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# Impact of Polluted River Water on Ground Water of Agricultural Area and its Suitability for Irrigation

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## Abstract

This paper describes the impact of polluted river water on ground water of agricultural area and its suitability for irrigation. In this study seven villages were selected for investigating river and groundwater contamination. Hence 11 river and 54 well water samples were obtained from either side of Kham River. Pollution by TDS, Cl, $NO_3$, Ca, Mg, and Na in 22 river water sample during pre-monsoon and post-monsoon period was observed. 6 groundwater sample during pre-monsoon period and 8 well water samples during post-monsoon period have $NO_3$ concentration more than 45 mg/lit as per Indian Irrigation and drinking water standard. The suitability of river and groundwater for irrigation was determined on the basis of chemical indices like Sodium adsorption ratio (SAR), Soluble Sodium percentage (SSP), Kelly's ratio (KR). IS 11624:1986 and analytical data plotted on US salinity diagram illustrates that, 22 river water samples during pre-monsoon and post monsoon period are having SAR above 26 and EC above 6000 micromhos/cm. This suggests that river water is unsuitable for irrigation. 6, 13 groundwater samples along left and right bank of Kham river respectively have SAR between 18 to 26 and EC 3000 to 6000 micromhos/cm. Such water when used for irrigation decreases soil solution capacity and irrigated water is not available to plant even though soil appears wet. A statistical correlation was attempted on above mentioned water quality parameter. River and groundwater sample analysis shows increased concentration of sodium, calcium, magnesium, nitrate and chloride which indicates the influence of domestic and industrial effluent on river and groundwater hydrochemistry in village Waluj, Patoda, Naigaon, Valdgaon of Aurangabad and Gangapur taluka. This was clarified in Spatial relationship between river water and groundwater.

**Keywords:** Aurangabad; Domestic sewage; Ground water; Ground water contamination; India; Industrial effluent; Kham river; Maharashtra; Quantum geographical information system; River water

## Introduction

Chemical contamination of river and groundwater is the most serious pollution problems, particularly in arid and semi-arid areas with deficient water resources. Chemical pollutions and waste water pollutions in river and GW are normally unidentified until some disease affects the local population. In the recent years, India has been subjected to pollution attributed to industrial and domestic source of pollutant, owing to unethical practices and poor enforcement of environmental law and regulation. Many aquatic ecosystems are severely threatened by human mediated contamination since several industrial establishments are concentrated near river basin for obvious reasons. Such activities put high hydrological stress on existing groundwater by deteriorating its quality. It is with advent of industries and discharge of effluent in injection well. As a result, pollutant has entered into the aquifer system. Numerical simulations were conducted to estimate nitrogen species concentrations along a flow path during irrigation [1]. Hence periodic assessment of the ground water becomes necessary to ensure the suitability of water for drinking and irrigation. This can be done by formulation of SAR as per Suitability Criteria for Irrigation water is IS 11624:1986. Geographic Information System not only facilitates data capture and processing but also serves as a powerful computational tool that facilitates multi map integrations and helps to prepare water quality mapping [2]. GIS was used to assess the spatial and temporal variability of nitrate occurrences in the aquifer. Results show that the first quartile of nitrate concentration for the years 1990 and 2000–2004 exceeds the MCL (Almasari 2008). The EC distribution and indices such as, Sodium Adsorption Ratio (SAR), Sodium percentage (Na%) and Kelley's Ratio (KR) are used to estimate the sodium concentration against calcium and magnesium. Soluble Sodium Percent (SSP) was calculated with respect to calcium, magnesium. These are important parameters for determining the suitability of groundwater for irrigational use [3]. Considering the above facts, the effect of polluted river water on ground water is focused in present research work. This makes it very necessary to investigate level of concentration of physical, chemical water quality parameter of river and groundwater of selected wells along river basin. Based on the above, the motivation behind the present study was to perform following objectives (a) To analyze eight physical and chemical parameters of the river and GW namely pH, EC, TDS, $NO_3$, Cl, Na, Mg, Ca and SAR (b) To develop river water quality and Ground water quality map of study area using Q-GIS. To achieve this objective author had selected 11 river and 54 GW samples obtained from selected wells on either side of the Kham River at various villages. River and GW was analyzed for pre-monsoon and post-monsoon period in the year 2014 [4-6].

## Study area

Aurangabad is one of the fastest developing cities well-known for its Industrial auto cluster, situated in the central part of Maharashtra. The summer temperature is max 43°C and Min. 28°C whereas for winter it is Max 32°C Min. 5°C. The sources of irrigation are streams, percolation tanks and wells. Ground water plays a major role for irrigation as well as domestic uses. The Study area covers the Aurangabad taluka and Gangapur taluka which lies between latitude 19° 53' north and longitude 75° 20' east along Kham River [7-10]. The most important economic activity in the rural area is agriculture, with chief crops being jawar, wheat, maize, fodder crops for dairy animal and vegetables like onion, cauliflower, chili, tomato and cucumber. As described earlier, Kham River, which is one of the major tributaries

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of the Godavari River, receives all domestic and industrial waste water from the Aurangabad city and MIDC Waluj, which includes six and three streams respectively [11]. Six streams from Aurangabad city are Barudnagar stream, Khadkeshwar stream, Aushadhi Bhavan stream, stream behind Aurangabad Municipal Corporation, Gandhi Nagar streams and streams from Satara Nagar Parishad (Figure 1). Three streams from MIDC-Waluj are Tisgaon stream, streams near Oasis chowk, streams beside Bajaj-nagar from Waluj and Ranjanagon industrial area as shown in location map (Figure 2). This river ultimately confluences with the upstream Godavari of Jaikwadi dam. Since groundwater is directly in the contact with river or surface water, soil, rocks, and plants, the constituents of these sources might contaminate the groundwater [12]. The geological formations of the area are characterized by the Deccan traps (Upper cretaceous to lower Eocene). The granitic rocks have given rise to red as well as black cotton soils. Major part of this area has deep black soil derived from the trap rock. Certain variations occur due to exposure and protection [13]. A mixture of laterite and black soil is encountered in the eastern parts together with sandy soil along river banks. Most of the hill tops are bare or covered by coarse gravel while the low lying area accumulates clay and loam. From a geological point of view, Figure 3, which illustrates the geological information, the study area comprises 12 flows out of which 7 flows are thick and closely to broadly joint aphanites compact basalt and 5 flows is irregular amygdaloidal basalt [14]. In waluj village closed spaced sheet joint was traced during well inventory study. In this region flow is irregular sheet jointed amygdaloidal basalt with small to medium seized amygdaloidal filled with silica and zeolites [15]. This flow starts from RL 1642 to RL 1657 ft. In village Patoda, the flow is thick compact aphanites basalt showing closely spaced jointed top portion of the flow is hydrothermally altered amygdaloidal basalt of thickness 3 ft. (RL 1679 to RL 1683 ft), it was traced in well no. P/WL2, maximum thickness of the flow is 23 ft. the flow start from RL 1657 to RL 1682 ft. In village Valadgaon, the flow is thick compact aphanites basalt showing closely spaced jointed [16-20]. It was traced in well no. V/WR1, V/WR3, V/WL3 of village and maximum thickness of the flow is 10 ft. the flow start from RL 1682 to RL 1692 ft.


**Figure 1:** Stream coming from Satara nagar parishad and meeting at village golwadi and river sampling location.

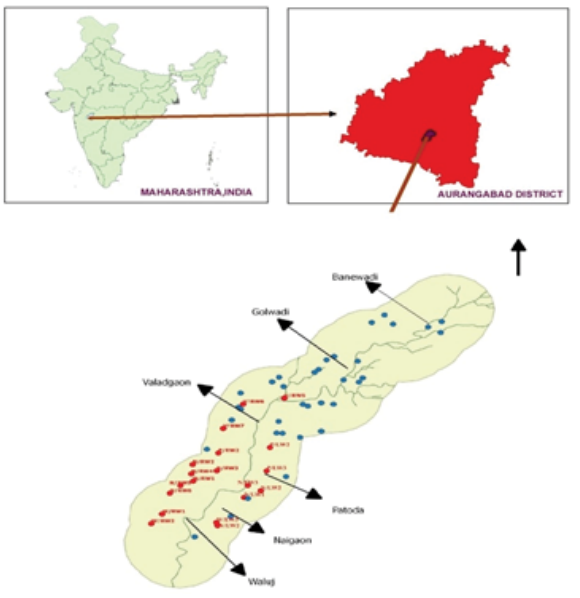


**Figure 2**: Location of Study area with river and well water sampling location In India.

## Problems in study area

The three main sources of river and groundwater pollution include Domestic waste, Industrial effluents, leaks and non-point source activities such as agricultural management practices. In surrounding area of Kham River the groundwater is spoiled due to waste disposal and improper agricultural practices (Figures 4-9). Total generation of sewage in Aurangabad city is 107 MLD.

