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# Agricultural Suitability and Static Modelling of Safidon Tehsil in Jind District, Haryana, India

**Manjeet[1], Arushi Rana[2], Shresthi Jaiswal[3] and Urvashi Bist[4]**

***Banasthali Vidyapith (School of Earth Science), Newai (Rajasthan), India***

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**ABSTRACT**

India is an agro-based economy and the primary source of income comes from agriculture and related industries. Irrigation is one of the most important inputs for an efficient and sustainable agricultural production. The evaluation of agricultural suitability is essential for identifying which crops can be cultivated properly in a particular area as well as the methods and practices that must be used to have the maximum production and sustainability. Being an agro-based economy it is necessary to have a good quality of water for irrigation. About 89% India's groundwater is used for irrigation, 9% for residential use and 2% for irrigation purposes. This study was conducted to evaluate the Irrigation Suitability of Safidon tehsil in Jind District, Haryana. Total 76 samples were collected from the Safidon tehsil. The water samples were analysed for major cations: $Na^+$, $Ca^{2+}$, $K^+$ and $Mg^{2+}$. The Irrigational suitability will be calculated by using Sodium Adsorption Ratio (SAR), Magnesium Adsorption Ratio (MAR), Sodium Percent (Na %), Kelley's Ratio (KR), Electrical Conductivity (EC) and Soluble Sodium Percent (SSP). The values obtained from the study area show that 96% samples of SAR values came under excellent category and remaining 4% lies under good category, the value of EC lies between 605µS to 5540µS, the values of SSP shows that 64% were suitable and 36% were unsuitable, KR values shows that 64% samples were suitable and 36% were unsuitable and for MAR only 18% samples were suitable and 82% samples were unsuitable for irrigation purposes and these values shows the *magnesium hazard* in the study area, and Sodium Percent values lie between 17.20 to 79.15%.

***Key words:*** *Irrigational Suitability, Sodium adsorption ratio, Magnessium Adsorption Ratio, Sodium Percent, Soluble sodium percent, Kelley's Ratio.*

## Introduction

India contributes around 14% of country's gross domestic product (GDP) in agriculture sector. If the suitability of water for irrigation purposes is good of any region it will result in the maximum crop yield under the water and soil management practices. Now a days farmers using varies type of fertilizers in their fields to have a high crop production which has a negative impact on the water suitability it decreases the quality of soil.

An area-specific water quality index (WQI) must be developed since the quality of water used for irrigation purposes varies from region to region and it can be affected by several factors such as plant characteristics, soil quality, and climatic and local conditions. When evaluating water quality, physical and chemical parameters are important factors to consider but analyzing these factors individually doesn't provide a clear picture of the water quality

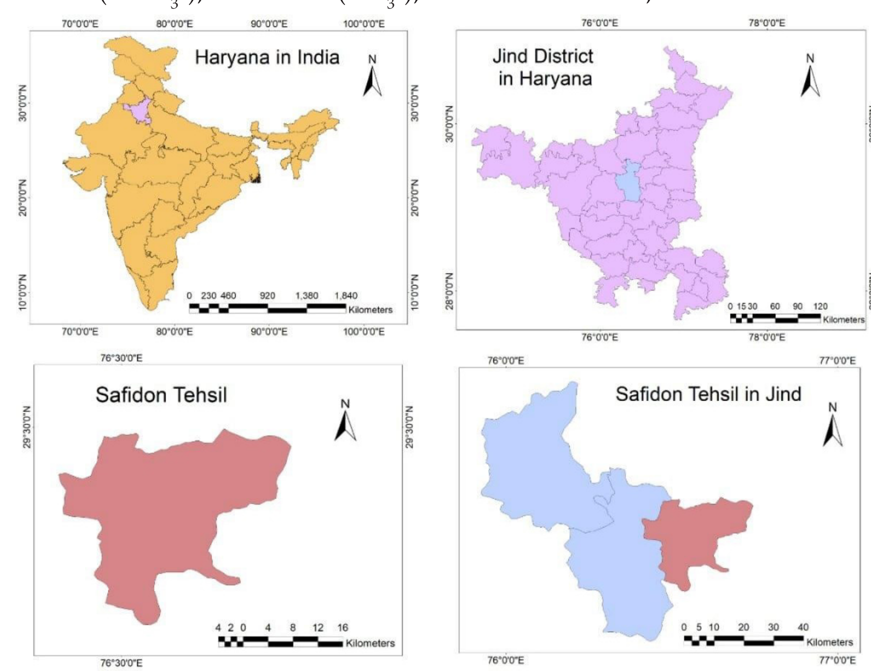
([1,3,4]Research Scholar, [2]Assistant Professor)
[1]ORCID- 0009-0008-1425-9204, [2]ORCID- 0000-0003-1223-5950,
[3]ORCID- 0009-0001-2440-9826

