iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** I **Month of publication:** January 2018

DOI: http://doi.org/10.22214/ijraset.2018.1061

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor :6.887
Volume 6 Issue I, January 2018- Available at www.ijraset.com

Assessment of Groundwater Quality Using ArcGIS for Mangadu

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Abstract*: Water plays a vital role in the development of activities in an area. Due to over exploitation, the water table falls too below the ground surface leading the people to go for confined aquifer. But groundwater resources also get contaminated due to discharge of sewage and solid wastes. Keeping this in view, the present study has been attempted to delineate contaminated groundwater zones in the Mangadu area. Open well water samples have been collected. Chemical analysis was carried out and the concentration levels of various chemical parameters were determined. The values of different physicochemical parameters for the entire study area were obtained by using Inverse Distance Weighted (IDW) interpolation technique through ArcGIS 10.1 software. The temporal variation of various chemical parameters over the study area is plotted. The map shows that water quality index at eastern region is little lowered compared to the western region. This is due to the water stagnation and inhabited area in western low areas by which water been started to contamination. Specifically individual parameter analysis shows that chlorine and hardness is slightly more in the northern region due to the nearest factory. In the central agricultural area due to fertilizers and other mineral implementation potassium and iron is slightly more compared to other areas. Overall the parameters are within limits and can be used for domestic purposes.

Keywords: ArcGIS, Water quality, Mangadu, Water quality index, Groundwater.

I. INTRODUCTION

Water quality checks been carried out at all the stages namely source, treatment level, service reservoir level and at the consumer level during the monsoon, summer and winter seasons. (See data here). Water samples from sources viz. Poondi lake, Cholavaram lake, Chembarambakkam lake, Red Hills lake and Porur lake were monitored once for all water quality parameters. Samples were also collected from service reservoirs and analyzed for residual chlorine and bacteriological contamination. Both the treatment plants were evaluated unit wise on three different dates at various stages of treatment system. The parameters analyzed were Turbidity, Total Coliforms (TC) &Total Faecal Coliforms (TFC). The water quality of Cholavaram, Poondi, Porur and Chembarampakkam lakes are within desirable limits for all parameters except for TC and TFC. Both these are present in large amounts during all the three seasons. The water from the service reservoir is distributed to the consumer end through pipelines. 59% of places are receiving contaminated water in summer and monsoon while only 54% of places are affected in winter. Thus in all the seasons more than half of the city is receiving contaminated water. Apart from the bacterial contamination, the quality of drinking water is within permissible limits of BIS drinking water standard IS 10500 *(NEERI Report 2002)*. Due to human and industrial activities the ground water is contaminated. This is the serious problem now a day. Thus analysis of the water quality is very important to preserve and prefect the natural eco system. The assessment of the ground water quality was carried out in the different wards of Indore City. The ground water samples of all the selected stations were collected for a chemical analysis. For calculating present water quality status, water quality index and 27 parameters (pH, colour, total dissolved solids, Electrical conductivity, total alkalinity, total hardness, calcium, chromium, zinc, manganese and nickel) have been considered.. The obtained results are compared with Indian Standard Drinking Water specification IS: 10500-2012. The study of physiochemical and biological characteristics of this ground water sample suggests that the evaluation of water quality parameters as well as water quality management practices should be carried out periodically to protect the water resources (Barber C et al, 1996). There are high possibilities for contamination of leachate at ground water table because of solid waste on dumping ground. Generally in developing countries have no proper segregation system so waste thus it contains both bio and non bio degradable waste generally present among them E wastes more dangerous as because it heavy metal contamination possible in ground water by leachate. Solid waste contains many kinds of toxic substance and these substance get easily mix with water, in our country we have many such cases. This form of contamination is because of unscientifically dumping of solid waste. (*Asadi SS et.al., 2007*). Assessing the ground water quality using Water Quality index (WQI) for Tumkur taluk, for calculating the WQI, the following 12 parameters have been considered. The regression analysis is carried out by taking TDS as dependent variable and Ca, Mg, Cl, SO_4, NO_3, Na and (HCO_3+CO_3) as independent variables. Trend analysis represents the process of using the analyzed data for predictions. This may be