All the villagers were using the groundwater for domestic purposes and farming before one decade but in present scenario is completely different in mentioned villages. In many part of Banewadi, Golwadi, Valadgaon, Patoda, Naigaon and village Waluj, groundwater usage is obsolete. Therefore water quality monitoring is necessary in and around Kham River [21-23].

## Land use and land cover details

Total area of village and cultivable land detail in study area is as

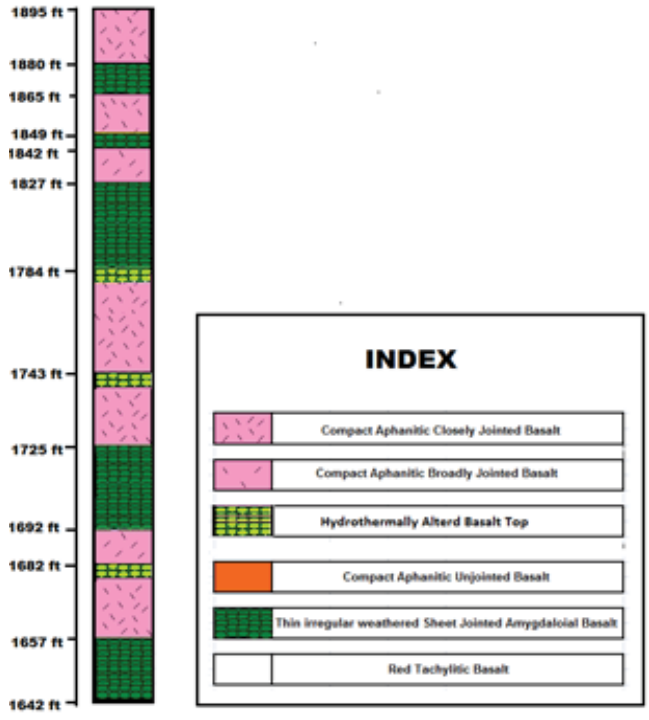


**Figure 3:** Litho logical details of study area.


**Figure 4:** Evidence of Irrigation to vegetable crop using river water (RW) at village Banewadi.

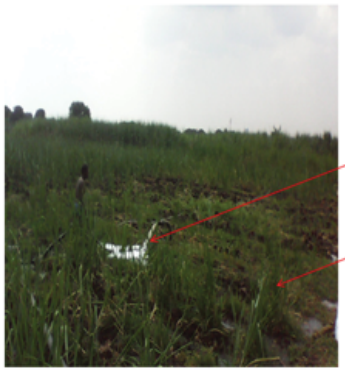


**Figure 5:** Evidence of Irrigation to sugarcane crop using river water

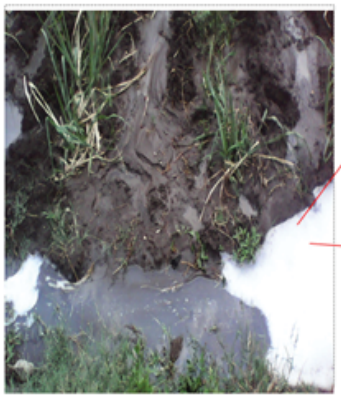


**Figure 6:** Irrigated water was not easily infiltrated through soil at village Valadgaon.

shown in Table 1 Study area consists of seven villages, which includes 4520 Ha. land in which total cultivable land is 2635 Ha.

## Industry Classification and Distribution

There are four clusters of industries in Aurangabad districts shown in Table 2. There is scattered Industrial development along the periphery of Aurangabad city along Beed Road and Paithan road. (MPCB-Aurangabad)

## Methodology and Experimental Site Details

### Preliminary survey

Preliminary survey is carried out with well inventory survey (Figures 10 and 11) to get the detail information of selected wells (Tables 3 and 4) with their accessibility for sampling and planning for collection of sample the points at which major contamination of Kham River occurs was find out and then following stations were selected (Tables 3 and 5). In Well inventory survey of 54 dug wells from north to south direction, a questionnaire filled by farmers which gives detail farming information like gut number, cropping pattern details by farmer, static water level, daily pumping rate, recharge rate of well per 24 hours and irrigated area by well [24-27].

### Sample collection procedure and details

All the dug well were equipped with electrical pumps. GW samples collected from the dug-well at a depth of 10 to 12 m below the ground level at 54 locations, 27 wells at right hand side and 27 wells at left hand side along the Kham River (Table 5). Two water samples were collected for one year per sampling station covering both PRM and POM seasons. A total 108 groundwater samples and 22 river water samples collected, (Figures 12 and 13) tested and analyzed in the year 2014 for PRM and POM period. GW samples were collected (Figures 14 and 15). After long standing, discharges and floating matter was removed using cellulose nitrate membrane filters with 0.45 mm-pore size, samples of one litre plastic bottles were collected and stored in the refrigerator in order to sustain low temperature (<4°C) for further analysis work. Sample collection was completed during morning hours i.e. 6.00 am to 9.00 am (Figure 16).


**Figure 7:** Evidence of Cattle's were drinking river water at village Ptoda.

**Figure 8:** Existing dairy farm near Left bank of Kham river at village Patoda.


**Figure 9:** Existing Hip of dairy manure on the left bank of Kham river at village patoda.

| Sr. No | Name of village | Total Area (Ha) | Cultivable land (Ha) | Well no |
|---|---|---|---|---|
| 1 | Banewadi | 895 | 460 | B/LW1,B/LW2,B/LW3,B/RW1,B/RW2,B/RW3 |
| 2 | Golwadi | 508 | 126 | G/LW1,G/LW2,G/LW3,G/LW4,G/RW1,G/RW2,G/RW3, G/RW4 |
| 3 | Valadgaon | 988 | 931 | V/LW1, V/LW2,V/LW3,V/LW4, V/LW5, V/LW6, V/LW7, V/LW8,V/LW9, V/RW1,V/RW2,V/RW3,V/RW4, V/RW5,V/RW6, V/RW7,V/RW8, V/RW9,V/RW10 |
| 4 | Patoda | 564 | 518 | P/LW1,P/LW2,P/LW3,P/RW3,P/RW4 |
| 5 | Pandharpur | 110 | 53 | |
| 6 | Naigaon | 175 | 167 | N/LW1,N/LW2,N/LW3,N/LW4,N/LW5 N/RW1,N/RW2,N/RW3,N/RW4,N/RW5,N/RW6 |
| 7 | Waluj | 1280 | 380 | W/LW1,W/LW2,W/LW3,W/RW1,W/RW2, |
| | Total | 4520 | 2635 | |

**Table 1:** Present status of cultivable land details of different villages in study area.

| Sr.No | MIDC | Distance from Aurangabad | Area (Ha) | Remarks |
|---|---|---|---|---|
| 1 | Shendra | 15 Km | 600 | New Developing area |
| 2 | Chikalthana | Within AMC area | 400 | Old Industrial area |
| 3 | Waluj | 12 Km | 1520 | Major Industrial area |
| 4 | Railway Station MIDC | Within AMC area | 20 | Very small area , having many sick units, |

**Table 2:** Present Industrial Cluster established nearby study area in Aurangabad.

**Figure 10 :** Well inventory survey in the month of May 2014 period at village Patoda (Well inventory survey - Depth and diameter of Well, Geological information ,Static and pumping water level, Recharge time ,cropping pattern, Irrigation scheduling information at village Patoda).