(Orozco *et al.,* 2017). Pure water is a poor conductor of electricity and acids, basic, and salts make it a better conductor. Such substances are termed electrolytes. The ones with poor solubility are known as weak electrolytes and the ones with higher solubility are known as strong electrolytes. Thus, the higher the concentration of electrolytes more the electrical conductance. Conductance of distilled water is 1 to 5 µS. Water up to 20 µS is considered suitable for irrigation. Since the conductivity varies with temperature it is reported at 25°C (Saxena, 1990). In the maintenance of crop development and growth and also their yields $Na^{+}$, $Mg^{2+}$, $Ca^{2+}$, and $K^{+}$ plays a great role. Sodium hazards affects the crops ability to absorb water from the soil by decreasing the permeability of the soil. In the summer, as the osmotic pressure drops, fewer water molecules are able to reach the branches and leaves (Tahmasebi *et al.,* 2018; Xu, *et al.,* 2019). To evaluate the water quality for irrigation of the *Simav Plain* in Turkey, Simsek and Gunduz (2007) developed a Global Information System (GIS) which was based on the irrigation water quality index (IWQI). They discovered that the surface aquifers local groundwater quality is generally suitable and that the aquifer water is best appropriate for irrigation through the combination of well-known hydrochemical characteristics (Simsek and Gunduz, 2007). By using sodium adsorption ratio (SAR), Sodium Percent (Na %), residual sodium carbonate (RSC), permeability index (PI), soluble sodium percentage (SSP), Magnessium ratio, Kelley's Ratio (KR), and Magnessium Hazard, and the cations and anions for groundwater quality assessment.

After applying SAR 100% of the samples were categorized as excellent, after applying sodium percent 98% were good and permissible while 95% were rated safe after implementing RSC and after implementing SSP 99.6% were good and 93.2% were rated permissible by Kelley's ratio (Hwang *et al.,* 2017). To perform analysis of the groundwater suitability and the geographical mapping of water quality in the *Faridpur District,* a number of water quality indices and geospatial modelling were used. The primary anions were $HCO3^{-} > Cl^{-} > SO^{2-}$ and the tremendous amount of cations was $Ca^{2+} > Na^{+} > Mg^{2+} > K^{+}$. According to Irrigation Water Quality Index (IWQI), 70% of the samples belonged to water types that were high suitable for irrigational use, whereas 30% belonged to water types that were low suitable. According to the data of electrical conductivity (EC), sodium percent (Na%), and sodium adsorption ratio (SAR) the majority of the groundwater samples classified into "excellent to good" category for the purpose of irrigation. Additionally, the majority of the groundwater samples that were gathered were determined to be safe for irrigation based on, total hardness (TH), Kelley's ratio (KR), residual sodium bicarbonate (RSBC) and magnessium adsorption ratio (MAR). The groundwater of *Faridpur* area was found to be suitable for agricultural purposes, according to the Wilcox Diagram-aided classification of water (Rahman *et al.,* 2017). The water suitability for irrigation purposes was calculated by using parameters such as sodium absorption ratio (SAR) (Wilcox, 1955), Sodium percent (Na %) (Ayers and Westcot, 1985), Kelley's ratio (KR) (Kelley, 1963), and Electrical conductivity (EC) (Richards, 1954). The static modelling of these irrigational parameters was carried out in Arc GIS using the inverse distance weightage method of interpolation. SAR value range from 0.98 to 11.16, while Electrical conductivity values lies between 367µS to 939µS, in the north of the tehsil the region shows low SAR value and in the central and southern part which is an active mining belt shows high SAR Values, Sodium percent values range between 11.43 to 60.14% and the range of Kelley's index values range between 0.12 to 1.35, high values can be seen towards North-west of the tehsil (Rana and Sharma, 2022). In the Wet Pampa Plain, Argentina from 2005 to 2010 a hydrogeological field studies were performed. An irrigation water index (IWI) is produced by combining variables such as EC, sodium absorption ratio (SAR), residual sodium carbonates (RSC), slopes, and hydraulic gradient. An aquifer thickness and the appropriate classes from the IWI are then integrated to create a *restricted water index* (RIWI). The result showed that about 61.3 % of the area came under "Very high" to "moderate" and remaining 31.4% is unsuitable for irrigation. 46% of the area is highly suitable for irrigation and has moderate groundwater availability and the *restricted water index* RIWI in the tested area is the "2" with high suitability and has moderate aquifer potential (Romanelli *et al.,* 2012). The weathering and the leaching of rocks alongside agricultural drainages strongly influenced the water quality of Al-Wehda. For this 40 surface water samples were collected in February in all seasons of 2010 and analyzed for several water quality parameters. Also, there is evidence of sewage water effluents. May month marks the peak of the seasonal variations in the concentrations of total nitrogen (TN), total phosphorous (TP), Chlorophyll (A), chemical oxygen demand (COD), and biological oxygen demand (BOD). Although eutrophication often happens all year long, it became more severe in the spring because of the availability of TN, TP and high temperatures.

