THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Assessment of Ground Water Quality and its Spatial Distribution Near Old Landfill Site of Kothrud, Pune

Rajkumari Suryawanshi
Masters in Environment Science
Bharati Vidyapeeth Institute of Environment Education and Research, Katraj, Pune, Maharashtra, India
Dr. I. A. Khan
Associate Professor, Department of Geology Nowrosjee Wadia College, Pune, Maharashtra, India

Abstract:
Water is the basic element of social and economic infrastructure and is essential for a healthy society and sustainable development. Pune is one of the major developing cities in India. Groundwater is being the favorite alternative to water provided through taps, is facing threats due to anthropogenic activities in India, which has led to deterioration of ground water quality. Hence, monitoring of ground water quality has become indispensable. GIS not only facilitates data capture and processing but also serve as powerful computational tools that facilitate multi-map integrations. In this study ground water quality analysis was carried out 'near old landfill site Kothrud' 'Pune'. Water samples were collected in downstream direction of the old Landfill Site and strategically analyzed results are presented in a GIS based water quality mapping

Key words*: Groundwater, Quality, GIS Application, Old Landfill Site Kothrud*

1. Introduction

Groundwater resources are dynamic in nature. These are affected by factors such as, the expansion of irrigation activities, industrialization and urbanization. Hence, monitoring and conserving this important resource is essential. The quality of water is defined in terms of its physical, chemical and biological parameters. Ascertaining the quality of groundwater is crucial before its use. Water may be used for various purposes such as drinking, agricultural, recreational and industrial activities. Groundwater assessment has been based on laboratory investigation, but the advent of Satellite Technology and Geographical Information System (GIS) has made it very easy to integrate various databases.

2. Study Area

For study of ground water quality assessment exists in the vicinity of Old Landfill Site of Kothrud, Pune which has Latitude 18° 30' 34.2" Longitude: 73° 48' 0.72" near Paud Road Pune as shown in fig.1

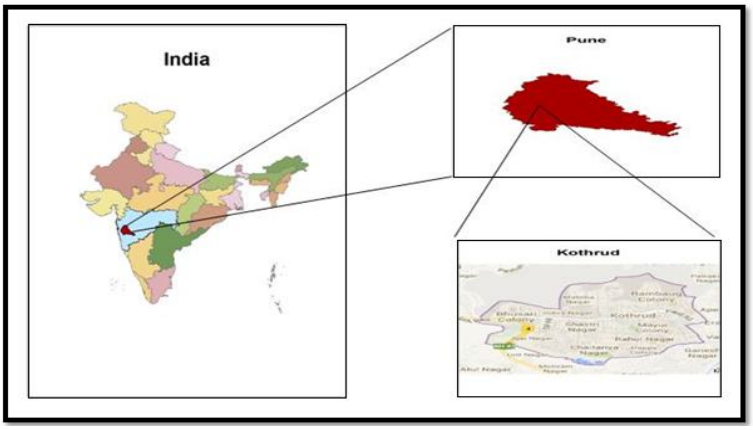

Figure 1

3. Purpose and Scope of Study

Groundwater levels in the city are rising but geologists say a large portion of the groundwater in Pune could have bacterial contamination as it is recharged by water from the city's drainage system, besides rainwater. The main purpose of carrying study in this area is earlier Kothrud had a landfill site which is permanently closed in 1999 because it crossed its saturation limit and People get started to complaining against it. The landfill site was in use about 15 years; hundreds of tons of garbage were deposited daily during this period.

4. Materials and Methods

Ground water samples were collected for monsoon and Post monsoon season, total 16 water sample were collected in downstream direction of landfill site Kothrud in which 15 were from bore well and one from an open well. The samples were analyzed for various physical, Chemical, Biological parameters in laboratory. Physical-chemical analysis was carried out as per the standard procedures prescribed by American Public Health Association (APHA), to determine pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Alkalinity, Total Hardness (TH) , Mg^{2+}, Ca^{2+}, Na^{+}, Cl^{-}, SO_4^{2-}, PO_4^{2-} and NO_3^{-} and for Biological analysis MPN (most probable number) coliform test was carried out. The results were compared with standard values recommended by Indian Standard specification for drinking water: IS: 10500-1992.