**Figure 11:** Use of Garmin–GPS system for Well inventory survey for preparation of Spatial variation map using QGIS.

| Sr. No | Name of village | Name of village | Latitude | Longitude | Type of Well | Total depth(m) |
|---|---|---|---|---|---|---|
| 1 | Banewadi-LW1 | Banewadi | 19.86623 | 75.31314 | DW | 15.0 |
| 2 | Banewadi-LW2 | Banewadi | 19.86415 | 75.30901 | DW | 14.5 |
| 3 | Banewadi-LW3 | Banewadi | 19.86204 | 75.31284 | DW | 14.2 |
| 4 | Golwadi-LW1 | Golwadi | 19.8445 | 75.28914 | DW | 15.1 |
| 5 | Golwadi-LW2 | Golwadi | 19.85099 | 75.28768 | DW | 14.5 |
| 6 | Golwadi-LW3 | Golwadi | 19.8429 | 75.28801 | DW | 14.8 |
| 7 | Golwadi-LW4 | Golwadi | 19.84378 | 75.28339 | DW | 15.2 |
| 8 | Valadgaon-LW1 | Valadgaon | 19.82317 | 75.26488 | DW | 15.8 |
| 9 | Valadgaon-LW2 | Valadgaon | 19.82327 | 75.26308 | DW | 16.2 |
| 10 | Valadgaon-LW3 | Valadgaon | 19.8216 | 75.27015 | DW | 15.6 |
| 11 | Valadgaon LW4 | Valadgaon | 19.82773 | 75.26366 | DW | 14.0 |
| 12 | Valadgaon LW5 | Valadgaon | 19.83363 | 75.27258 | DW | 17.4 |
| 13 | Valadgaon LW6 | Valadgaon | 19.8349 | 75.27661 | DW | 18.5 |
| 14 | Valadgaon LW7 | Valadgaon | 19.83432 | 75.27103 | DW | 17.5 |
| 15 | Valadgaon LW8 | Valadgaon | 19.8344 | 75.2803 | DW | 7.5 |
| 16 | Valadgaon LW9 | Valadgaon | 19.82395 | 75.27663 | DW | 19.4 |
| 17 | Patoda-LW1 | Patoda | 19.80644 | 75.26593 | DW | 15.0 |
| 18 | Patoda-LW2 | Patoda | 19.81768 | 75.26105 | DW | 15.0 |
| 19 | Patoda-LW3 | Patoda | 19.80866 | 75.26009 | DW | 18.0 |
| 20 | Naigaon-LW1 | Naigaon | 19.79838 | 75.25323 | DW | 18.0 |
| 21 | Naigaon-LW2 | Naigaon | 19.801 | 75.25829 | DW | 18.5 |
| 22 | Naigaon-LW3 | Naigaon | 19.80301 | 75.25436 | DW | 20.5 |
| 23 | Naigaon-LW4 | Naigaon | 19.798 | 75.2544 | DW | 20.4 |
| 24 | Naigaon-LW5 | Naigaon | 19.79102 | 75.24911 | DW | 15.0 |
| 25 | Waluj-LW1 | Waluj | 19.7832 | 75.23823 | DW | 15.0 |
| 26 | Waluj-LW2 | Waluj | 19.78754 | 75.24516 | DW | 16.0 |
| 27 | Waluj-LW3 | Waluj | 19.78874 | 75.24481 | DW | 15.0 |

**Table 3:** Salient features of wells inventory of selected wells along left bank of Kham River.

## Result and Discussion

The analysis consists of the 11 river water samples and 54 GW samples obtained from selected wells on either side of the Kham River at the various locations. The collected samples have been stabilized with nitric acid (0.5% $HNO_3$), preserved in cool place (about 4˚C) and transferred to the laboratory. By following Protocol of analysis as per IS: 3025/APHA-2012 and referring limits as per IS: 10500:2012 and IS 11624.1986, the pH and EC (Electric conductivity) were measured

in laboratory immediately after the arrival of sample according to standard method using recommended pH and EC meter. The samples were then analyzed for following physical and chemical parameters namely Total dissolved solids (TDS), Cl (Chloride), $NO_3$(Nitrate) , Ca(Calcium), Mg(Magnesium), Na(Sodium). In this lab, Nitrate ($NO_3$) was determined by UV Visible Spectrophotomer. The analytical results have been evaluated to ascertain the suitability of river water of the study area for agricultural uses. The irrigation water quality is evaluated by comparing with specifications of as per IS 11624.1986 (Indian Standard guidelines for the quality of Irrigation water-Reaffirmed 2001 –FAD 17), UDC 631-671-03:626-810 (026) and IS 10500-2012.

## River water quality analysis

The pH of RW samples ranged between 8.36-9.05 which is alkaline in nature at village Banewadi, Golwadi, and Valadgaon-I and range of pH of RW samples ranged between 6.27 to 6.43 which is acidic in nature during pre-monsoon period at sampling location. Valadgaon-II, Pandharpur, Patoda, Baqaual Nagar, Naigaon and Waluj. Post Monsoon chemical analysis in the year 2014 of river water sample shows River water sample within range of 8.51 to 9.04, indicating alkaline nature of river water (Table 6). Nitrate concentration during pre-monsoon water quality analysis of RW samples at village Banewadi, Golwadi, Valadgaon and Pandharpur, Patoda, Baqual Nagar, Naigaon, Waluj was above MPL as shown in Figure 17. Minimum concentration was recorded was 59.6 mg/lit at Baqual Nagar and maximum concentration was recorded was 143 mg/lit at Valadgaon. Banewadi to Waluj in the year 2014.

| Sr. No | Name of village | Latitude | Longitude | Type of Well | Total depth(m) |
|---|---|---|---|---|---|
| 1 | Banewadi-RW1 | 19.8688 | 75.2958 | DW | 13.0 |
| 2 | Banewadi- RW2 | 19.8659 | 75.29194 | DW | 18.5 |
| 3 | Banewadi- RW3 | 19.8653 | 75.29838 | DW | 18.2 |
| 4 | Golwadi- RW1 | 19.8528 | 75.28048 | DW | 20.1 |
| 5 | Golwadi- RW2 | 19.8478 | 75.2758 | DW | 18.5 |
| 6 | Golwadi- RW3 | 19.8467 | 75.27461 | DW | 15.5 |
| 7 | Golwadi- RW4 | 19.8515 | 75.2782 | DW | 18.5 |
| 8 | Valadgaon- RW1 | 19.8448 | 75.26381 | DW | 18.5 |
| 9 | Valadgaon- RW2 | 19.843 | 75.26173 | DW | 19.0 |
| 10 | Valadgaon- RW3 | 19.8412 | 75.26517 | DW | 18.6 |
| 11 | Valadgaon- RW4 | 19.8387 | 75.25217 | DW | 14.0 |
| 12 | Valadgaon- RW5 | 19.8367 | 75.26541 | DW | 17.4 |
| 13 | Valadgaon- RW6 | 19.8344 | 75.25291 | DW | 18.5 |
| 14 | Valadgaon- RW7 | 19.825 | 75.24688 | DW | 17.0 |
| 15 | Valadgaon- RW8 | 19.8283 | 75.24952 | DW | 15.0 |
| 16 | Valadgaon- RW9 | 19.8332 | 75.2515 | DW | 18.0 |
| 17 | Valadgaon- RW10 | 19.8325 | 75.25221 | DW | 18.0 |
| `18 | Patoda- RW1 | 19.817 | 75.24197 | DW | 18.0 |
| 19 | Patoda- RW2 | 19.81554 | 75.24543 | DW | 15.0 |
| 20 | Naigaon- RW1 | 19.8047 | 75.2378 | DW | 17.0 |
| 21 | Naigaon- RW2 | 19.8111 | 75.23763 | DW | 20.0 |
| 22 | Naigaon- RW3 | 19.8087 | 75.24493 | DW | 18.5 |
| 23 | Naigaon- RW4 | 19.8075 | 75.23723 | DW | 18.4 |
| 24 | Naigaon- RW5 | 19.803 | 75.23389 | DW | 18.0 |
| 25 | Naigaon- RW6 | 19.8 | 75.23073 | DW | 15.0 |
| 26 | Waluj- RW1 | 19.792 | 75.22841 | DW | 15.0 |
| 27 | Waluj- RW2 | 19.7883 | 75.22508 | DW | 25.0 |

**Table 4:** Salient features of wells inventory of selected wells along Right bank of Kham River.

Post-monsoon river water quality analysis indicates that Nitrate concentration at village Banewadi, Golwadi1, Golwadi2, Valadgaon, Pandharpur, Patoda, Baqual Nagar, Naigaon, Waluj was above maximum permissible limit as per IS 10500:2012. Minimum concentration recorded was 46 mg/lit at village Golwadi and maximum concentration was recorded as 61 mg/lit at Baqual nagar. Chloride concentration of RW varies from 1725-2530 mg/lit which was above permissible limit during pre-monsoon period. Total dissolved solid concentration for pre-monsoon and post-monsoon season at village Banewadi, Golwadi, Valadgaon and Pandharpur, Patoda, Baqual Nagar, Naigaon, Waluj was above maximum permissible limit as per IS 11624:1986. The major components of TDS include calcium, magnesium, sodium, nitrates. The TDS of river water is mainly due to the vegetable decay and disposal of effluent from industries (Figure 18).