The evaluation of water for irrigational use was done during the summer when irrigation water demand rises, has been done using several water quality criteria. Na% and total hardness (TH) measurements indicated that water of reservoir was unsuitable for irrigation (Al-Tanni, 2013). In Isfahan Iraq, 66 samples of groundwater have been tested and analyzed through the Gibbs diagram. The value of pH ranged from 7.05 to 8.95 irrigational suitability and risk assessment were evaluated through electrical conductivity (EC), sodium percent (Na %), sodium adsorption ratio (SAR), and residual sodium carbonate (RSC). The value of SAR lies from 0.47 to 39 meq/L. The RSC value varies from -18.2 to 4.7 in the study area (Rezaei and Hassani, 2018). Balaji *et al.* (2017) worked on the quality of groundwater of the *Tirupati region* in the Chittor district of Andhra Pradesh and analyzed the groundwater parameters according to *Chaddha's diagram* including calcium ($Ca^{2+}$), magnessium ($Mg^{2+}$), sodium ($Na^{+}$), potassium ($K^{+}$), bicarbonate ($HCO_3$-), carbonate ($CO_3$-), sulfate chloride, fluoride ($F^-$), total dissolved solids (TDS), calcium hardness, alkalinity, pH, Electrical conductivity (EC), sodium adsorption ratio (SAR), residual sodium carbonate (RSC), permeability index (PI), Kelly's ratio (KR), indices of base exchange, Gibbs ratio I, Gibbs ratio II. Major ions were mostly detected within the permissible limit in most of the sites, and groundwater was capable of drinking and irrigational purpose except for a few samples. To evaluate the groundwater for the purpose of irrigation and drinking water, the Telangana region's Nalgonda district underwent a Quality assessement. A total of 78 groundwater samples were taken and compared to WHO and BIS standards, 86% samples were appropriate for irrigation and for drinking purposes 72.5% were suitable. According to Wilcox, United States Salinity Laboratory diagrams (USSL diagram) and Doneen's chart the majority of the samples were suitable for irrigation. There was increase in water quality used for irrigation in the season of post monsoon. The concentration of $NO_3$-, F. $NO_3$ ranges from 3.3 to 236 mg/L in most of the region (Roy *et al.*, 2018).

Safidon is a tehsil of Jind district in Haryana. It is located at 29°24'21.84"N and 76°39'41.35"E with an elevation of 221 meters above mean sea level. It is located at the centre of Panipat and Jind District in Haryana, India. Situated at the bank of the Western Yamuna canal, the total area of Safidon tehsil is




Survey of India, 2011

**Fig. 1.** The locational aspect of Safidon Tehsil, Haryana

489.33 km$^2$ including 475.45 km$^2$ of rural area and 13.88 km$^2$ of urban areas. Safidon Tehsil, which is the 35$^{th}$ Haryana Vidhan Sabha constituency, has 70 villages.

There are 2 towns in Safidon named Safidon Municipal Committee which has a 34,728 total population and Bhuran Census Town which has a 5,603 population. Safidon is a tehsil, situated in Jind district of Haryana has an agro-based economy. Irrigation is one of the most important inputs for an efficient and sustainable agricultural production.

## Materials and Methods

A total 76 samples from different locations of Safidon tehsil were taken for analyses the irrigation suitability. For data collection Random Sampling Method was used. 1 L of the sample are collected in a dark coloured bottles which are washed with distilled water beforehand. Multi parameter Kit PC5 Test R35 series kit was used for measuring the Electrical Conductivity (EC) in the field. The samples were then analysed in the Environmental laboratory of Banasthali Vidyapith. The analysed parameters included four cations $Na^+$, $Mg^{2+}$, $Ca^{2+}$ and $K^+$. The estimation of $Na^+$ and $K^+$ is based on the Spectroscopy using Flame Photometer. Calcium ($Ca^{2+}$) and Magnessium ($Mg^{2+}$) analysed by Titration method by using standard Ethylenediaminetetraacid (EDTA). The water suitability for irrigation purpose in the study area will be calculated by using sodium adsorption ratio (Richards, 1954), Kelley's ratio (Kelley, 1963), Sodium percent (Ayers and Westcot, 1985), magnessium adsorption ratio (Raghunath, 1990), soluble sodium percent (Todd, 1980). The parameters will be calculated by the following equations:

$$SAR = \frac{Na^+}{\sqrt{Ca^{2+}+Mg^{2+}/2}} \quad \text{- (Equation (1)}$$

$$KR = \frac{Na^+}{Ca^{2+}+Mg^{2+}} \quad \text{- (Equation (2)}$$

$$Na\% = \frac{Na^+ + K^+}{Na^+ + Ca^{2+}Mg^{2} + K^+} \quad \text{- (Equation (3)}$$

$$MAR = \frac{Mg^{2+}}{Ca^{2+}+Mg^{2}+} \quad \text{- (Equation (4)}$$

$$SSP = \frac{Na^+}{Na^+ + Ca^{2+} + Mg^{2+}} \times 100 \quad \text{- (Equation (5)}$$

