Numerical Modelling Techniques To Optimize Ground Water Withdrawals And Minimize Stream Flow Depletion In Salem District Using MODFLOW 2000

T.Subramani[1], A.Anbuchezian[2]

[1]Professor & Dean, Department of Civil Engineering, VMKV Engineering College, Vinayaka Missions University, Salem, India

[2] Professor & Head, Department of Civil Engineering, Annapoorana Engineering College, Salem, India.

ABSTRACT

Groundwater stores can be an important asset in easing rising water requests around the world. The groundwater is by and large pumped out of surficial aquifers utilizing withdrawal wells. In any case, unregulated groundwater withdrawals can affect the stream in close-by streams contrarily, bringing about stream consumptions. This can upset the natural adjust of streams and imperil the amphibian life text style is that call such streams home. In this manner, groundwater withdrawals must be completed utilizing an all around oversaw withdrawal methodology. Salem has a developing yearly water request that has been anticipated to surpass ebb and flow supply in parts of the state by 2020. Subsequently, a few new withdrawals have been proposed to be inherent the Big River territory. Notwithstanding, an advanced well withdrawal system should be created with an eye towards limiting any potential stream exhaustion that such exercises may bring about. Ground-Water Management (GWM), a groundwater streamlining process for the three-dimensional groundwater displaying programming MODFLOW 2000, is an instrument that can help in growing such systems. An arranging skyline of three year or more was fundamental for the withdrawals from the wells inside the model area to achieve a condition of element harmony and along these lines bode well as far as long haul supportability. Our project focusing Salem district as one to modelling the groundwater enrichment from stream flow from Sarabanga river water shed.

Keywords: Numerical modelling Techniques, Optimize, Ground Water, Salem District

1..INTRODUCTION

Groundwater is a vital wellspring of water for some human needs, including open supply, horticulture, and industry. With the improvement of any common asset, however, adverse consequences may be associated with its use. One of the essential concerns identified with the advancement of groundwater assets is the impact of groundwater pumping on stream. Groundwater and surface-water frameworks are associated, and groundwater release is regularly a considerable part of the aggregate stream of a stream.

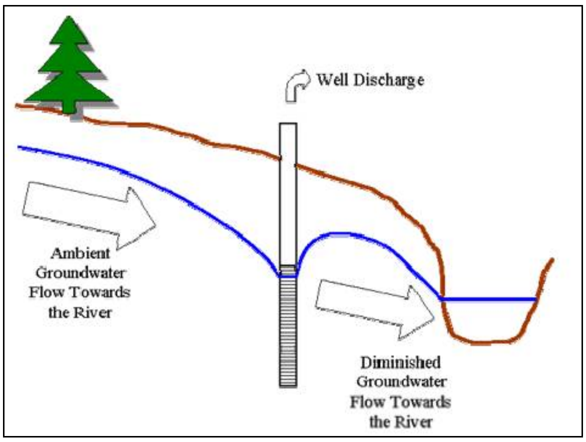

Figure. 1 Pumping well in the groundwater flow field of a gaining stream

Groundwater pumping decreases the measure of groundwater that streams to streams and, now and again, can draw stream into the fundamental groundwater framework. Stream diminishments (or consumptions) brought about by pumping have turned into an essential water-asset administration issue due to the negative effects that decreased streams can have on amphibian biological systems, the accessibility of surface water, and the quality and stylish estimation of streams and waterways. Logical research in the course of recent decades has made vital commitments to the essential comprehension of the procedures and elements that influence stream consumption by wells.

2.MATERIALS AND METHODS

2.1 About Salem District

Salem District is one among 32 Districts of Tamil Nadu State,India. Salem District Administrative head quarter is Salem. It is is Located 321 KM East towards State capital Chennai. Salem District population is 3480008. It is 5th Largest District in the State by population. (Figure.2)

2.2 Geography And Climate Salem District

It is Located at Latitude-11.6, Longitude-78.1. Salem District is sharing border with Dharmapuri District to the North, Erode District to the west, Namakkal District to the South , Villupuram District to the East . Salem District occupies an area of approximately 5220 square kilometres. . Its in the 432 meters to 169 meters elevation range. This District belongs to Southern India.

2.3 Climate Of Salem District

It is Hot in summer. Salem District summer highest day temperature is in between 31 ° C to 41° C. Average temperatures of January is 23 ° C , February is 24 ° C , March is 28 ° C , April is 31 ° C , May is 32 ° C .