used to predict or forecast values of the dependent variable. The regression models can be used to find out the ionic concentration of the groundwater samples, if the dependent variable TDS is measured for different locations, by inverse calculations. Need for the study is that Mangadu, a suburban of Chennai, In India it is situated in between kumananchavadi to kundrathur at a distance of 3 kilometers. Mangadu forms a part of kanchipuram district. The ground water is prone to pollution by the pollutants from the agricultural field like artificial manure and dumping of municipal solid waste. These pollutants fall heavily on the quality of the drinking water. The impact is felt very much on the drinking water sources, which are available for the people, settled on the dumping of waste. Objective of the study is to assess the quality of ground water in surrounding of Mangadu by water sampling and checking whether various chemical parameters are within the Indian Standard permissible limits (IS 10500 : 2012) Further using GIS software the quality mapping is done with spatial variations and find area of pollution.

II. STUDY AREA

Kozhumanivakkam & Chikkarayapuram, a suburban of Chennai, In India it is situated in between Kumananchavadi to Kundrathur at a distance of 3 kilometres. Mangadu forms a part of Kanchipuram district.. The drinking water for Mangadu comes from various source points. There are many water reservoirs are situated in and out of Mangadu town, in which city depends upon only specific reservoirs mentioned in Fig 1. As of 2011 India census, In Mangadu, Kozhumanivakkam had a population of 38,188. Males constitute 50%of the population and females 50%.In Mangadu, 11% of the population is under 6 years of age. There are hundreds of houses, institutions are situation in Chikkarayapuram, and water is an important need in these areas. On day one we inspected the Chikkarayapuram area and it surroundings, we found in many residential apartments there where using sump water supply system, only in houses open well and ground water are used. We started our project in Kozumanivakkam and Chikkarayapuram, thus in result we found 11 well backside of our college campus in which we specifically selected bore well. From 11 open well now are in usable condition. These eleven open well are situated in different latitude and longitudinal distance as shown in Table 1. Totally eleven samples in an surrounding of Kozhumanivaakam and Chikkarayapuram around are collected, these sample where collected using plastic containers of two liters. These plastic containers will maintain the temperature of the water and it original characteristics. The samples taken backside of the college campus where taken on the same day, and samples from front side the campus where collected on the same day. The well location points are shown in Fig 2.

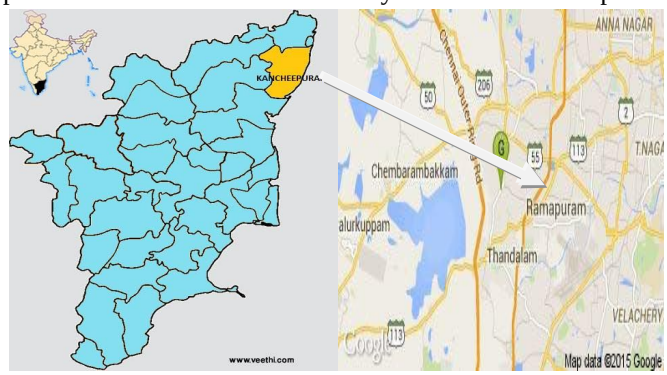


Fig. 1 Index map for Mangadu

Fig. 2 Study area and Well locations

TABLE I
WELL LOCATION

Well Number	Latitude	Longitude
1	13º0´59.95” N	80º6´37.74” E
2	13º0´59.29” N	80º6´36.56” E
3	13º0´59.21” N	80º6´36.99” E
4	13º6´11.81” N	80º6´25.38” E
5	13º1´1.44” N	80º6´17.23” E
6	13º1´10.43” N	80º6´9.93” E
7	13º1´13.83” N	80º5´45.3” E

8	13º1´15.56” N	80º6´13.67” E
9	13º1´19.41” N	80º6´7.7” E
10	13º1´18.09” N	80º6´4.2” E
11	13º1´21.33” N	80º6´12.09” E