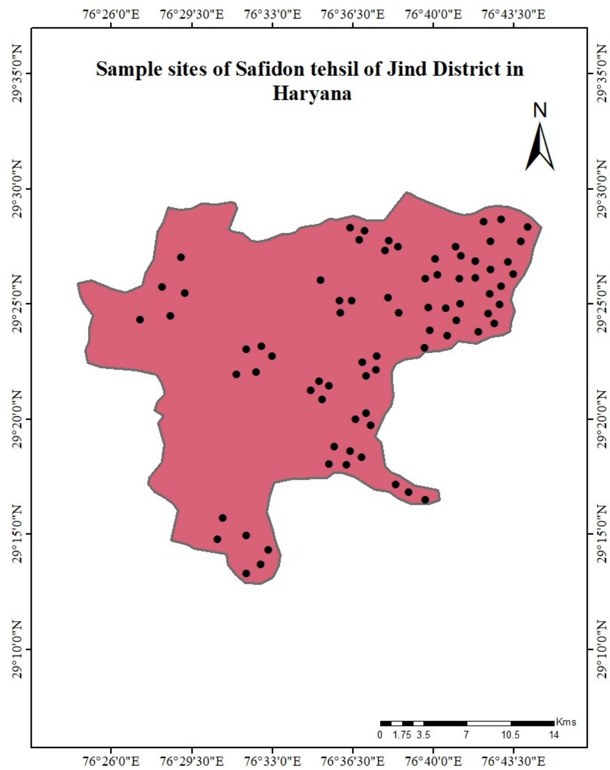



**Fig. 2.** Sampled Sites of Safidon tehsil

The technique that identifies unknown values that fall between known data points is known as *Interpolation*. Using a weighted index average of the values of points known, the IDW technique determines the interpolated values of unknown points. The Inverse Distance Weighted Method and Indicator Kriging shall be used as the interpolation method. Arc GIS 10.4.1 software is shall be used to interpolate water and soil data in the non-sampled portion of the tehsil.

## Results

Total seventy Six samples were collected from the study area for the analysis of water suitability for irrigation purposes. The results are presented in the Table 1.

## Discussion

**Sodium Adsorption Ratio (SAR) -** SAR measures the alkali or sodium hazard to crops and it is an important parameter for determining the irrigational suitability. About 96% of the samples lie in excellent