2.4 Demographics Of Salem District

Tamil is the Local Language here. Salem District is divided into 20 Taluks, Panchayats, 3188 Villages.

2.5 Census 2011 Of Salem District

Salem district Total population is 3480008 according to census 2011.Males are 1780966 and Females are 1699042 .Literate people are 2302373 among total.Its total area is 5220 km². It is the 5 th largest district in the state by Population . But 7 th Largest District in the state By Area. 89 th Largest District in the Country By Population. 27 th highest District in the State By literacy rate. 312 nd highest District in the Country By literacy rate.its literacy Rate is 73.23

2.6 Salem District Tourism

Yercaud , Big Lake , Killiyur Falls , Anna Park , Grange , Silk Farm , Shevaroy Temple , Pagoda Point , are the Tourist destinations to Visit.

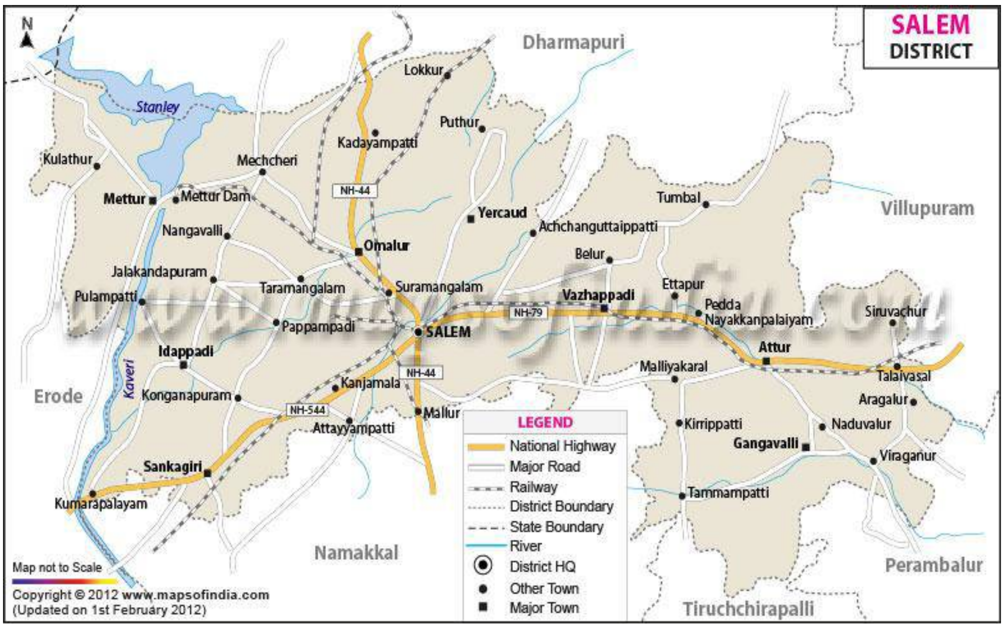

Figure 2 Study area

3.MIGRATION PATTERN

3.1 Migration Pattern

Migration is a common phenomena in the Salem District. Migration that occurs among the public is classified as follows. Migration from the rural areas to a nearby Industrial Town or City seeking employment opportunities. 2. Migration from the villages to the nearby towns seeking education facilities to the children and in search of basic amenities. Among these two categories, migration seeking employment opportunities stands first.

3.2 Seasons Of Migration

Thousands of people, predominantly comprising agricultural labourers migrate to neighbouring districts and State during the agricultural lean season from the month of March Many villagers move especially to Thirupur, Coimbatore, Chennai and Bangalore, the metropolitan city in search of livelihood.

3.3 Rural To Urban Migration

This type of migration occurs in search of Medical, Educational and Job opportunities. Since the rate of migrations varies from time to time, rate of migration cannot be accurately estimated. Urban to Rural Areas Migration:- The rate of Migration from urban to rural areas is very low in Salem District. Migration within District:- This type of migration is felt among the people in Government Services and the small-scale businessmen. The rate is very low. Migration from outside the District:- Migration from outside the Salem district occurs only in the student community. So rating in this category is also very low. 126 Demographic features Population The total population as per 1991 census is 2547367. The proportion of male and female in the total population works out at 52.44%, and 47.56% respectively. Out of total population nearly 68% live in rural areas and 32% live in urban areas. Literacy Level Literacy level has increased considerably from 38.69% in 1981 to 65.78% in 1991.