Water used for irrigation should meet the requirements for crop growth to achieve maximum crop productivity. EC and SAR play vital role in suitability of water for irrigation. U.S. Salinity Laboratory of the Department of Agriculture adopted certain techniques based on which the suitability of water for agriculture is explained. Figure 19 illustrates correlation between sodium adsorption ratio and electrical conductivity for river and ground water and plotted on the US salinity diagram. It was observed that the river water of two seasons from study area fall in C4S4 class, indicating very high salinity and very high sodium water and which is not suitable for irrigation

Figure 19, Tables 7 and 8 illustrates the water quality classification of river and groundwater for irrigation based on SAR and EC concentration. Pre-monsoon river water quality analysis indicates Calculated SAR value for village Banewadi, Golwadi, Valadgaon and Pandharpur, Patoda, Baqual Nagar, Naigaon, Waluj which was above MPL i.e. 26. This indicates RW during PRM season is not suitable for irrigation. Minimum calculated SAR value was 27.03 at village Waluj and maximum calculated value was 38.82 at Baqual nagar. POM river water quality analysis indicates, calculated SAR value for village Banewadi, Golwadi1, Golwadi2, Valadgaon, Pandharpur, Patoda, Baqual Nagar, Naigaon and Waluj which as Shown in Figure 20. Here SAR values were between 10 to 18 which were also hazardous for soil structure and its permeability capacity. Min. and max. Concentrations i.e. 16.14 and 28.69 were recorded at villages Patoda and Baqual Nagar respectively.

| Sr. No | Sampling Location | Name of sampling location | River water sample No. | Well water (GW) sampling location along Left bank | Well water (GW) sampling location along right bank | Total GW Samples | (PRE+ PMO) (RW+GW) | Total |
|---|---|---|---|---|---|---|---|---|
| 1 | B | Banewadi | 1 | 3 | 3 | 6 | 7+7 | 14 |
| 2 | G-I,G-II | Golwadi | 2 | 4 | 4 | 8 | 10+10 | 20 |
| 3 | V-I,V-II | Valadgaon, pandharpur | 2 | 9 | 10 | 19 | 21+21 | 42 |
| 4 | Patoda-I, II | Patoda | 2 | 3 | 2 | 5 | 7+7 | 14 |
| 5 | Naigaon-I,II | Naigaon, Baqual nagar | 2 | 5 | 6 | 11 | 13+13 | 26 |
| 6 | W-I,II | Waluj | 2 | 3 | 2 | 5 | 7+7 | 14 |
| | | Total | 11 | 27 | 27 | 54 | 108 | 119 |

**Table 5:** Pre-monsoon and post-monsoon river and well water (GW) sampling location details for the year -2014.

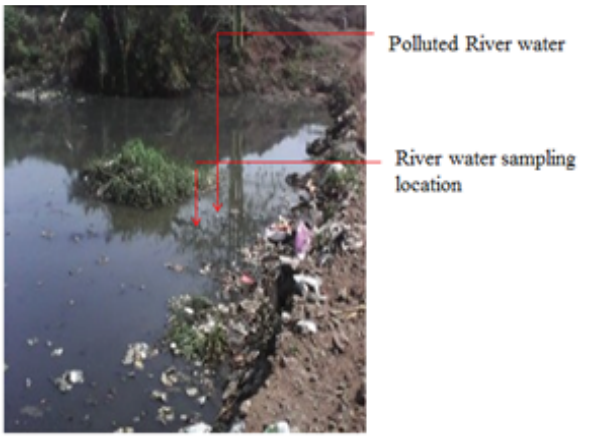


**Figure 12:** Pre-monsoon and post- monsoon river water sampling location near Valadgaon.

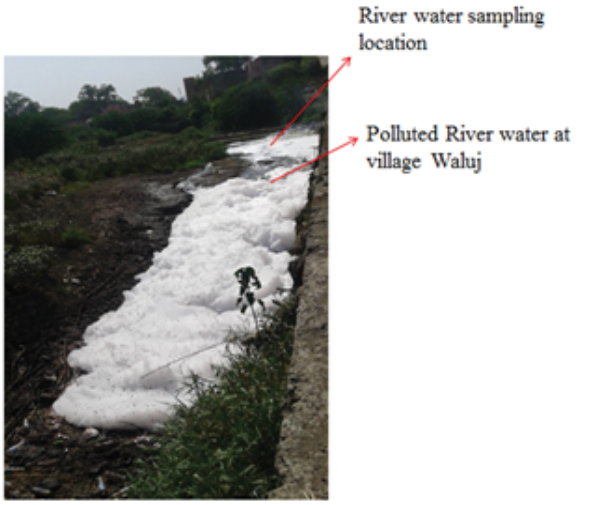


**Figure 13:** Pre-monsoon and post monsoon river water sampling location at village waluj.

**Figure 14:** Pre-monsoon and post monsoon well water sampling location at village Patoda with Litho logical study(Well water sampling location at village Patoda).

**Figure 15:** Pre-monsoon and post monsoon well water sampling location at valadgaon (Well water sampling location at village valadgaon).

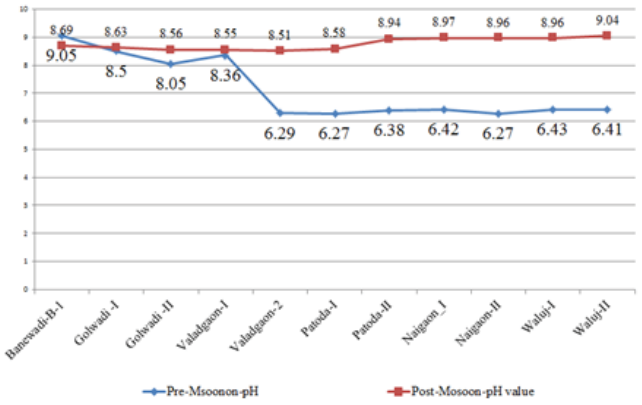


**Figure 16:** Pre-monsoon and post monsoon pH variation in river water for the year 2014.

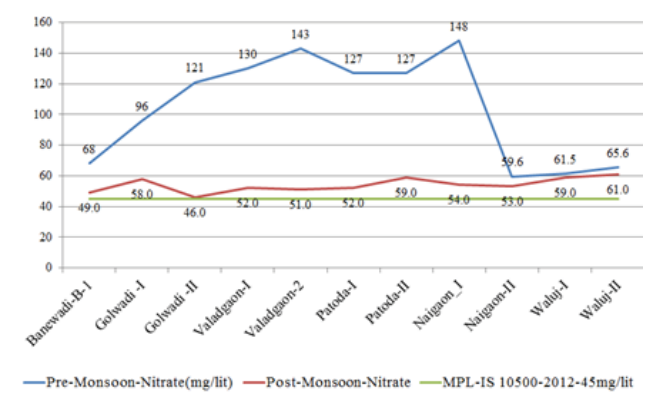


**Figure 17:** Pre-monsoon and post monsoon nitrate concentration in Kham river water at various location from village Banewadi to Waluj (near waluj MIDC) in the year 2014.