**Table 1.** Irrigational Suitability Assessment- SAR, KR, MAR, NA%, SSP, EC

| Sample No. | Sodium Adsorption Ratio (SAR) | Kelley's Ratio (KR) | Sodium Percent (Na %) | Magnessium Adsorption Ratio (MAR) | Soluble Sodium Percent (SSP) | Electrical Conductivity (μS) |
|---|---|---|---|---|---|---|
| 1 | 1.73 | 0.43 | 32.35 | 21.76 | 30.14 | 1325 |
| 2 | 0.87 | 0.22 | 21.85 | 47.83 | 17.87 | 798 |
| 3 | 2.65 | 0.66 | 41.45 | 83.03 | 39.82 | 988 |
| 4 | 2.57 | 0.64 | 40.61 | 78.79 | 39.08 | 942 |
| 5 | 1.02 | 0.25 | 21.97 | 46.68 | 20.30 | 1026 |
| 6 | 7.49 | 1.87 | 65.73 | 70.00 | 65.19 | 2330 |
| 7 | 5.38 | 1.34 | 58.80 | 67.19 | 57.33 | 1257 |
| 8 | 1.57 | 0.39 | 29.97 | 76.25 | 28.21 | 1174 |
| 9 | 13.13 | 3.28 | 77.60 | 10.98 | 76.65 | 1714 |
| 10 | 2.22 | 0.56 | 37.85 | 85.64 | 35.71 | 1437 |
| 11 | 5.02 | 1.25 | 57.99 | 66.63 | 55.63 | 1859 |
| 12 | 1.17 | 0.29 | 24.30 | 61.61 | 22.66 | 1568 |
| 13 | 0.74 | 0.18 | 17.20 | 55.85 | 15.57 | 786 |
| 14 | 1.94 | 0.49 | 34.48 | 77.01 | 32.68 | 1307 |
| 15 | 4.76 | 1.19 | 55.20 | 28.13 | 54.36 | 3000 |
| 16 | 5.51 | 1.38 | 58.62 | 67.28 | 57.93 | 2350 |
| 17 | 1.51 | 0.38 | 28.98 | 65.21 | 27.35 | 1128 |
| 18 | 7.99 | 2.00 | 67.20 | 70.15 | 66.64 | 2310 |
| 19 | 3.23 | 0.81 | 45.77 | 93.58 | 44.70 | 1817 |
| 20 | 1.27 | 0.32 | 26.00 | 72.82 | 24.08 | 1253 |
| 21 | 1.43 | 0.36 | 28.38 | 70.16 | 26.36 | 1582 |
| 22 | 1.59 | 0.40 | 30.35 | 58.13 | 28.51 | 1858 |
| 23 | 9.12 | 2.28 | 70.18 | 75.85 | 69.51 | 2330 |
| 24 | 13.89 | 3.47 | 79.15 | -325.83 | 77.64 | 1197 |
| 25 | 1.14 | 0.29 | 24.05 | 71.57 | 22.24 | 1515 |
| 26 | 1.30 | 0.32 | 26.86 | 59.81 | 24.48 | 946 |
| 27 | 2.45 | 0.61 | 39.69 | 84.15 | 38.01 | 1258 |
| 28 | 1.66 | 0.41 | 34.13 | 26.43 | 29.33 | 1085 |
| 29 | 3.69 | 0.92 | 49.55 | 66.08 | 48.00 | 779 |
| 30 | 2.11 | 0.53 | 36.08 | 81.33 | 34.52 | 621 |
| 31 | 1.58 | 0.40 | 30.98 | 68.72 | 28.35 | 640 |
| 32 | 5.45 | 1.36 | 58.35 | 59.85 | 57.67 | 1931 |
| 33 | 1.90 | 0.47 | 33.99 | 72.78 | 32.16 | 910 |
| 34 | 5.01 | 1.25 | 56.66 | 82.83 | 55.62 | 2200 |
| 35 | 2.66 | 0.66 | 41.19 | 48.21 | 39.93 | 1973 |
| 36 | 6.30 | 1.58 | 61.91 | 69.38 | 61.17 | 1467 |
| 37 | 2.53 | 0.63 | 39.85 | 75.92 | 38.76 | 2840 |
| 38 | 0.93 | 0.23 | 20.74 | 60.57 | 18.91 | 1261 |
| 39 | 1.40 | 0.35 | 27.55 | 23.16 | 25.88 | 1240 |
| 40 | 1.02 | 0.25 | 22.65 | 73.08 | 20.28 | 1098 |
| 41 | 4.50 | 1.13 | 53.69 | 7.87 | 52.94 | 2710 |
| 42 | 1.15 | 0.29 | 24.57 | 81.36 | 22.35 | 1478 |
| 43 | 1.71 | 0.43 | 32.09 | -169.78 | 29.92 | 928 |
| 44 | 10.34 | 2.58 | 72.64 | 79.93 | 72.10 | 2020 |
| 45 | 4.68 | 1.17 | 54.83 | 73.28 | 53.92 | 2330 |
| 46 | 6.11 | 1.53 | 61.13 | 66.94 | 60.44 | 1580 |
| 47 | 5.88 | 1.47 | 60.10 | 70.93 | 59.50 | 2820 |
| 48 | 1.33 | 0.33 | 26.50 | 66.93 | 24.95 | 1618 |
| 49 | 4.06 | 1.02 | 51.66 | 72.90 | 50.40 | 1208 |
| 50 | 5.28 | 1.32 | 57.10 | 79.64 | 56.88 | 1435 |
| 51 | 3.94 | 0.98 | 50.44 | 77.89 | 49.61 | 2550 |