GIS technology proved to be very useful for enhancing the accuracy. We obtained the location of the well by using the GPS and Arc GIS software. Software which is used is ARC GIS 10.1.The IDW was applied to find out the spatial distribution of groundwater quality. Steps were followed;

In ARC MAP → Arc Tool box → Spatial Analysis Tools → Interpolation → IDW → input point feature → Z value field → Output raster → OK

On the basis of result significance test was done for whole data for that T-test method was used.

No.	Sample stations	Address	Type of well
1	W1	Harmony Rajpath Society nearby Shikshak Nagar, Kothrud, Pune	Bore well
2	W2	Mragank apartment nearby shikshak nagar, Kothrud Pune	Bore well
3	W3	Shri Gajanan (B) sehkari grehrachna sanstha maryadit, Kothrud Pune	Bore well
4	W4	Satyam Society Indira Nagar, Kothrud Pune	Bore well
5	W5	Attharva construction, near utsav Mangal karyalya,Kothrud Pune	Bore well
6	W6	Shri shiv Shankar, sehkari grehrachna sanstha maryadit paud road, Kothrud Pune	Bore well
7	W7	Swaranjali,Shivtearth Nagar, Lokmanya colony, Kothrud Pune	Bore well
8	W8	Silver Criest,lokmanya colony, Kothrud Pune	Bore well
9	W9	Kanchanvan,lokmanya colony, Kothrud Pune	Bore well
10	W10	Adhirath Alkapuri, paud road, Kothrud Pune	Bore well
11	W11	Shri Suvarn apartment, Lokmanya colony, Kothrud Pune	Bore well
12	W12	Karan Sanskriti society, shastri nagar, Kothrud Pune	Bore well
13	W13	Jeet Construction, Paud road, Kothrud Pune	Bore well
14	W14	Suraj nagar Sehkari greh rachana sanstha maryadit,indira Shankar nagri, Kothrud Pune	Bore well
15	W15	Shrishti Guruganesh nagar Shashtri nagar, Kothrud Pune	Bore well
16	W16	Woodland housing society, Gandhi bhavans chock, Kothrud Pune	Open well

Table 1: Detail of Sample Stations

5. Result and Discussion

Understanding the groundwater quality is important as it is the main factor determining its suitability for drinking use. The groundwater quality maps were prepared for each selected parameter.

5.1. General

In the present study, ground water quality parameters were analyzed and integrated water quality map of study area was prepared considering the ground water quality data using GIS. This integrated ground water quality map helps us to know the existing ground water condition of the study area.