| Water quality parameter | Pre-monsoon (Well water samples along left bank) | | | | Pre-monsoon (Well water samples along right bank) | | | | Pre-Monsoon River water samples | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Min | Max | Median | SD | Min | Max | Median | SD | Min | Max | Median | SD |
| pH | 6.38 | 8.01 | 7.59 | 0.36 | 6.23 | 7.80 | 7.22 | 0.53 | 6.27 | 9.05 | 6.42 | 1.1 |
| TDS | 983 | 2470 | 1740 | 461.2 | 980 | 2690 | 1822 | 489.0 | 2161 | 4552 | 3488 | 793.1 |
| $NO_3$ | 19.4 | 59 | 38 | 12.51 | 21.40 | 64 | 39 | 11.62 | 59.60 | 148 | 121 | 34.77 |
| CL | 236 | 1050 | 563 | 234.4 | 231 | 1030 | 650 | 230.3 | 1569 | 2530 | 2180 | 308.3 |
| EC | 314 | 4640 | 4130 | 447.1 | 1250 | 4615 | 3560 | 840.7 | 3460 | 8320 | 6340 | 1209. |
| Ca | 109 | 228 | 181 | 38.13 | 89.00 | 286 | 189 | 39.15 | 215 | 618 | 347 | 45.72 |
| Mg | 22 | 67 | 47 | 11.12 | 28.80 | 69.9 | 45.80 | 10.33 | 49 | 186 | 143 | 76.77 |
| Na | 85 | 206 | 125 | 36.29 | 75.0 | 208 | 139 | 36.18 | 268 | 512 | 378 | 4.29 |
| **Water quality parameter** | **Post -monsoon (Well water samples along left bank)** | | | | **Post-monsoon (Well water samples along right bank)** | | | | **Post -Monsoon River water samples** | | | |
| | **Min** | **Max** | **Median** | **SD** | **Min** | **Max** | **Median** | **SD** | **Min** | **Max** | **Median** | **SD** |
| pH | 7.09 | 8.04 | 7.67 | 0.27 | 7.23 | 8.02 | 7.69 | 0.25 | 8.51 | 9.05 | 8.69 | 0.21 |
| TDS | 830 | 20500 | 1150.0 | 350 | 780.0 | 1950.0 | 1120.0 | 364.9 | 1840.0 | 2830 | 1884 | 510.0 |
| $NO_3$ | 15.0 | 33.0 | 25.0 | 4.77 | 12.0 | 37.0 | 26.0 | 5.81 | 46.0 | 61.00 | 53.0 | 4.71 |
| CL | 138. | 367 | 236.0 | 53.6 | 140.0 | 389.0 | 258.80 | 54.31 | 1230. | 1949. | 1760.0 | 226.3 |
| EC | 2100 | 3400 | 2800 | 387.06 | 1800.0 | 3550.0 | 2850.0 | 445.06 | 9.0 | 4900.0 | 4200 | 1356.0 |
| Ca | 89.0 | 176 | 121.0 | 24.07 | 104 | 214.0 | 121 | 26.83 | 164.0 | 410.0 | 210.0 | 79.61 |
| Mg | 21.8 | 67 | 42.0 | 11.67 | 28.8 | 69.90 | 45.80 | 10.01 | 49.0 | 186.7 | 143.0 | 53.50 |
| Na | 85.0 | 150 | 118.0 | 16.87 | 109.0 | 205.0 | 145.0 | 22.45 | 205 | 364.0 | 254.0 | 50.06 |

**Table 6:** Minimum, maximum, average values and standard deviation of physical and chemical parameters of river and ground water samples of wells present along left and right bank of Kham river for the year 2014.

EC is the expression of total salt concentration. Higher the EC of irrigation water, the lesser is the water available to plant, even though soil may appear wet (Figure 6 and 21). As EC increases, usable plant water in soil solution decreases dramatically. Actual yield reduction from irrigation with high EC water varies. EC of RW sample was high during Pre-monsoon period in May 2014 at village Banewadi, Golwadi, Valadgaon and Pandharpur, Patoda, Baqual Nagar, Naigaon, Waluj and above the maximum permissible limit as per IS 11624:1986. Minimum EC recorded was 3460 micromhos/cm at Valadgaon and maximum concentration recorded as 8320 micromhos/cm at Waluj. Also, EC was high during POM RW quality analysis at village Banewadi, Golwadi1, Golwadi2, Valadgaon, Pandharpur, Patoda, Baqual Nagar, Naigaon, Waluj. Minimum concentration recorded was 2730 micromhos/cm at village Golwadi whereas maximum was recorded as 4900 micromhos/cm at Baqual Nagar. River water samples included in this class are medium hazardous and if used as irrigation water will affect the soil properties like porosity, permeability and chemical composition, also irrigated water is not easily available for plant root.

## Ground water quality analysis for irrigation purpose

The quality of ground water sources is affected by the characteristics of the media through which the water passes to the ground water zone of saturation. Ground water quality may be affected by natural factors, such as (i) the quality of irrigation water which depends primarily on the presence of dissolved salts and their concentration. (ii)Sodium Adsorption Ratio is the most important quality criteria. Sodium hazard depends on relative proportion of sodium to calcium and magnesium ions. Which influence the water quality and its suitability for irrigation (iii) the higher Electrical Conductivity, the less water is available to plant, even though soil may appear wet. Usable plant water in soil solution decreases dramatically as EC increases (IS 11624.1986).

## Ground water quality mapping using GIS

GIS is used to evaluate the quality of groundwater in Aurangabad taluka. Spatial variation map major water quality parameter like pH, EC, TDS, $NO_3$, Cl, Na, Ca, Mg, SAR were prepared for Aurangabad based on these spatial variation maps of major water quality parameters, integrated ground water quality map of study area was prepared using QGIS. This groundwater quality map helps us to know the existing GW condition of the study area. The spatial distribution of $NO_3$ concentration in twenty seven well water samples along left bank and right bank of Kham River is illustrated in Figure 22. The $NO_3$ concentration of ground water sample of wells along left bank of Kham River having range from 21.9 mg /lit to 58.0 mg /lit during PRM season and 21.4 mg /lit to 64.0 mg /lit during POM period. This map illustrates that total 8 well water sample have nitrate concentration in excess of 45 mg/lit during PRM period which is shown by red well spot on map. The $NO_3$ concentration in eight well water samples along right bank have $NO_3$ concentration is in excess of MPL during PRM season. The TDS concentration in well water sample range from 1089 mg/lit to 2442 mg/lit during PRM season and 830 mg/lit to 2189 mg/lit during POM season. Spatial variation map for TDS illustrates that the eight well water sample out of 27 selected wells have TDS concentration in excess of 2000 mg/lit during pre-monsoon period and One well water Sample out of 27 selected wells have TDS concentration in excess of maximum permissible limit during post-monsoon period and twelve well water sample out of 27 selected wells at right hand side of kham river have TDS concentration in excess MPL, it is observed that majority of well water sample along right hand side kham river have TDS concentration below maximum permissible level during post monsoon (Figure 23).

To determine the suitability of water for irrigation based on EC, the spatial distribution of electric conductivity in fifty four well water samples along left bank and right bank of kham river is illustrated in Figure 24. It indicates total eighteen ground water sample of wells along left bank and seventeen groundwater sample of wells along right bank of kham river having range for EC from 1500 to 3000 micromhos/cm during PRM season. This map illustrates that the four well water sample along left bank were having range for EC from 3000 to 6000 micromhos/cm during post-monsoon period which is shown by red well spot on map, fifteen well water sample along left bank out off 27 selected wells having range for EC from 3000 to 6000 micromhos/cm during PRM season.

The suitability of water for irrigation based on SAR, the spatial distribution of fifty four well water samples along left bank and right

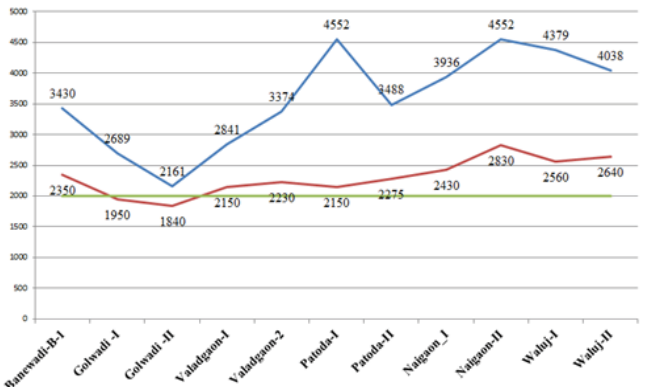


**Figure 18**: Pre-monsoon and post monsoon total dissolved solids distribution in river water at various location from village Banewadi to Waluj (near waluj MIDC).

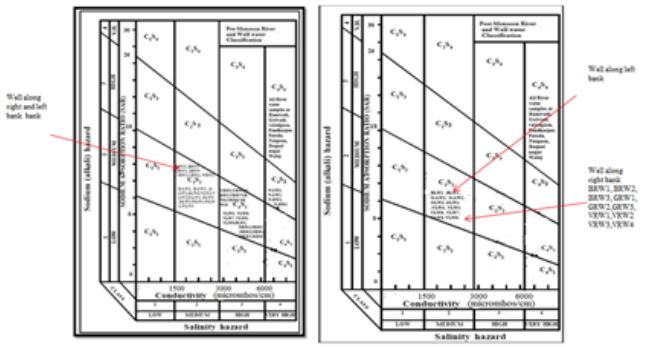

**Figure 19:** Classification of river and groundwater samples in relation to salinity and sodium hazard.

| WQ Parameter | Range | Water Class | Pre-monsoon(2014) | | | Post-Monsoon(2014) | | |
|---|---|---|---|---|---|---|---|---|
| | | | river | right | left | river | right | left |
| SAR | 1-10 | Excellent(S-1) | 0 | 1 | | 0 | | 4 |
| | 11-18 | Good, (S-2) | 0 | 10 | 13 | | 23 | 22 |
| | 18-26 | Fair, (S-3) | 0 | 13 | 12 | | 4 | 1 |
| | >26 | Poor, (S-4) | 11 | 2 | 2 | 11 | | |
| EC | 1500 | Low(C-1) | 0 | | 0 | | | |
| | 1500-3000 | Medium(C-2) | 0 | 22 | 10 | | 25 | 10 |
| | 3000-6000 | High(C-3) | 0 | 17 | 17 | | 4 | 5 |
| | >6000 | Very high(C-4) | 11 | | | 11 | | |
| KR | <1 | Suitable | | 25 | 25 | | 27 | 27 |
| | >1 | Unsuitable | 11 | 2 | 2 | 11 | 2 | 2 |
| SSP | <50 | Good quality | | 25 | 25 | | 27 | 27 |
| | >50 | Unsuitable | 11 | 2 | 2 | 11 | 2 | 2 |