4.DATA NEEDS

Keeping in mind the end goal to decide and measure the way of groundwater withdrawals on the ethods Considered to Assess Groundwater Withdrawal Impacts on Surface Water Flow The classes of strategies to evaluate the measure of surface water entering groundwater wells are separated into the accompanying four classifications: physical obstruction, scientific model, Souhegan River, most importantly dependable information should be secured. Information needs classes include: the well, the development, and the client. Despite the fact that not all information is accessible at each well, an almost thorough rundown of attractive information takes after. Data needs concerning the well include: a well finish report/plan, well profundity, well measurement, screen/open interim area, packaging profundity, static water level, dynamic water level, pump area, sort of pump and engine, separation to surface water, wellhead height, ground rise, and even arranges. Development information needs include: lithology, stratigraphy, material grouping, grain estimate dissemination, pressure driven conductivity, immersed thickness, transmissivity, particular yield, stockpiling coefficient, pumping test drawdown information, checking admirably organize, water level data (time histories), piezometric delineate, head security contemplate, aquifer energize think about, groundwater temperature, and ground water science. At long last, information needs about the client include: pumping plan, pumping rates, return streams (septic frameworks, invasion bowls, and so on.), and wasteful utilize.

4.1 Numerical Model

At this writing there are a substantial number of numerical groundwater codes that can be employed to quantify induced recharge. Popular models include: MODFLOW, FLOWPATH, WHPA, WhAEM, and GMS. Some of these models are public domain and others must be purchased through vendors. The advantage of the numerical models to more accurately determine the induced flow is lost by the significant degree of model input requirements as well as for trained personnel to calibrate, validate, verify, and use the model. The data requirements for numerical models are non-trivial: not only are aquifer geometries and hydraulic characteristics needed, but also boundary conditions, initial conditions, and calibration data. Not uncommonly, induced recharge is a calibration parameter for numerical models rather than the variable computed by the models. Numerical groundwater modeling can also be coded into spreadsheet software. However these user developed codes have no less input and user requirements than the more widely-available models.

4.2 Field Measurements

To quantify prompted energize with field perceptions, regularly the initiated stream itself is not measured, but rather derived or processed from other perception factors. The two most generally measured factors for evaluating initiated energize are groundwater levels and disintegrated compound species. On account of groundwater levels., monitoring wells or piezometers between the stream and the pumping well can delineate the groundwater table.

5.GROUNDWATER SYSTEMS

5.1 Characteristics Of Groundwater Systems And Groundwater Interactions With Streamflow

This section provides brief descriptions of several terms and concepts that contribute to an understanding of streamflow depletion by wells. For a more broad dialog of these ideas, the peruser is alluded to writings on groundwater, hydrogeology, and hydrology by Freeze and Cherry (1979), Linsley and others (1982), Heath (1983), Domenico and Schwartz (1990), and Fetter (2001). Aquifers and Groundwater Flow