**Table 1.** *Continued ...*

| Sample No. | Sodium Adsorption Ratio (SAR) | Kelley's Ratio (KR) | Sodium Percent (Na %) | Magnessium Adsorption Ratio (MAR) | Soluble Sodium Percent (SSP) | Electrical Conductivity (μS) |
|---|---|---|---|---|---|---|
| 52 | 3.71 | 0.93 | 49.69 | 82.00 | 48.15 | 958 |
| 53 | 4.47 | 1.12 | 55.29 | 73.31 | 52.80 | 1017 |
| 54 | 2.19 | 0.55 | 37.10 | 76.14 | 35.39 | 651 |
| 55 | 3.60 | 0.90 | 48.23 | 70.72 | 47.38 | 2330 |
| 56 | 3.86 | 0.96 | 50.59 | 71.09 | 49.08 | 1178 |
| 57 | 2.07 | 0.52 | 35.95 | 67.35 | 34.07 | 1012 |
| 58 | 1.39 | 0.35 | 27.77 | 68.10 | 25.82 | 986 |
| 59 | 5.92 | 1.48 | 60.72 | 90.69 | 59.67 | 1852 |
| 60 | 3.69 | 0.92 | 48.90 | 80.52 | 48.00 | 2160 |
| 61 | 5.00 | 1.25 | 56.44 | 69.44 | 55.56 | 1026 |
| 62 | 4.58 | 1.15 | 56.02 | -48.91 | 53.39 | 1808 |
| 63 | 2.80 | 0.70 | 42.81 | 34.79 | 41.18 | 1200 |
| 64 | 1.39 | 0.35 | 27.99 | 73.05 | 25.79 | 1251 |
| 65 | 0.83 | 0.21 | 19.25 | 69.52 | 17.27 | 605 |
| 66 | 4.23 | 1.06 | 52.58 | 58.19 | 51.40 | 1397 |
| 67 | 4.75 | 1.19 | 55.16 | 25.98 | 54.31 | 1629 |
| 68 | 1.69 | 0.42 | 31.37 | 63.22 | 29.75 | 1473 |
| 69 | 1.73 | 0.43 | 32.47 | 81.13 | 30.25 | 976 |
| 70 | 1.79 | 0.45 | 32.07 | 81.68 | 30.86 | 1106 |
| 71 | 6.38 | 1.59 | 62.13 | 58.36 | 61.46 | 1894 |
| 72 | 2.08 | 0.52 | 35.48 | 83.75 | 34.21 | 2920 |
| 73 | 2.28 | 0.57 | 37.13 | 82.20 | 36.28 | 5540 |
| 74 | 6.66 | 1.66 | 63.69 | 71.51 | 62.47 | 2630 |
| 75 | 3.97 | 0.99 | 50.38 | 92.42 | 49.82 | 2300 |
| 76 | 1.79 | 0.45 | 33.54 | 75.60 | 30.90 | 1794 |

As per table 2, Irrigational Suitability Assessment

**Table 2.** Statistical analysis for six parameters of groundwater samples

| Parameters | Mean | Median | St. Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| SAR | 3.66 | 2.61 | 2.66 | 0.74 | 13.89 |
| KR | 0.91 | 0.65 | 0.66 | 0.18 | 3.47 |
| Na% | 43.59 | 40.9 | 15.33 | 17.2 | 79.15 |
| MAR | 52.26 | 70.16 | 56.22 | -325.83 | 93.58 |
| SSP | 42.06 | 39.45 | 15.79 | 15.57 | 77.64 |
| EC | 1636 | 1436 | 760.47 | 605 | 5540 |

category and remaining 4% of the samples lie in good category (Table 3).

**Table 3.** Sodium Adsorption Ratio and Irrigational Suitability

| Water Suitability for Irrigation based on SAR Values (Richards, 1954) | Category | Percent of Sample |
|---|---|---|
| 0-10 | Excellent | 96% |
| 10-18 | Good | 4% |
| 18-26 | Fair | Nil |
| >26 | Poor | Nil |

**Kelley's Ratio (KR) –** If the Kelley's ratio (KR) is more than 1 it indicates an excess level of sodium in water. The value less than 1 is suitable for irrigation whereas more than 1 is unsuitable for irrigation purposes. The value of Kelley's ratio lies between "0.18 to 3.47" with a high variability depicted by standard deviation as 0.66. 64% of the sample are less than 1 and suitable for irrigation purposes and rest of 36% of the sample are more than 1 and indicate unsuitable water quality for irrigation (Table 4).