**Table 7:** Classification of river and ground water quality for irrigation purposes according to SAR,EC,KR, and SSP for Pre-monsoon and Post-monsoon period for the year 2014.

| Sr.No | Class | Range of SAR SAR=Na/(SQRT(Ca+Mg)/2) | Remark |
|---|---|---|---|
| 1 | Low | Below 10 | Low sodium hazard |
| 2 | Medium | 10-18 | Medium sodium hazard |
| 3 | High | 18-26 | High sodium hazard |
| 4 | Very high | Above 26 | Very high sodium hazard |

**Table 8:** Water Quality rating based on the Sodium Adsorption ratio (SAR) (IS 11624.1986).

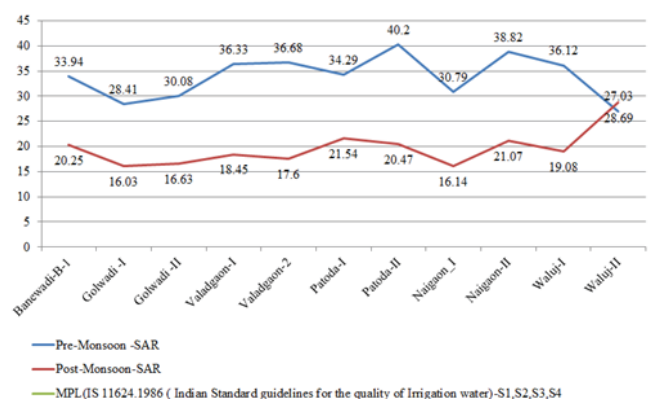


**Figure 20:** Pre-monsoon and post monsoon Sodium adsorption ratio of River water at various sampling location in the year 2014.

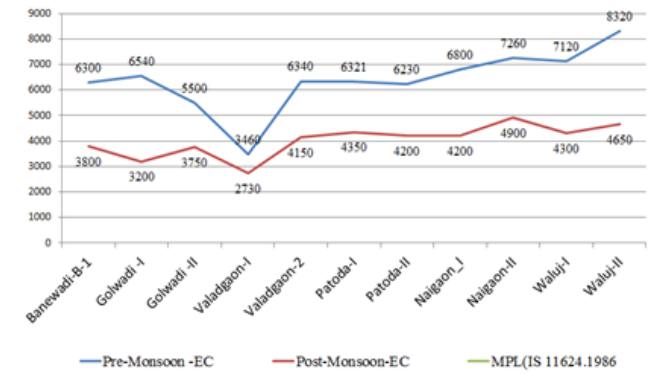


**Figure 21:** Pre-monsoon and post monsoon EC distribution in river water at various sampling location in the year 2014.

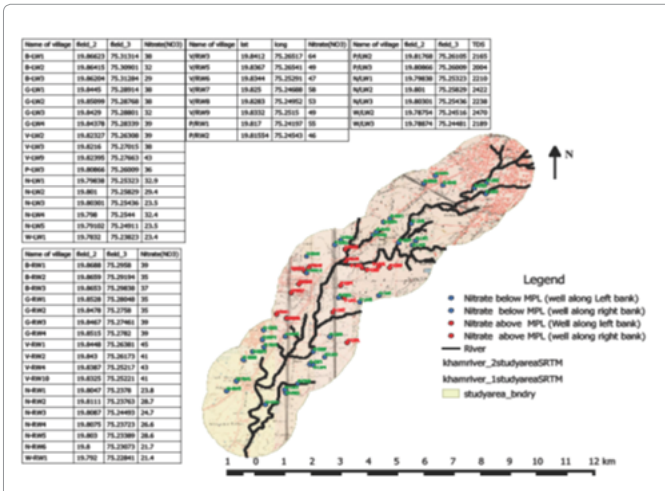


**Figure 22:** Spatial variation map of nitrate concentration using QGIS with nitrate contaminated wells along left and right bank of Kham River in the year 2014.

bank of kham river is illustrated in Figures 19 and 25. It indicates that eleven GW sample of wells along left bank and twelve GW samples of wells along right bank of Kham River having range for SAR, between 18 to 26 during PRM season. This map illustrates that the two well water sample along left bank having value above 26, which was shown by

red well spot on map, two well water sample along right bank having value above 26 during pre-monsoon period. This map illustrates that four ground water samples of well located along left bank of kham river having SAR value below 10 during post-monsoon period and twenty three well water samples along left bank are having SAR value between 18-26 during post monsoon period. The results (Table 7, Figures 19 and 26) shows RW and GW classification of selected wells located along left and right bank of kham river, on the basis of SAR and EC as per IS 11624.1986. Figure 19 illustrates correlation between sodium adsorption ratio and electrical conductivity for ground water and plotted on the US salinity diagram. It was observed that the groundwater of from study area of wells along left bank of kham river namely (B1/LW-1, B1/LW-2 -banewadi), (G/LW2, G/LW4-golwadi), (V/LW2, V/LW5-Valadgaon), (N/LW3, N/L4, N/LW5-Naigaon), (W/LW1, W/LW2, W/LW3-waluj) and wells along right bank are (B/RW1, B/RW2, B/RW3- banewadi), (G/RW3, G/RW4-Golwadi), (V/RW1, V/RW2, V/RW4, V/RW5, V/RW9-Valadgaon) are rated as C2S2 class during Pre-monsoon season. Groundwater samples collected from

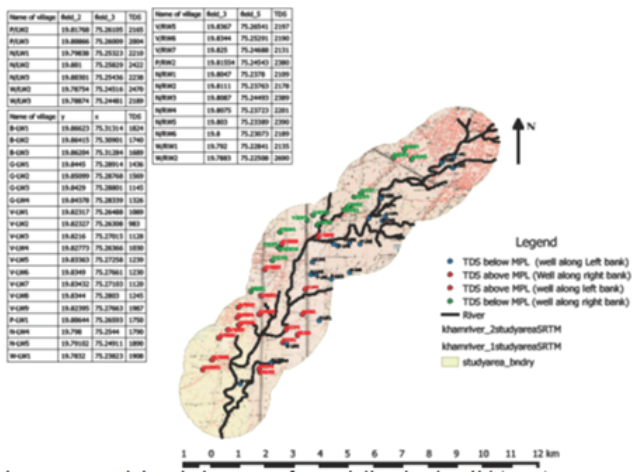


**Figure 23:** Spatial variation map of Total dissolved solid (TDS) concentration using QGIS with wells exceeded MPL along left and right bank of kham river for Pre-monsoon period in the year 2014.

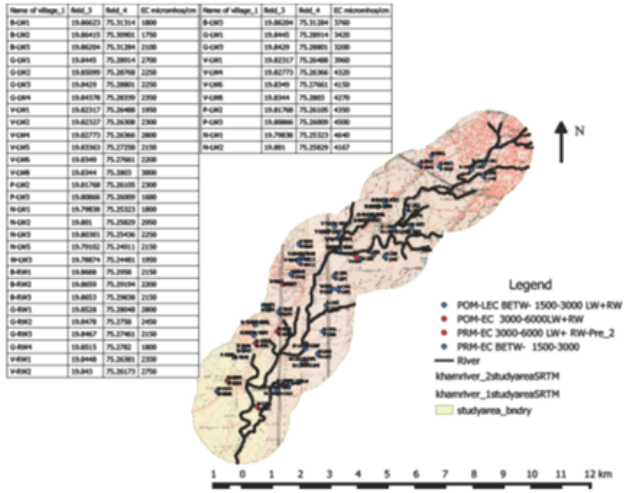


**Figure 24:** Spatial variation map of Electric Conductivity (EC) concentration using QGIS with wells exceeded MPL along left and right bank of Kham river for Pre-monsoon and Post monsoon period in the year 2014 .