Sample Stations	Locations		Season	PH	Conductivity (mili Simons)	Alkalinity (mg/l)	Chloride (Mg/l)	Hardness (Mg/l)	Calcium (Mg/l)	Magnesium (Mg/l)	Phosphate (µg/l)	Sulphate (Mg/l)	Nitrate (Mg/l)	Sodium (Mg/l)	TDS (Mg/l)	MPN/100 ml
	Latitude	Longitude														
W1	18.50974	73.80459	M	7.8	1.066	440	258.7141	400	120	280	2.8	14	1.05	89.81	1598	11
			PM	7.58	0.991	328	133.72	455	315	140	1.7	8	0.1	73.7	710	4
W2	18.51016	73.80368	M	7	0.36	100	58.138	150	90	60	0.9	2	0.05	17.4	216	300
			PM	7.24	0.249	122	37.79	100	65	35	1.4	3	0.9	13.86	312	220
W3	18.51114	73.80475	M	7.3	0.505	250	58.138	290	165	125	0.9	3	0.09	38.51	406	1600
			PM	7.59	0.687	270	43.6	290	170	120	2	2.8	0.5	29.37	330	1600
W4	18.50892	73.80681	M	7.5	0.144	64	17.4414	65	45	20	1.2	0.2	0.09	6.15	110	2
			PM	7.43	0.15	58	22.768	80	55	25	1.8	1	0.7	4.87	130	6
W5	18.51099	73.8061	M	7.6	0.763	264	58.138	345	200	145	1.8	7	0.16	43.4	554	140
			PM	7.83	0.651	110	37.79	305	125	180	1.4	11	0.13	28.77	400	900
W6	18.51131	73.80856	M	7.1	0.561	224	58.138	285	140	145	0.6	4	0.18	34.9	380	240
			PM	7.26	0.769	312	66.858	425	200	225	1.8	6	0.2	23.76	584	220
W7	18.51309	73.80595	M	7.1	0.92	238	55.2311	425	245	183	1.7	10	0.34	39.39	670	9
			PM	7.33	0.911	292	69.76	390	220	170	2.1	8	0.45	25.14	656	7
W8	18.51547	73.82419	M	7.5	0.656	220	66.8587	335	140	195	2.7	4	0.09	36.42	494	900
			PM	7.46	0.445	152	49.42	220	110	110	3.8	2	2.7	19.01	366	1600
W9	18.51168	73.81696	M	7	0.122	300	72.6725	525	320	205	1.4	16	0.18	41.38	362	1600
			PM	7.23	0.204	288	78.48	315	275	40	1.3	9	0.12	29.38	688	900
W10	18.50695	73.81696	M	7.2	0.881	228	75.5794	425	250	175	2.6	8	0.01	36.77	536	300
			PM	7.3	0.89	207	59.98	375	280	95	2.4	7	0.05	22.79	450	240
W11	18.50391	73.81584	M	8.1	0.656	250	40.6966	185	75	110	1.3	0.28	0.1	38.74	442	21
			PM	7.89	0.64	190	34.76	230	140	90	1.5	0.3	0.7	24.76	320	14
W12	18.50193	73.81696	M	7.4	0.558	206	31.9761	240	75	165	2.4	3	0.32	46.2	2216	170
			PM	7.14	0.586	184	52.324	290	170	120	2.3	2	0.29	28.6	414	220
W13	18.50883	73.82134	M	7.5	0.552	196	46.5104	255	155	100	1.8	4	0.03	25.94	172	500
			PM	7.5	0.581	194	61.044	275	110	165	1.4	6	0.18	14.5	360	300
W14	18.50413	73.79744	M	7.7	0.737	234	72.6712	230	80	150	2.5	6	0.42	22.4	556	4
			PM	7.2	0.678	214	58.132	285	160	125	1.3	12	0.25	22.28	400	11
W15	18.50571	73.79628	M	7.9	0.14	70	26.1621	60	50	10	1.1	2	0.08	5.58	128	<2
			PM	7.8	0.12	63	40.345	90	60	30	2	1.4	0.04	3.36	90	2
W16	18.49886	73.80463	M	7.4	0.713	254	46.5104	210	100	110	2.6	4	0.01	27.22	446	220
			PM	7.38	0.618	236	43.6	365	190	115	2.8	3	0.2	21.79	418	140

Table 2: Ground Water Quality Analysis

5.2. pH

In general, pH is the measure of acidity or alkalinity of water. It is one of the most important operational water quality parameters with the optimum pH required often being in the range of 7.0-8.1. The maximum permissible limit for pH for drinking water as given by the WHO is 9.2. The pH values in the groundwater samples collected varied from 7 to 8.1 which is showing that all the water samples are slightly alkaline in nature. Spatial distributions of pH concentrations are shown in Figure. There is only one figure because there is no so much variation in pH result for both seasons. The values of pH show that all of the samples displayed a pH value within the maximum permissible limit. Special variation map shown in fig. 2.

5.3 Electrical Conductivity

The importance of EC is its measure of salinity; which greatly affects the taste. Thus EC has a significant impact on determining the portability of water. variation in pH is due to some presence of solid as E.C. in ms/cm. the measurement of electrical conductance is directly related to the concentration of ionized substances in water and may also be related to problems of excessive hardness and/or other mineral contamination the conductivity values in the ground water samples for monsoon is vary from 0.14 - 1.066 micro Simons and for post monsoon 0.12 - 0.991 micro Simons in which W1 is showing high conductance (nearest sample station from Old Landfill Site) and W15 is showing lowest conductance for both season. Special variation map shown in fig. 3.