III.METHODOLOGY

In general we know the characteristics of groundwater, thus we particularly selected only necessary parameter condition for testing purpose. Usually there is a minimum percentage chances for the presence of BOD (bio-chemical oxygen demand), and COD (chemical oxygen demand), so we neglected these parameter will testing. Thus the selected parameters are Chloride, pH, Turbidity, Calcium, Total Hardness, potassium, sodium, iron and fluoride. Every 10^{th} of January, February and March of 2017 the groundwater levels are measured and samples are collected in 2 litre can which are tightly closed thus volatile materials cannot escape. The can are is choose for sampling as they are capable to maintain the temperature. These samples are immediately taken to laboratory and the tests for all parameters are conducted. The tests are conducted according to corresponding Indian Standard codes in laboratory. The results are then mapped in GIS software to find the spatial water quality index map. Fig 3 shows the flow chart of process. The mapping is done with ArcGIS 10.1 software which is widely used around worldwide. The results of samples are tabulated with latitude and longitude and feed to the software and it is made to draw contour maps of each parameter for month of January, February and March of 2017.

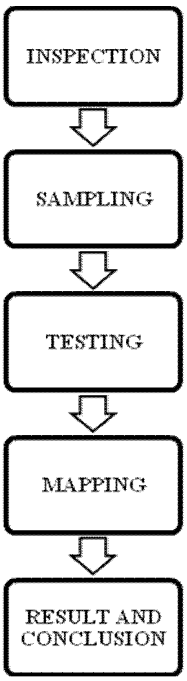
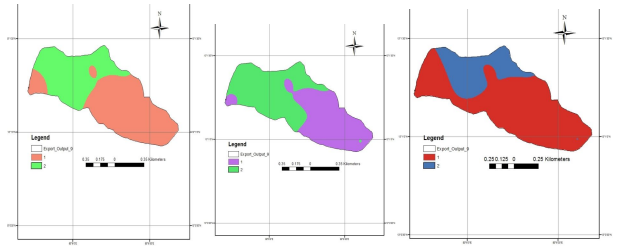


Fig. 3 Methodology flow chart

IV. RESULT AND DISCUSSION

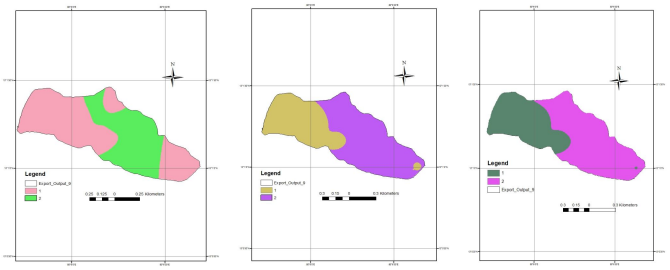
From the testing results of water samples from all 11 wells water quality index is the important parameter. The water quality index is good in entire area, but north western zone have little pollution effect but within the desirable limits. The pH parameter is also in desirable limit with slight basic in nature. Chloride parameter is excellent with below 250 ppm in majority area and is little higher in the northern zone in a minor area. No turbidity in month of January and February, but turbity increased in March due to reduction of water table and frequent pumping. Similar as chlorine calcium and hardness is slightly more in the northern zone compared to other zones. Potassium important mineral in agriculture fertilizer is also in desirable range over most area but slight more in the central area where agriculture is been done. Sodium is of within desirable limits and imparts no pollution. Iron which causes decolouring in white cloths are under desirable limits over all but have a slight higher value in the agricultural area where fertilizers are used. The mapping of each parameter for January, February and March is shown in Fig. 3.