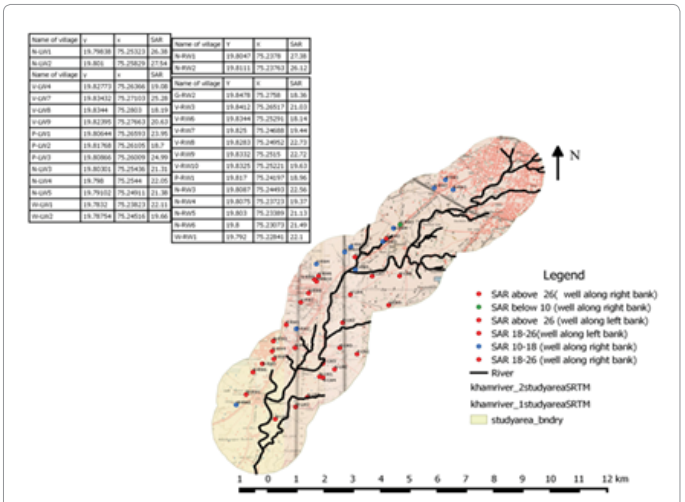


**Figure 25:** Spatial variation map of sodium adsorption ratio (SAR) using QGIS with sodium contaminated wells along left and right bank of kham river for Pre-monsoon period in the year 2014.

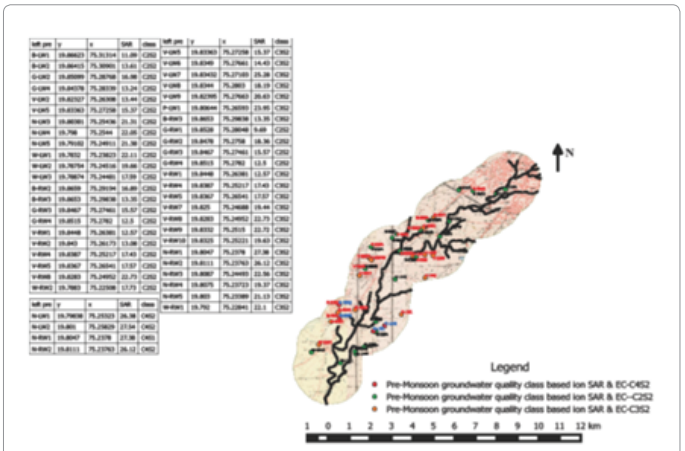


**Figure 26:** Spatial variation map of classification based on SAR and EC concentration in river and ground water using QGIS for Pre-monsoon period in the year 2014.

wells namely (B/LW3, B/LW1-banewadi), (G/LW3-Golwadi), (V/LW1, V/LW3, V/LW4, V/LW6-Valadgaon) are rated as C2S3 class for Pre-monsoon season. Groundwater samples collected from wells along left bank of Kham River - (V/LW7, V/LW8, V/LW9-valadgaon),( P/LW1, P/LW2, P/LW3-Patoda), and Groundwater samples along right bank namely (G/RW2-golwadi), (V/RW3, V/RW6, V/RW7, V/RW9, V/RW10-Valadgaon), (P/RW1, P/RW2-Patoda), ( N/RW3, N/RW4, N/RW5, N/RW6-Naigaon), (W/RW1-Waluj) are rated as C3S2 class for pre monsoon season. Groundwater samples collected from wells along left and right bank of kham river namely (N/LW1, N/LW2, N/RW2-Naigaon) are rated as C4S2 class during PRM season. In Post monsoon groundwater quality analysis, well water samples collected along left bank of kham river namely-(B1/LW-1, B1/LW-2, B/LW3-Banewadi), (G/LW1, G/LW2, G/LW3-Golwadi), (V/LW1, V/LW2, V/LW3, V/LW4, V/LW5, V/LW6, V/LW7, V/LW8, V/LW9-Valadgaon),(P/LW1, P/LW2, P/LW3-Patoda) and wells along right bank are( B/RW1, B/RW2, B/RW3-banewadi),( G/RW3, G/RW4-Golwadi), (V/RW1, V/RW2, V/RW4, V/RW5, V/RW9, V/RW10-Valadgaon),( P/RW1, P/RW2-Patoda), (N/RW1, N/RW2, N/RW3, N/RW4, N/RW5, N/RW6-Naigaon), (W/RW1, W/RW2-Waluj) are rated as C2S2 class

during POM season. A GW sample collected from well along left bank namely- (N/LW4-Naigaon) was rated as C2S3 class for post monsoon season (Figures 19 and 27).

## Statistical analysis

The qualities of river water and underground water have been assessed by calculating mean, variance, coefficient of variance, standard deviation, Minimum, maximum, median, standard deviation (Table 6). The Statistical relationship between the water quality parameter was examined through the analysis of the linear correlation method. The correlation coefficient between various Water Quality Parameter

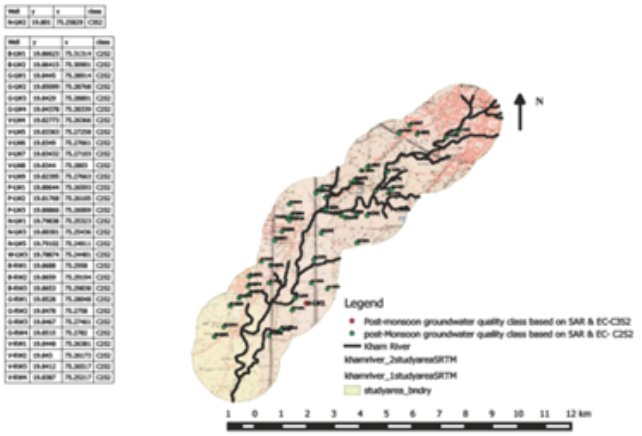


**Figure 27:** Spatial variation map of classification based on SAR and EC concentration in river and ground water using QGIS for Pre-monsoon and post monsoon period in the year 2014.

| r- value range | | Significant |
|---|---|---|
| -1.0 to -0.8 | 1.0 to 0.8 | Strong Significant |
| -0.8 to -0.6 | 0.8 to 0.6 | Good Significant |
| -0.6 to -0.5 | 0.6 to .05 | Significant |
| -.05 to 0.0 | 0.5 to 0.0 | Poor Significant |

**Table 9:** The significance for r-value ranges is shown below.

| River | pH | TDS | $NO_3$ | Cl | EC | Ca | Mg | Na |
|---|---|---|---|---|---|---|---|---|
| pH | 1.0 | | | | | | | |
| TDS | 0.489 | 1.00 | | | | | | |
| $NO_3$ | 0.422 | 0.8983 | 1.0 | | | | | |
| Cl | 0.347 | 0.8537 | 0.75042 | 1.00 | | | | |
| EC | 0.4197 | 0.9149 | 0.81416 | 0.76219 | 1.00 | | | |
| Ca | 0.276 | 0.8697 | 0.8971 | 0.6438 | 0.8910 | 1.00 | | |
| Mg | 0.493 | 0.7009 | 0.8159 | 0.6972 | 0.7538 | 0.843 | 1.00 | |
| Na | 0.4929 | 0.8741 | 0.8834 | 0.8375 | 0.9172 | 0.871 | 0.6524 | 1.00 |

**Table 10:** Correlation coefficient for different river water quality parameter -Pre-monsoon.

| Sr. No | Class | Range of EC (micromhos/cm) | Remark |
|---|---|---|---|
| 1 | Low | Below 1500 | Suitable for irrigation |
| 2 | Medium | 1500-3000 | Will effect on soil permeability, and water is not easily available for plant root, |
| 3 | High | 3000-6000 | soil solution decreases, water is not available to plant, even though soil may appear wet. |
| 4 | Very high | Above 6000 | Not suitable for irrigation, hazardous effects of the total salt concentration |

**Table 11:** Water Quality rating based on the total salt concentration (Electrical conductivity) (IS 11624.1986).

| River | pH | TDS | $NO_3$ | Cl | EC | Ca | Mg | Na |
|---|---|---|---|---|---|---|---|---|
| pH | 1.0 | | | | | | | |
| TDS | 0.514 | 1.00 | | | | | | |
| NO3 | 0.395 | 0.783 | 1.0 | | | | | |
| Cl | 0.347 | 0.791 | 0.839 | 1.00 | | | | |
| EC | 0.396 | 0.823 | 0.851 | 0.832 | 1.00 | | | |
| Ca | 0.421 | 0.732 | 0.746 | 0.710 | 0.745 | 1.00 | | |
| Mg | 0.381 | 0.819 | 0.683 | 0.617 | 0.702 | 0.647 | 1.00 | |
| Na | 0.418 | 0.860 | 0.915 | 0.792 | 0.835 | 0.729 | 0.737 | 1.00 |