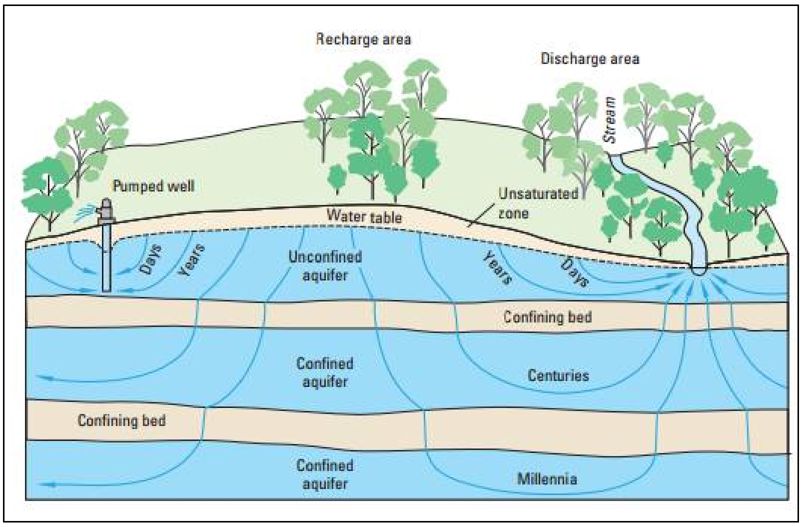

Figure. 3 Groundwater flow paths in a multi-aquifer groundwater system

The pores, breaks, and different voids that are available in the silt and shakes that lie near the Earth's surface are mostly to totally loaded with water. In most locations, an unsaturated zone in which both water and air fill the voids exists immediately beneath the land surface (Figure.3). In numerous ranges of the india, groundwater frameworks are made out of a vertical grouping of aquifers in which an upper, unconfined aquifer is underlain by a progression of at least one limiting quaint little inns aquifers, such as is illustrated. In many other areas, however, the groundwater system consists of a single, often unconfined, aquifer underlain by geologic formations, such as crystalline rock, whose permeabilities are so low that the formation can be assumed to be impermeable to groundwater flow. Aquifers of this type are used throughout the report to illustrate many of the factors that affect stream flow depletion by wells. A steady-state system is one in which groundwater levels and flow rates within and along the boundaries of the system are constant with time, and the rate of storage change within the flow system is zero. A transient system is one in which groundwater levels and flow rates change with time and are accompanied by changes in groundwater storage. Transient conditions occur in response to changes in flow rates along the boundaries of a groundwater system, such as short-term and long-term fluctuations in recharge rates, or changes in flow rates at points within a groundwater system, such as fluctuations in pumping rates. Although steady-state flow conditions, such as illustrated in figure 3A, rarely occur for real-world hydrologic conditions, it is often acceptable to assume that steady-state conditions exist if the fluctuations in water levels and storage changes are relatively small or if there is an interest in an evaluation of the long-term average condition of the flow system.

6.ABOUT THE SOFTWARE

6.1 MODFLOW

MODFLOW is the U.S. Topographical Survey measured limited contrast stream display, which is a PC code that settles the groundwater stream condition. The program is utilized by hydrogeologists to reenact the stream of groundwater through aquifers. The source code is free open area software,[1] composed principally in Fortran, and can assemble and keep running on Microsoft Windows or Unix-like working frameworks.Since its original development in the early 1980s, the USGS have released four major releases, and is now considered to be the de factostandard code for aquifer simulation. There are several actively developed commercial and non-commercial graphical user interfaces for MODFLOW. Utilizing numerical models has begun since 1800 A.D. In result of creating propelled PCs in the 1960s, utilizing scientific models with numerical arrangement has turned into a proper approach in the investigation of groundwater. Numerical solution of fluids flow problems in porous media was used in oil industry for the first time, before 1950 (Stalk, 1959; Mazrooei, 2003). Cross breed models were created after 1972, and these models reproduced immersed and non-soaked situations all the while. Among the individuals who have grown such models Vaklyn, Khanji and Vakad can be specified. Since these models are muddled and additionally settling conditions are tedious, the models were usable for little ranges (Safari Moghadam & Mazrooei, 2003).Then with regard to hydraulic information of the springs and wells, it was attempted for hydraulic simulation of the aquifer using PMWIN software, and in the following, the aquifer parameters such as hydraulic conductivity coefficient (K) and aquifer specific yield coefficient (Sy). The outcomes demonstrated a high consistency amongst computed and watched water powered heads and additionally positive yearly groundwater adjust in the plain, accordingly it can be expressed that, the plain has a potential for more groundwater extraction in the long haul.In the second part of this study, information about contaminant sources and groundwater quality in terms of physical, chemical and biological was briefly studied in Yasouj plain. Distribution and transport of contamination in Yasouj plain was simulated using PMWIN software.

7.STREAM FLOW DEPLETION

7.1 General Procedures For Evaluating Streamflow Depletion

Below is a general outline of the methodology. It allows for progressively more data-intensive analyses if such data is available or a more refined estimate of stream flow depletion is necessary. Note that for wells in bedrock that produce more than 35 gpm, the porous media assumptions inherent in the following methodologies may be appropriate, and these methods may provide reasonable estimates of stream flow depletion. However, if hydrogeologic data are available that would improve such estimates, an alternative approach can be taken under s 4 or 5. More detailed discussion of each follows in subsequent sections of this guidance.

- The simplest assumption is that groundwater is withdrawn at the maximum allowable rate all the time and that one hundred percent of the water is coming directly from the stream, at the closest point on the stream. This method may be appropriate if the withdrawal is very small compared to streamflow or the targeted standard, or if additional data on the groundwater withdrawal or the aquifer system are not available.
- If actual-use data on the daily pumping rate is available, along with some basic data on aquifer properties and distance of the well from the stream, 2 methods can be applied to improve the stream flow depletion estimate. A point of assessment (POA) for stream flow calculations (which is not necessarily the closest point on the stream) can be determined in this and the maximum-month, average-day withdrawal can be used instead of the maximum withdrawal rate.