Water quality index



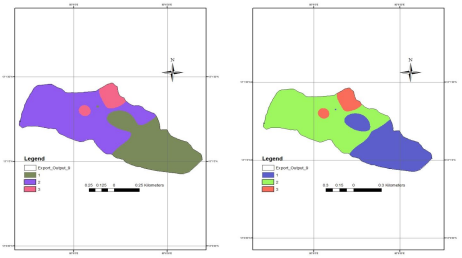
January February March

pH



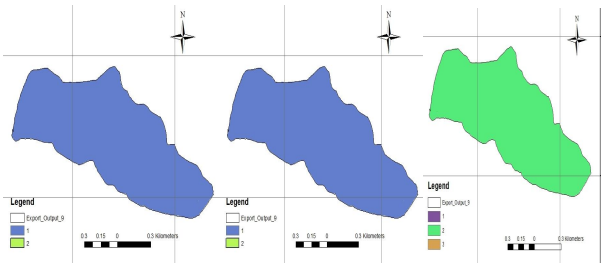
January February March

Chloride



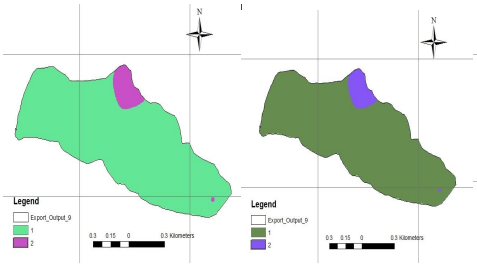
January February March

Turbidity



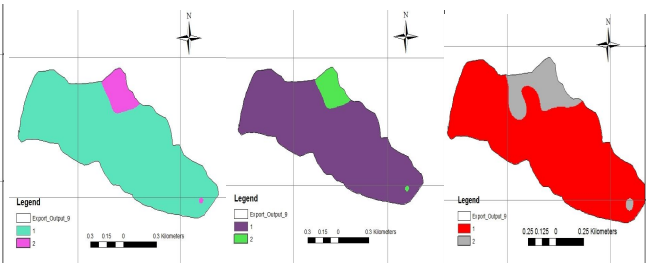
January February March

Calcium



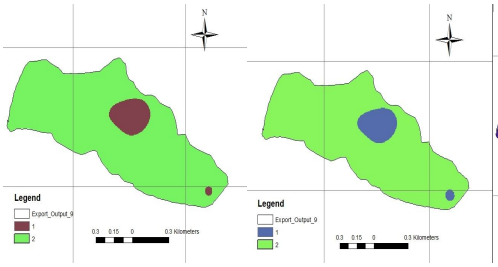
January February March

Total Hardness



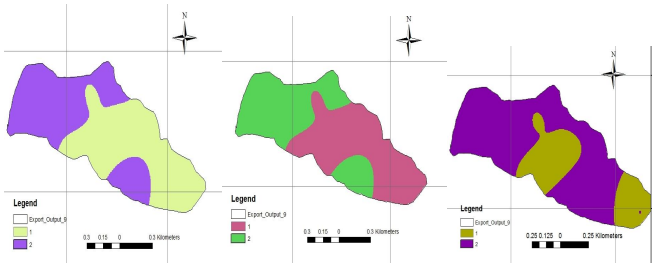
January February March

Pottasium



January February March

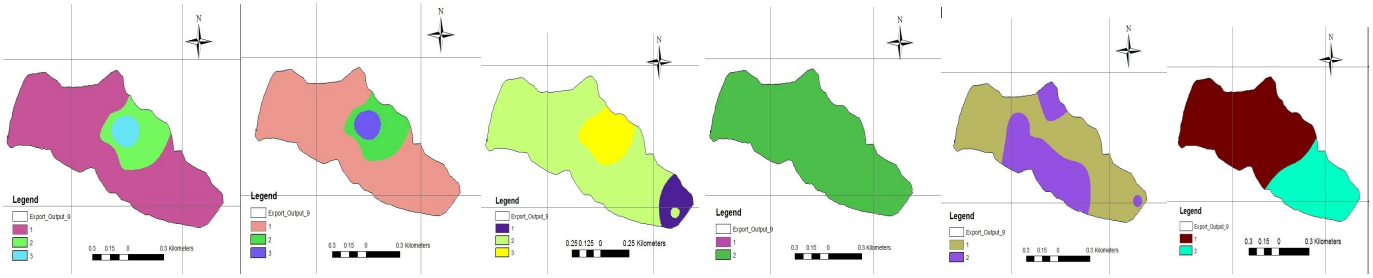
Sodium



January February March

Iron

Fluoride



January February March January February March

Fig.3. Mapping results with all parameters

V. CONCLUSIONS

This study produced a groundwater recharge potential map of the Mangadu in Chennai. The result indicates that the most effective groundwater recharge potential zone is located in downstream. In this region the gravelly stratum and agriculture land have high infiltration ability. Additionally, the concentration of drainage also indicates the ability of stream flow to recharge the groundwater system. The groundwater recharge potential zones are demonstrated using the GIS MAPPING, which can be partially modified to study groundwater recharge potential factors (such as changes in terrain and river courses caused by an changes in land utilization) in a small area in the future. The map shows that water quality index at eastern region is little lowered compared to the western region. This is due to the water stagnation and inhabited area in western low areas by which water been started to contamination. Specifically individual parameter analysis shows that chlorine and hardness is slightly more in the northern region due to the nearest factory. In the central agricultural area due to fertilizers and other mineral implementation potassium and iron is slightly more compared to other area Overall the parameters are within limits and can be used for domestic purposes.