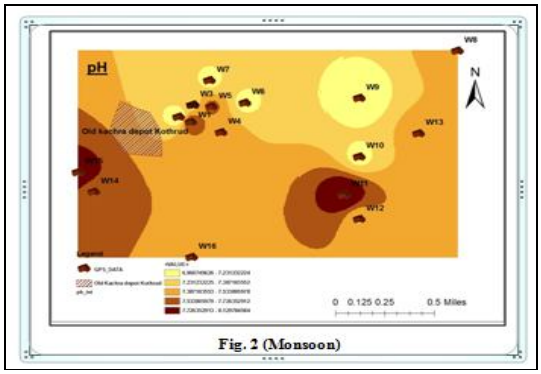

Figure 2

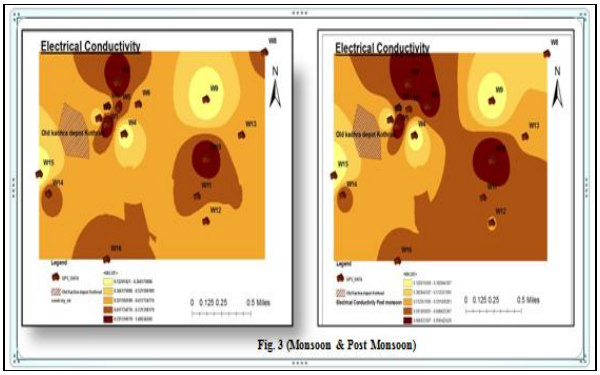

Figure 3

5.4. Total Hardness

The hardness of water is due to presence off certain salts, such as carbonates and bicarbonate, chloride and sulphates of calcium and magnesium dissolve in it. The classification of ground water based on total hardness (TH) shown that a majority of the most permissible limit is 600mg/l as per the Indian standard (IS: 10500-1992). The tested values of TH of the samples range from 60 to 575mg/l for monsoon season and from 80 to 455mg/l for post monsoon season. TDS shows high mineralization in W1 sample. Special variation map for TH shown in figure 4.

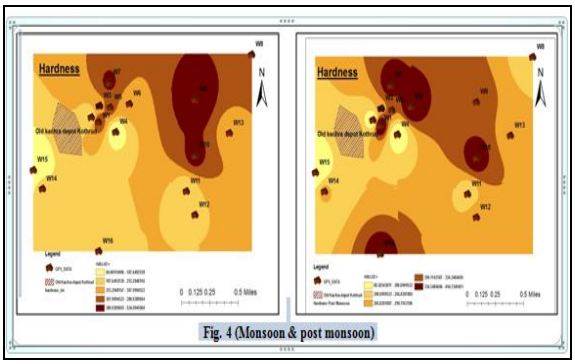

Figure 4

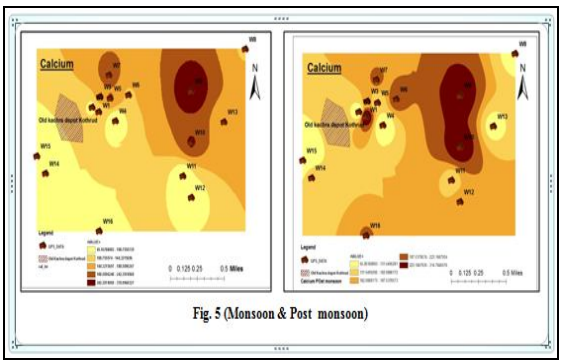

Figure 5

5.5. Calcium

Calcium for analyzed samples various from 45 to 320 mg/l for monsoon season and 55 to 315 mg/l for post monsoon which is illustrated in the spatial variation Map shown in fig. 5

5.6. Magnesium

Calcium for analyzed samples various from 10 to 280 mg/l for monsoon season and 25 to 225 mg/l for post monsoon which is illustrated in the spatial variation Map Shown in fig. 6.