**Magnessium Adsorption Ratio (MAR) –** The excess quantity of magnessium in groundwater can reduce

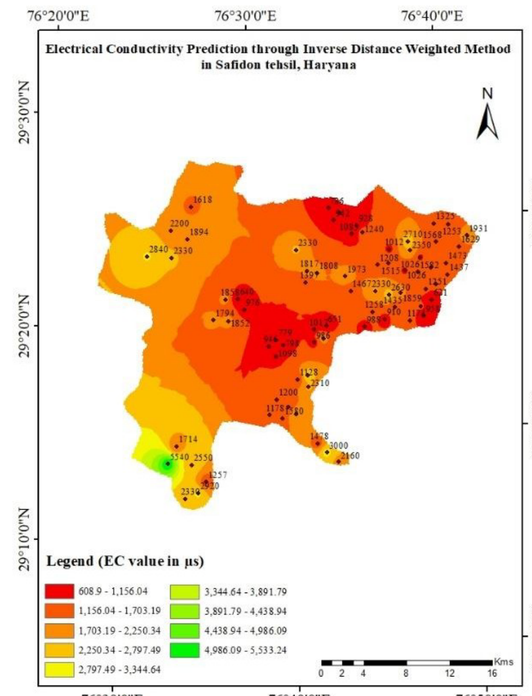



**Fig. 3.** Electrical Conductivity Predictive Map

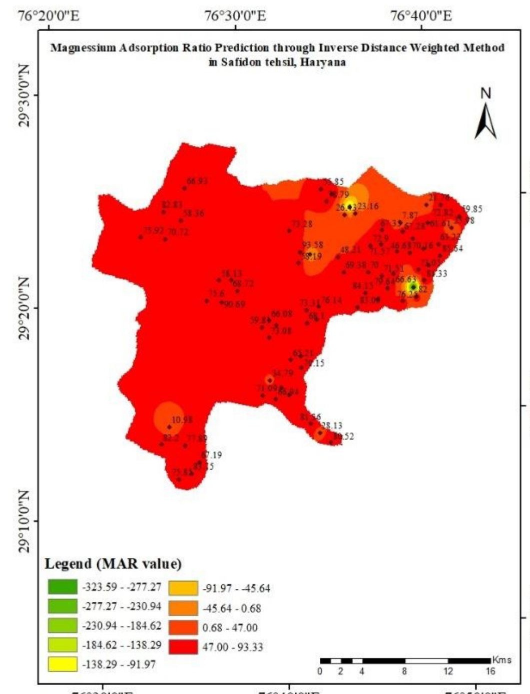



**Fig. 5.** Magnessium Adsorption Ratio Predictive Map

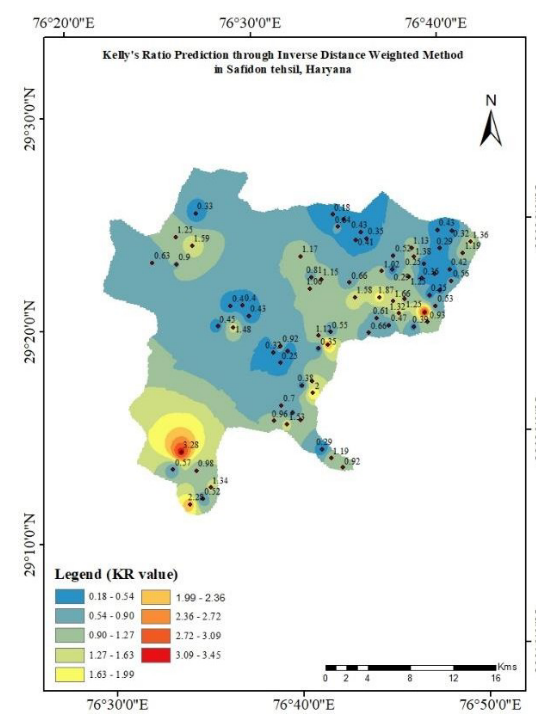



**Fig. 4.** Kelley's Ratio Predictive Map

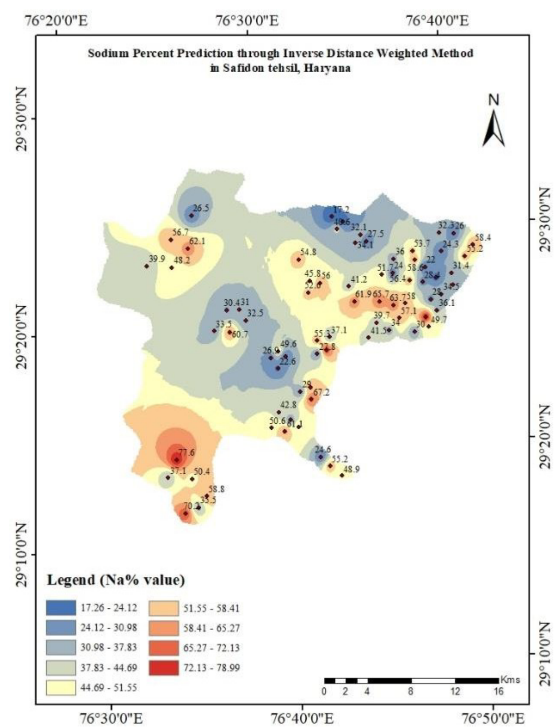



**Fig. 6.** Sodium Percent Predictive Map

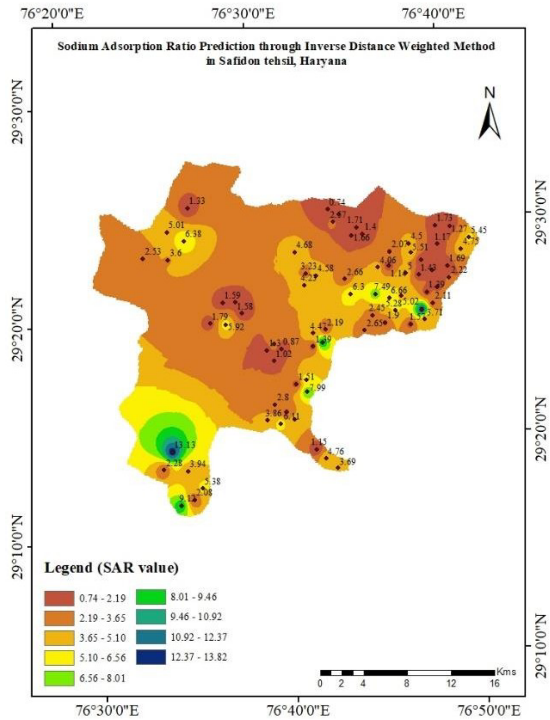



**Fig. 7.** Sodium Adsorption Ratio Predictive Map

**Table 4.** Kelley's Ratio and Irrigational Suitability

| Water Suitability according to Kelley's Ratio (1963) | Category | Percent of Sample |
|---|---|---|
| <1 | Suitable | 64% |
| >1 | Unsuitable | 36% |

