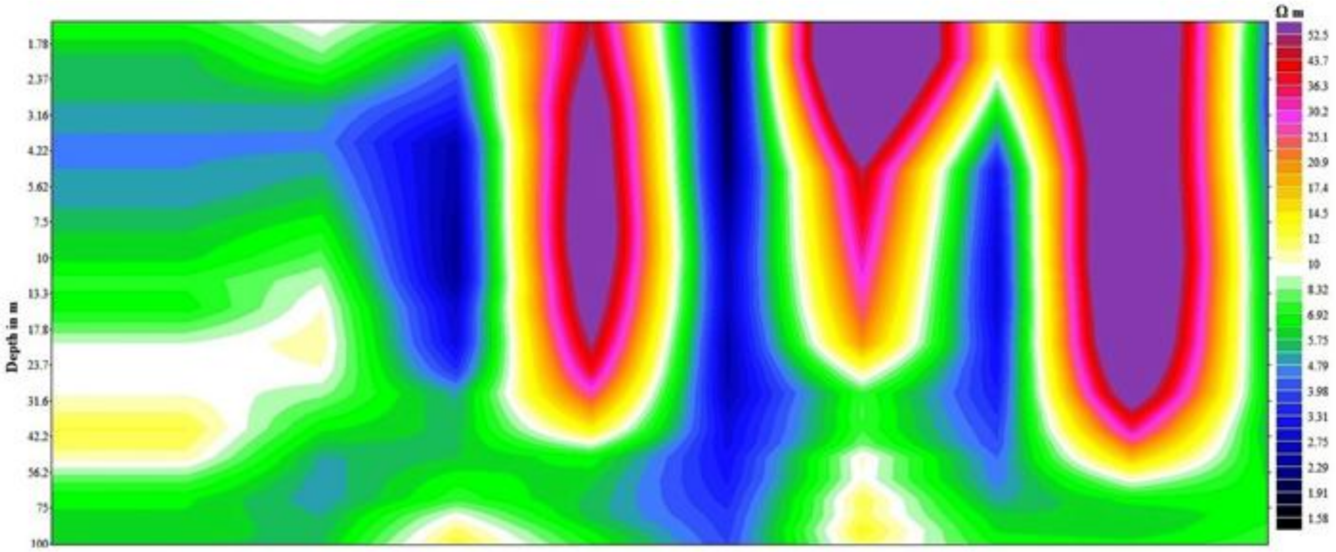




VES 13 - Kizhamungiladi **VES 14 - Melmungilladi** **VES 15 - Keerapalayam**

VES 16 - Ayipettai **VES 17 - Orathur**

Figure 4 Interpreted resistivity curve of the Lower Vellar bank



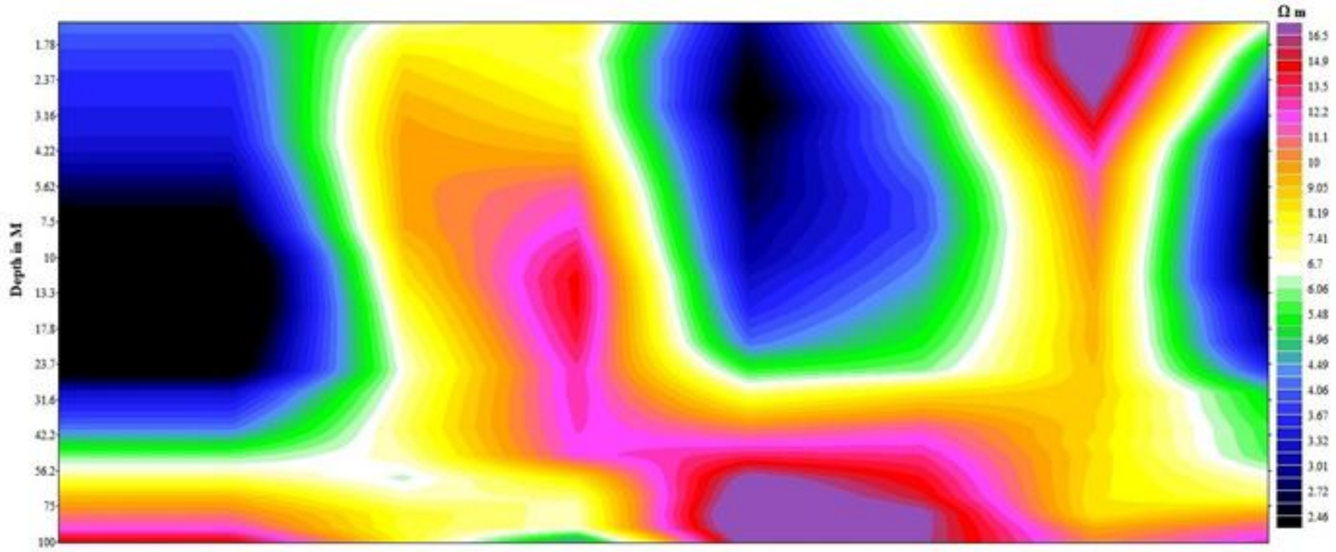


Figure 5 - Pseudo Section of Electrical Resistivity

Table 1 Interpreted resistivity data of the Lower Vellar bank.

S.no	Location	R1	R2	R3	R4	H1	H2	H3	Curve Type
1.	Light House	230.00	33.80	3806.00	-	1.20	10.10	-	H
2.	Pudhukuppam	1517.00	45.80	18424.00	-	1.01	7.31	-	H
3.	Thithampalayam	6.54	1.34	5.78	19.80	0.78	0.40	66.60	HA
4.	B.Mutlur	9.39	31.00	9.72	-	6.19	6.08	-	K
5.	Tn Pattinam	16.78	2.45	4.74	139.60	1.00	12.10	46.36	HA
6.	Melbhuvanagiri	1.74	5.28	0.74	4.96	3.99	2.70	4.60	KH
7.	Adhivaraganatham	1.69	7.59	0.00	-	5.70	-	-	A
8.	Nallathattu	4.02	16.30	2.98	20.20	0.90	3.69	5.54	KH
9.	Siyappadi	2.07	0.81	47.40	5.04	1.20	4.13	5.91	HK
10.	Anaivari	6.64	1.32	12.36	3.82	1.44	2.01	27.64	HK
11.	Ponanthittu	6.70	19.80	4.96	0.02	3.39	2.63	58.10	KQ

12.	Manambadi	1.45	24.59	1.21	8.34	1.00	1.08	2.82	KH
13.	Kizhamungiladi	78.50	25.80	2.24	149.00	2.19	7.34	8.58	QH
14.	Melmungilladi	2.79	2.36	118.00	-	0.75	8.69	-	H
15.	Keerapalayam	9.99	3.61	34.80	13.40	1.20	0.73	1.67	HK
16.	Ayipettai	5.99	20.00	-	-	9.60	-	-	A
17.	Orathur	3.96	0.50	376.00	-	3.46	3.96	-	H

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AUTHORS PROFILE

K. Karthikeyan did his under graduate in Civil Engineering in 1997 and P.G in Water Resources Engineering and Management, 2005 and also PhD in Civil Engineering at Annamalai University, India, 2013. He is currently working as Associate Professor in Civil Engineering, Faculty of Engineering