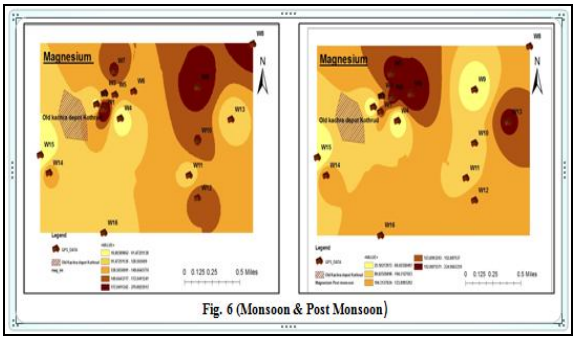

Figure 6

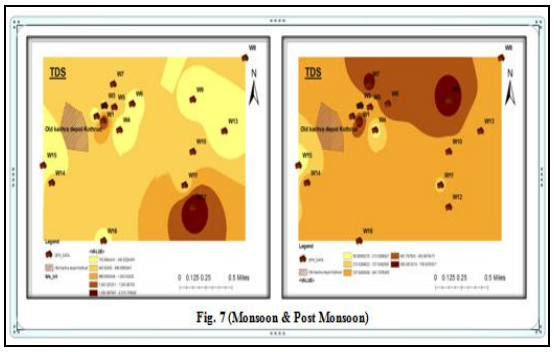

Figure 7

5.7. Tds (Total Dissolved Solid)

To ascertain the suitability of ground water for any purposes, it is essential to classify the ground water depending upon their hydro chemical properties based on their TDS Values. It ranges from110mg/l - 2216 mg/l during monsoon season and for 90 mg/l - 710 mg /l during post monsoon season. TDS result showing high mineralization in W1 and W15 is showing lowest TDS as it is as far from the Old Landfill Site. Special variation map for TDS shown in fig. 7.

5.8. Sulphate

The concentration of sulphate in the study area varies from 0.28 to 16 mg/l during monsoon and 0.3 to 12mg/l during post monsoon season and result shows on both season of the site as well the considerable below the limit and illustrated in the spatial variation map shown in fig. 8.

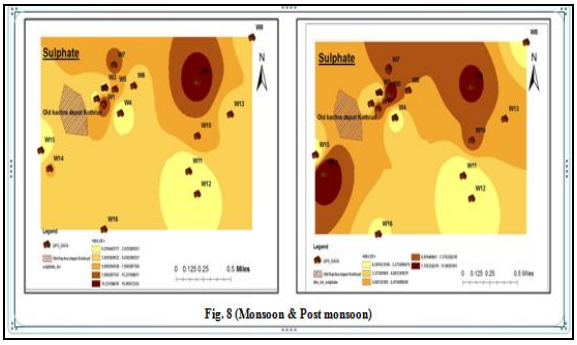

Figure 8

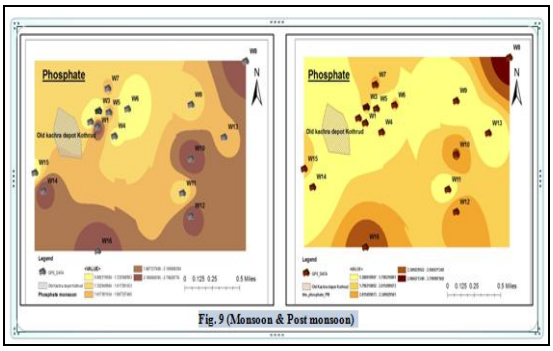

Figure 9

5.9. Phosphate

Phosphorus is an essential plant nutrient and is extensively used as fertilizers. Phosphate get absorbed or fixed as aluminum or iron phosphate in acidic soils or as calcium phosphate in alkaline or neutral soils, as a result, the concentration of phosphate in ground water is usually low, but various chemical processes in soil strata may include the mobility of phosphate in sub-soil and ground water. The Phosphate content in the ground water varies from 0.6 to 2.8µg/l during monsoon and 1.3 to 3.8µg/l during post monsoon season which is very low illustrated in the spatial variation map shown in fig. 9.

5.10. Chloride

The chloride ion concentration various between value under desirable limit 200 to 250 mg/l as per Indian drinking water quality standard. Only sample W1 is showing high amount of chloride for both monsoon and post monsoon season and it also a nearest point from Old Landfill Site. The spatial distribution of chloride concentration in ground water of the study area is illustrated in fig. 10.