8.CONCLUSION

Simulator model of groundwater flow in the free aquifer of Sarabanga nadhi watershed was produced using Visual Modflow. The created model simulates the free aquifer behaviour properly. During the periods of the model performance, calculated water table values by the model where the piezometers are placed, are in accordance with observed groundwater level in the piezometers. Using the suggested model it is possible to forecast the aquifer status if the values of aquifer discharge and recharge are specified. Calculated balance by the model explains suitable situation of Sarabanga aquifer to access groundwater. Considering the results as well as high ability to extract water from the aquifer it is suggested that, water requirement of the region can be covered by groundwater. Available surface water also can be transported to downstream using water transport networks.

References

[1] 1.Blandford, T. N. and P. S. Huyakorn, 1990, WHPA: A Modular Semi-Analytical Model for the Delineation of Wellhead Protection Areas, USEPA, OGWP, Washington, DC.

[2] 2.Glover, R. E., 1971, Transient Ground-Water Hydraulics, Water Resources publications, Fort Collins, CO.

[3] 3.Hantush, M. S., 1965, Wells Near streams with Semi-pervious Beds, Journal of Geophysical Research, vol. 70, no. 12, pp. 2829-2838.

[4] 4.Jenkins, C. T. 1968, Computation of Rate and Volume of Stream Depletion by Wells, TWRI Chapter D1 Book 4, USGS, Washington, DC.

[5] 5.McWhorter, D. B. and D. K. Sunada, 1977, Ground-Water Hydrology and Hydraulics, Water resources Publications, Fort Collins, CO.

[6] 6.Theis, C. V., 1941, The Effect of a Well on the Flow of a Nearby Stream, American Geophysical Union Transactions, Vol. 22, part 3, pp 734-738. 7.Abrishami, J., Alavi Moghaddam, M.., Jovain Bahrami, R.. 2001. Water quality model of underground West Desert Tabas, Iran's third hydraulic Conference.

[7] Ahmadi, or. 2001. stream-like building in plain aquifer Izeh with Atfadh Numerical finite difference mathematical model (computer code Modflow V. 2.6 (Visual order to optimize management practices, end the letter undergraduate senior, martyr ChamranUniversity, Ahvaz.

[8] ChitSazan, M., SaatSaz, M.. 1384. Modflow mathematical model used in the various review options Ramhormoz plain water resource management, Journal martyr ChamranUniversity, No. 14, Part B.