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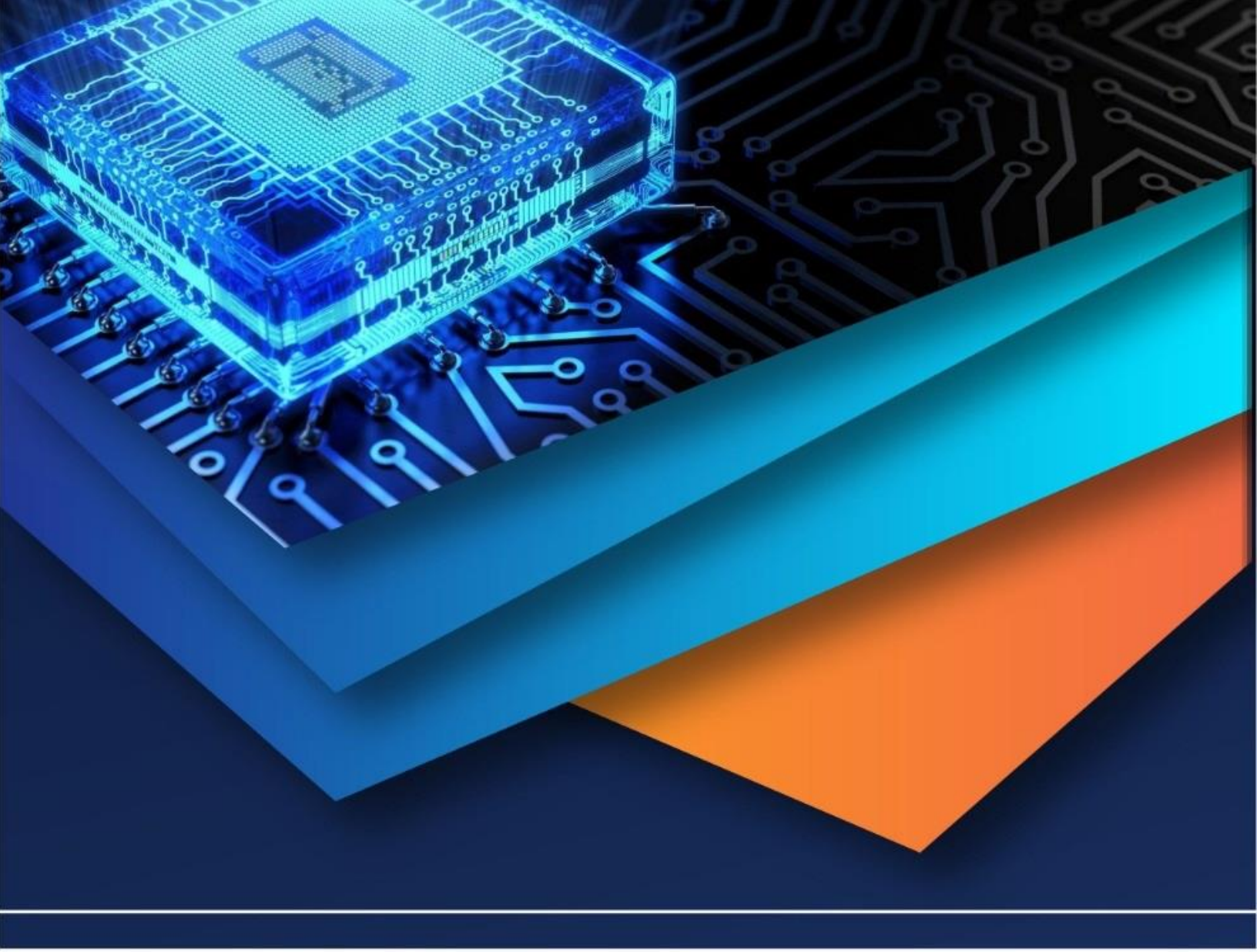

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