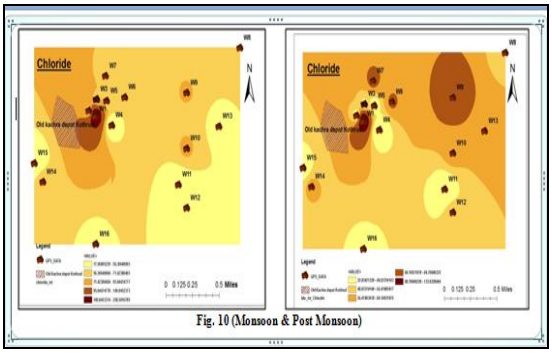

Figure 10

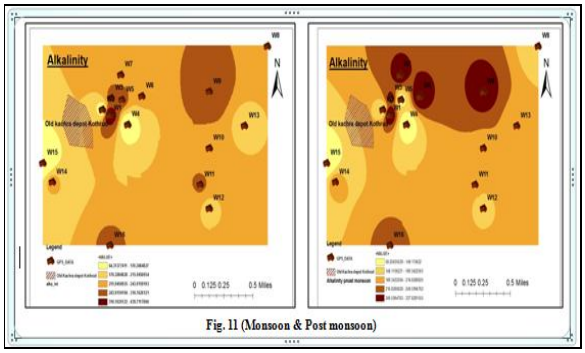

Figure 11

5.11. Alkalinity

The presence of carbonates, bicarbonates, and hydroxides are the main cause of alkalinity in natural water. The alkalinity value in ground water varies from 64 mg/l to 440 mg/l for monsoon season and 58 mg/l to 328 mg/l for post monsoon season. The spatial distribution of alkalinity in ground water of the study area is illustrated in fig. 11.

5.12. Nitrate

Nitrate content in drinking water is considered important for its adverse health effects. The Nitrate content in study area is very low it ranges from 0.01 – 1.05mg/l for monsoon and 0.05 – 0.9mg/l for post monsoon. As such, the ground water regions do not pose any nitrate hazard to human. The spatial distribution of nitrate concentration in ground water of the study area is illustrated in fig. 12.

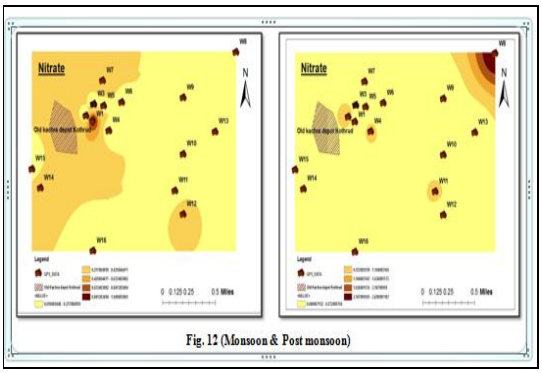

Figure 12

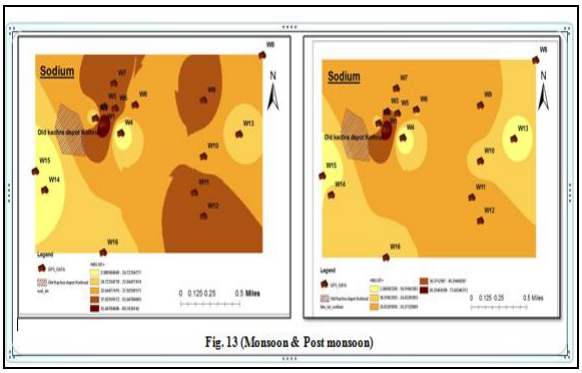

Figure 13

5.13. Sodium

Sodium is an essential nutrient and adequate levels of sodium are required for good health. Sodium in drinking water is only a health concern when the sodium level is high. Sodium value ranges from 5.58 to 89.81 in mg/l for monsoon and 3.36 to 73.7 in mg/l for post monsoon. The spatial distribution map is shown in fig. 13.

5.14. MPN (Most Probable Number)

Bacterial pollution of ground water has become a major problem in India; it is due to the lack of safe drinking water. The values for MPN/100 ml are found to vary from 2 to 1600 /100 ml for both monsoon and post monsoon season. The spatial distribution shown in fig. 14.