and Technology, Annamalai University, India. His present research interests include groundwater development and management, water resources management and building construction in Civil Engineering. He has published 21 papers related to water resources engineering in seminars and journals.

S. Sivaprakasam received his Post Graduate Degree from Annamalai University, India in 2005. His field of Specialization is Water Resources Engineering and Management, and got his doctoral programme in Civil Engineering in 2014 and also working as Associate Professor in Civil Engineering, Faculty of Engineering and Technology, Annamalai University, India. . His broad area of research is Climate Change with emphasis on long-term variability in hydro-meteorological parameters, likely influence/impact on aspects of irrigation on a regional basin in the Indian context. He has published 20 research articles in International/National peer-reviewed Journals and 8 research articles in International/National Conferences. He is a life Member in Indian Association of Hydrologists (IAH), Indian Water Resources Society (IWRS) and Institution of Engineers (India).

N. Nagarajan completed his ME (Water Resources Engineering and Management) in 2005 and PhD in Civil Engineering in Annamalai University, India awarded 2013. He is currently working as Associate Professor in Civil Engineering, Faculty of Engineering and Technology, Annamalai University, India. His research interests include surface and groundwater resources and management, watershed management, Remote Sensing and GIS. He has published 24 papers related to Water Resources Engineering in National and International seminars and journals.