the soil structure which cause an impact on the crop yield. The value more than 50 shows that the water is harmful and not suitable for irrigation. 18% of the samples lie in the suitable category and rest of 82% lie in the unsuitable category (Table 5).

**Table 5.** Magnessium Adsorption Ratio and Irrigational

| Water Suitability based on MAR (Ayers and Westcot, 1985) | Category | Percent of Sample |
|---|---|---|
| <50 | Suitable | 18% |
| >50 | Unsuitable | 82% |

**Sodium Percent (Na %) -** The value of Sodium Percent lies between "17.2 to 79.15" with a high variability depicted by standard deviation as 15.33. Only 2% of the samples lie in the Excellent category, 46% of the sample lie in the Good category, 36% of the sample lie in the Permissible category and rest of the 16% of the samples lie in the Doubtful category (Table 6).

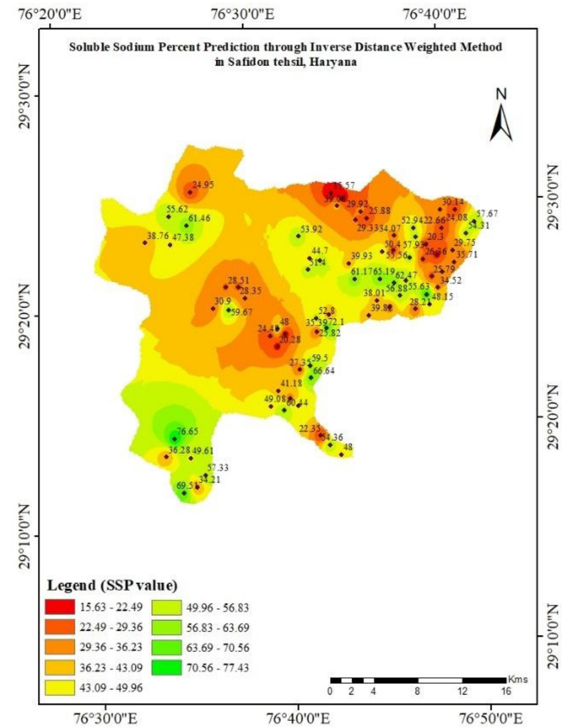



**Fig. 8.** Soluble Sodium Percent Predictive Map

**Table 6.** Sodium Percent and Irrigational Suitability

| Sodium Percent (Wilcox, 1955) | Category | Percent of Sample |
|---|---|---|
| <20 | Excellent | 2% |
| 20-40 | Good | 46% |
| 40-60 | Permissible | 36% |
| 60-80 | Doubtful | 16% |
| >80 | Unsuitable | NIL |

**Soluble Sodium Percent (SSP) -** The value of soluble sodium percent lie between "15.57 to 77.64" with a high variability depicted by standard deviation as 15.79. In the region 64% of the samples lies less than 50 which indicate good quality of water and suitable for irrigation purpose while remaining 36% are more than 50 which indicate the unsuitable water quality for irrigation (Table 7).

**Electrical Conductivity (EC) –** Electrical conductivity indicates the concentration of main ions and total dissolved solids in the water body and the high value of electrical conductivity affects both the struc-

**Table 7.** Soluble Sodium Percent and Irrigational Suitability

| Water Suitability based on SSP (Todd, 1980) | Category | Percent of Sample |
|---|---|---|
| <50 | Suitable | 64% |
| >50 | Unsuitable | 36% |

ture of the soil and crop yield. The value of Electrical Conductivity lies between "605 to 5540" with a high variability depicted by standard deviation as 760.47. Only 5% of the sample lie in Good category, 17% lie in the Permissible category, 22% of the sample lie I the Doubtful category and remaining 2% of the sample lie in the Unsuitable category (Table 8).

**Table 8.** Electrical Conductivity and Irrigational Suitability

| Water Suitability for Irrigation based on EC Values (Richards, 1954) | Category | Percent of Sample |
|---|---|---|
| <250 | Excellent | NIL |
| 250-750 | Good | 5% |
| 750-2000 | Permissible | 17% |
| 2000-3000 | Doubtful | 22% |
| Above 3000 | Unsuitable | 2% |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### Declaration of interest statement

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