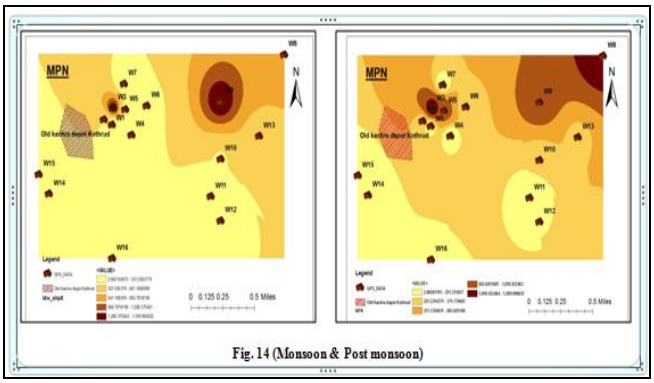

Figure 14

6. Conclusion

Spatial variations in ground water quality in the study area were studied successfully by using geographic information system (GIS). It is concluded from the analysis of ground water for monsoon and post monsoon seasons from nearby area of Old Landfill Site that due to dumping and disposal of the solid waste and other anthropogenic activities, leachate percolation in past, and also by the increasing environmental pollution due to urbanization the ground water quality in the study area has deteriorated. As per to the Indian drinking water quality standard drinking water from all station is potable after some treatment except W1 sample as it is nearest point to the old landfill site.

The results obtained in this case study and the spatial database established in GIS, shows the same approach can be used for determining, monitoring and managing ground water quality and its pollution for wide areas. The database formed can be very useful for future research and reference.

7. Acknowledgment

Authors are thankful to each and every person who helps directly or indirectly to accomplishing the project study.

8. R eferences

1. Indian Standard specification for drinking water: IS: 10500-1992
2. APHA Standard methods for examination of water and waste water, 19th Edition. Washington, DC: American Public Health Association, 1995.
3. Arvind kumar (2004). Assessment of ground water quality in residential colonies of ‘Vishakhapatnam.
4. Baride M. V. Patil S. N. Arti Baride (2010). Ground water Quality and its Suitability for Agricultural Use in Yawal Taluka, Jalgaon District, Maharashtra, India, International Publication, AOGS, Singapore Advance in Geoscience,Vol.2 3 Hydrological Science (2010) (In press).pages 271-294

5. M. R. G. Sayyed1, G. S. Wagh2 (may 2011). Assessment of groundwater quality for agricultural use: a case study from solid waste disposal site SE of Pune, India.
6. Patil DA, Deshmukh PK, Fursule RA, Patil PO (2010). Geochemical studies of fluoride and other water quality parameters of ground water in Dhule region Maharashtra, (India).
7. Professor & Head, Department of Geology, Sant Gadge Baba Amravati University, 2012, Ground water occurrence and future planning in Urad village,Warud Taluka, Amravati District, Maharashtra, published In International Journal of Science, Environment and Technology, Vol. 1, No 3, 2012, 205 – 216.
8. Rajkumar V. Raikar1, Sneha, M. K2, Karnataka (2012). Water quality analysis of Bhadravathi taluk using GIS – a case study, International Journal of Environmental Sciences volume 2, no 4, 2012
9. S. Babu, R. N. Jadhav,D. B. Sarode,Vasim Khatic, S. N. Patil and S. T.Ingle (march 2009)**.** Assessment of Ground water quality in North Maharashtra University Area, Jalgaon.
10. Swarna Latha.P 1, Nageswara Rao.K Visakhapatnam (2010). Assessment and Spatial Distribution of Quality of Groundwater in Zone II and III,Greater Visakhapatnam, India using water quality index (WQI) and GIS, international journal of environmental sciences volume 1, no 2 ,2010.
11. Shashwat Gupta Rai (April 2011). Assessment of impact on the groundwater quality due to urbanization by hydro geochemical facies analysis in SE part of Pune city India.
12. Tikle S, Saboori M.J, Sankpal R. (2012). Spatial Distribution of Ground water Quality in Some Selected parts of Pune city, Maharashtra, India using GIS.
13. T. Subramani1 S. Krishnan2 P. K. Kumaresan3 (may-june 2012). Groundwater Quality with GIS Application for Coonoor Taluk in Nilgiri District India, International Journal of Modern Engineering Research (IJMER) www.ijmer.com Vol.2, Issue.3, May-June 2012 pp-586-592 ISSN: 2249-6645