**Table 12:** Correlation coefficient for different river water quality parameter - post-monsoon.

| Right Well | pH | TDS | NO3 | Cl | EC | Ca | Mg | Na |
|---|---|---|---|---|---|---|---|---|
| pH | 1.0 | | | | | | | |
| TDS | 0.319 | 1.00 | | | | | | |
| $NO_3$ | 0.398 | 0..8354 | 1.0 | | | | | |
| Cl | 0,841 | 0.7870 | 0.8202 | 1.00 | | | | |
| EC | 0.532 | 0.7969 | 0.7528 | 0.6929 | 1.00 | | | |
| Ca | 0.568 | 0.7428 | 0.7307 | 0.6383 | 0.8631 | 1.00 | | |
| Mg | 0.418 | 0.8511 | 0.7720 | 0.7153 | 0.8173 | 0.753 | 1.00 | |
| Na | 0.577 | 0.7904 | 0.81728 | 0.6636 | 0.89213 | 0.7659 | 0.7377 | 1.00 |

**Table 13:** Correlation coefficient for GW quality parameters of wells along right bank of Kham River for Pre-monsoon period.

| Right Well | pH | TDS | $NO_3$ | Cl | EC | Ca | Mg | Na |
|---|---|---|---|---|---|---|---|---|
| pH | 1.0 | | | | | | | |
| TDS | 0.472 | 1.00 | | | | | | |
| $NO_3$ | 0.419 | 0.698 | 1.0 | | | | | |
| Cl | 0,520 | 0.885 | 0.745 | 1.00 | | | | |
| EC | 0.391 | 0.910 | 0.849 | 0.783 | 1.00 | | | |
| Ca | 0.453 | 0.618 | 0.694 | 0.727 | 0.693 | 1.00 | | |
| Mg | 0.325 | 0.693 | 0.740 | 0.602 | 0.644 | 0.7480 | 1.00 | |
| Na | 0.375 | 0.815 | 0.759 | 0.693 | 0.827 | 0.6521 | 0.593 | 1.00 |

**Table 14:** Correlation coefficient for the GW quality parameters of wells along right bank of Kham river-Post-monsoon period.

| Left well | pH | TDS | $NO_3$ | Cl | EC | Ca | Mg | Na |
|---|---|---|---|---|---|---|---|---|
| pH | 1.0 | | | | | | | |
| TDS | 0.441 | 1.00 | | | | | | |
| $NO_3$ | 0.3324 | 0.836 | 1.0 | | | | | |
| Cl | 0,332 | 0.8704 | 0.836 | 1.00 | | | | |
| EC | 0.322 | 0.93157 | 0.793 | 0.8183 | 1.00 | | | |
| Ca | 0.379 | 0.8.085 | 0.811 | 0.7175 | 0.8720 | 1.00 | | |
| Mg | 0.4104 | 0.8503 | 0.7832 | 0.837 | 0.8131 | 0.7865 | 1.00 | |
| Na | 0.3102 | 0.7134 | 0.898 | 0.724 | 0.745 | 0.7901 | 0.7162 | 1.00 |

**Table 15:** Correlation coefficient for the GW quality parameters for wells along left bank of Kham river for Pre-monsoon period.

| Left Well | pH | TDS | $NO_3$ | Cl | EC | Ca | Mg | Na |
|---|---|---|---|---|---|---|---|---|
| pH | 1.0 | | | | | | | |
| TDS | 0.538 | 1.00 | | | | | | |
| $NO_3$ | 0.495 | 0.782 | 1.0 | | | | | |
| Cl | 0.378 | 0.725 | 0.745 | 1.00 | | | | |
| EC | 0.453 | 0.819 | 0.792 | 0.727 | 1.00 | | | |
| Ca | 0.425 | 0.695 | 0.725 | 0.638 | 0.6619 | 1.00 | | |
| Mg | 0.368 | 0.736 | 0.657 | 0.699 | 0.7240 | 0.652 | 1.00 | |
| Na | 0.435 | 0.839 | 0.715 | 0.783 | 0.781 | 0.655 | 0.735 | 1.00 |

**Table 16:** Correlation coefficient for GW quality parameters of wells along left bank of Kham River for Post-monsoon period.

of river and well water has been calculated and numerical value of correlation coefficient is tabulated in Tables 9 and 10. Statistical study of correlation and regression coefficient of WQP not only helps to assess the overall WQP but also quantify relative concentration of various pollutants in river and groundwater. The correlation coefficient (r) has value between +1 and -1. The significance for r-value ranges is shown below in Table 11.

The correlation matrices for all the samples of the one year during pre-monsoon and post monsoon season for river water are listed in Tables 11 and 12. The TDS shows the high correlation with other parameter like EC, $NO_3$, Na, Cl with (r>0.912), (r>0.8983), (r>8741) and (r>0.8537) during pre-monsoon and post monsoon season in river water (Table 12). The conductivity shows a significant correlation with Na with (r>0.835) during pre-monsoon and post monsoon period season. In river water EC-$NO_3$ (0.814), EC-Cl (0.76) was found to be correlated significantly positively. The correlation matrices for all the samples of the one year during pre-monsoon and post monsoon season for well water (GW) are listed in Tables 13 and 14 (wells along right bank) and Tables 15 and 16 (wells along left bank). In Well water EC and $NO_3$ are strongly correlated with r (0.851) along left bank of kham river, EC and Na was significantly correlated to each other. TDS and Ca found moderately negative correlation (-0.579). It means if TDS increases in Well water Ca concentration will decreases. Nitrate also bears positive correlation with Na, Cl. In Well water along right bank of kham river EC shows the high correlation with other parameter like $NO_3$, Na, Cl , with (r>0.849) and (r>0.8271) during pre-monsoon and post monsoon season this indicates the anthropogenic activities such as discharge of sewage, which percolates and mixes with groundwater (Tables 13 and 14). The strong correlation found between TDS and Na (r>0.924 and r>0.852) during pre-monsoon and post monsoon period. A significant correlation found in well water along right bank between TDS and Cl (0.812), TDS and EC (0.832), TDS and Al (0.791).

## Conclusions

Ground water and river water interaction was studied in Aurangabad district (MS) India. Suitability of river and ground water for irrigation activity was assessed. There are wide variation in groundwater and river water with respect to IS 11624.1986 and IS 10500-2012. The results of the study indicate that the kham river water is highly polluted. EC of groundwater increased towards the south of Aurangabad city. The analysis in respect of eight parameters namely pH, EC, TDS, chloride, Nitrate, Calcium, Magnesium, Sodium reveals that 100% of the river water samples have exceeded the permissible limit prescribed by Indian standard. The river water which is contaminated by partly or completely untreated domestic and industrial sewage has penetrated through the soil and contaminated the ground water of the village Banewadi, Golwadi, Valadgaon, Patoda, Naigaon and Waluj. Additionally ground water quality is influenced considerably by the quality of recharge sources. In southern Aurangabad (MS), groundwater towards right of the bank is affected by the random input of Industrial effluent through different streams in rural area of Valadgaon, Patoda, Naigaon, and Waluj. The suitability of river and GW for irrigation was determined based on chemical index like Sodium Adsorption Ratio (SAR), Soluble Sodium Percentage (SSP), Kelly's ratio (KR). As per IS 11624:1986 and US salinity Laboratory (USSL) suggesting that 22 river water samples during pre-monsoon and post monsoon period lie in C4S4 categories, suggesting that river water is unsuitable for irrigation and. 6 GW samples along left bank and 13 GW samples along right bank of Kham river lie in C3S2 categories. Such water decreases soil solution capacity and irrigated water is not available to plant even though soil appears wet. 12 GW samples along left bank and 13 GW samples along right bank lies in C2S2 categories, suggesting that such water will affect the soil permeability and water is not easily available for plant root. River and GW sample analysis shows increased concentration of sodium, calcium, magnesium, nitrate, chloride which indicates domestic and industrial effluent are influencing river and groundwater hydrochemistry in village Waluj, Patoda, Naigaon, Valdgaon of Aurangabad and Gangapur taluka. A statistical correlation was attempted on above mentioned water quality parameter. The TDS shows the high correlation with other parameter like EC, $NO_3$, Na, Cl with (r>0.912), (r>0.8983), (r>8741) and (r>0.8537) during pre-monsoon and post monsoon season in river water. The conductivity shows a significant correlation with Na with (r>0.835) during pre-monsoon and post monsoon period season. In river water EC-$NO_3$ (0.814), EC-Cl (0.76) was found to be correlated significantly positively.

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