[9] T.Subramani, S.Krishnan.S. and Kumaresan.P.K., "Study of Ground Water Quality with GIS Application for Coonur Taluk In Nilgiri District.", International Journal of Modern Engineering Research,Vol.2, No.3, pp 586-592, 2012.
[10] T.Subramani, P.Krishnamurthi, "Geostatical Modelling For Ground Water Pollution in Salem by Using GIS", International Journal of Engineering Research and Applications ,Vol. 4, Issue 6(Version 2), pp.165-172, 2014.
[11] T.Subramani,, K.Prasath, Velmurugan.P, Baskaran.V, "Impacts of Irrigation and Drought on Salem Ground Water", International Journal of Engineering Research and Applications, Vol. 4, Issue 6(Version 3), pp.117-122, 2014.
[12] T.Subramani, T.Manikandan, "Analysis Of Urban Growth And Its Impact On Groundwater Tanneries By Using Gis", International Journal of Engineering Research and Applications, Vol. 4, Issue 6(Version 2), pp.274-282, 2014.
[13] T.Subramani ,M. Chandrasekaran, "Saline Ground Water and Irrigation Water on Root Zone Salinity", International Journal of Engineering Research and Applications,Vol. 4, Issue 6(Version 2), pp.173-179, 2014.
[14] T.Subramani , P.Someswari, "Identification And Analysis Of Pollution In Thirumani Muthar River Using Remote Sensing", International Journal of Engineering Research and Applications, Vol. 4, Issue 6(Version 2), pp.198-207, 2014.
[15] T.Subramani, D.Kavitha, R.Tiyagu, "Treatment Of Municipal Waste Water In Salem City", International Journal of Engineering Research and Applications, Vol. 4, Issue 6(Version 2), pp.259-263, June 2014.
[16] T.Subramani, Badrinarayanan.S, K.Prasath, S.Sridhar, "Performanance Evaluation of the Cauvery Irrigation System, India Using Remote Sensing and Gis Technology", International Journal of Engineering Research and Applications, Vol. 4, Issue 6(Version 2), pp.191-197, 2014.
[17] T.Subramani, C.T.Sivakumar., C.Kathirvel., S.Sekar," Identification Of Ground Water Potential Zones In Tamil Nadu By Remote Sensing And GIS Technique" International Journal of Engineering Research and Applications , Vol. 4 , Issue 12(Version 3), pp.127-138, 2014.
[18] T.Subramani,"Identification Of Ground Water Potential Zone By Using GIS", International Journal of Applied Engineering Research (IJAER), Volume 10, Number 38, Special Issues, pp.28134-28138, 2015
[19] T.Subramani, P.Malathi , " Drainage And Irrigation Management System For Salem Dist Tamilnadu Using GIS" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 199-210 , 2015
[20] T.Subramani, P.Malathi , " Land Slides Hazardous Zones By Using Remote Sensing And GIS" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 211-222 , 2015
[21] T.Subramani, P.Narasimhan, "Waster Water Treatment And Its Return Journey To The Environment", International Journal of Applied Engineering Research (IJAER), Volume 10, Number 38, Special Issues , pp.28223-28261, 2015
[22] T.Subramani, S.K.Somasundaram , " A Case Study Of Occupational Hazards In Silk Industry " , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5 , pp. 223-233 , 2015
[23] T.Subramani, S.Mohamed Ismail , " Develop To Model Assess Of River Basins In Tamilnadu" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 264-273 , 2015
[24] T.Subramani, C.Kathirvel , " Water Shed Management For Erode District Using Gis " , International Journal of Emerging Trends & Technology in Computer Science (IJETTCS) , Volume 5, Issue 3, pp. 093-103 , 2016.
[25] T.Subramani, R.Kumar , " Irrigation Schedule Models For The Management Of Surface And Groundwater Resources In Erode District Tamilnadu" , International Journal of Emerging Trends & Technology in Computer Science (IJETTCS) , Volume 5, Issue 3, pp. 104-113 , 2016.
[26] T.Subramani, G.Kaliappan , " Water Table Contour For Salem District Tamilnadu using GIS" , International Journal of Emerging Trends & Technology in Computer Science (IJETTCS) , Volume 5, Issue 3, pp. 147-158 , 2016.
[27] T.Subramani, C.M.Deepa , " Study And Analysis Of Water Level Fluctuation By Using GIS In Tiruppur District" , International Journal of Emerging Trends & Technology in Computer Science (IJETTCS) , Volume 5, Issue 3, pp. 159-170 , 2016
[28] T.Subramani, K.Kalpana , " Ground Water Augmentation Of Kannankuruchi Lake, Salem, TamilNadu Using GIS – A Case Study " , International Journal of Emerging Trends & Technology in Computer Science (IJETTCS) , Volume 5, Issue 3, pp. 210-221 , 2016.

AUTHOR

Prof. Dr.T.Subramani Working as a Professor and Dean of Civil Engineering in VMKV Engineering College, Vinayaka Missions University, Salem, TamilNadu, India. Having more than 27 years of Teaching experience in Various Engineering Colleges. He is a Chartered Civil Engineer and Approved Valuer for many banks. Chairman and Member in Board of Studies of Civil Engineering branch. Question paper setter and Valuer for UG and PG Courses of Civil Engineering in number of Universities. Life Fellow in Institution of Engineers (India) and Institution of Valuers. Life member in number of Technical Societies and Educational bodies. Guided more than 400 students in UG projects and 250 students in PG projects. He is a reviewer for number of International Journals and published 164 International Journal Publications and presented more than 25 papers in International Conferences.

Dr.A.Anbuchezian completed his B.E. Degree in the branch of Civil Engineering in IRTT, Erode, Bharathiyar University and M.E-Structural Engineering, GCE, Periyar University. He also completed his Ph.D. in of Civil Engineering in Vinayaka Missions University. Having more than 20 years of Teaching experience in Various Engineering Colleges. Currently he is working as a Professor and Head of the Department of Civil Engineering in Annapoorana Engineering College, Salem, TamilNadu. He is also holding the additional responsibility of Dean – Academic (Non Circuit branches) in Annapoorana Engineering College, Salem, TamilNadu. He published 14 International Journal Publications and presented more than 5 papers in International Conferences