Research Paper

Evaluating Pollution Potential of Irrigation by Domestic Wastewater on Fertile Soil Quality of Mamurabad Watershed Area near Jalgaon Urban Centre, Maharashtra, India

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Abstract

A water and soil quality investigation was carried out in the Mamurabad watershed area near the Jalgaon urban centre. Total six samples of soil and four samples of Wastewater of Lendi Nala were analyzed from the study area. Application of untreated sewage water for the irrigation purpose is the common practice in the study area. The main aim of this study was to investigate and correlate the adverse impacts on soil quality around the Mamurabad watershed area. The results showed that Electrical Conductivity (EC), Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), SO₄²⁻, Cl⁻, NO₃⁻ and some heavy metals such as Fe²⁺, Cu²⁺, were observed above the limit. The calculated values of Sodium Adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC) suggest the long-term use of untreated sewage will lead to some serious pollutional aspects and ultimately to the health of the peoples in the study area. Anthropogenic activities affect the variation of sewage quality. The social and economical development of the study area is closely associated with the hydrological networks of the study area.

Keywords: Wastewater, Soil, Irrigation, Mamurabad Watershed, Jalgaon

1. Introduction

Increasing scarcity of freshwater resources is deriving many countries in the arid and semi-arid regions to use marginal quality water for agriculture and related activities. The waste water used for agricultural purpose because it represents primarily a source of water and their nutrient content usually have fertilizers value for many crops which contribute to the improvement of the soil properties. The excessive input of wastewater in soil may likely lead to changes in physical and chemical characteristics of soil. It may also lead to loading of Nitrogen (N), Phosphorous (P), Potassium (K) and heavy metals in soil and ground water (Butt et al, 2005). It also contain a variety of pollutants including heavy metals and pathogens, which can potentially harm environment as well as human health (Blumenthal & Peasey, 2002). Soil may be defined as the naturally deposited unconsolidated material, which covers the earth's surface, whose chemical, physical and biological properties are capable of supporting plant growth (Chen et al, 2004). Soil is a product of natural decomposition forces and chemical and physical weathering forces acting upon native rocks, vegetation and animal matter over an extremely long period of time; in some cases literally thousands of years (Kachenko & Singh, 2006).

Soils, naturally, vary widely in their composition depending on their origin along with time and the natural forces involved in their formation process. Given the knowledge of the time required to develop a soil, it is of utmost importance that mankind use this natural resource
in cooperation with the laws of nature to optimize soil conservation (Peter & Adeniyi, 2011).

1.1. Nature of Urban and Suburban Soils

Urban and suburban soils are extensively modified by human activities. Industrialization and urbanization transformed a large percentage of the planet (Emongor & Ramolemana, 2004). World’s population increase and economical changes have increased urban population land. Urban and suburban landscapes may be extensively modified; however, the soils are preserving relics that allow tracing back and interpreting at least a part of the cities’ history: memory is an important feature of urban and suburban soils (Wang & Lu, 2011).

Human activities generate large amount of debris and organic and inorganic wastes, from domestic and industrial origin, that are often accumulated in landfill sites at the periphery of the sites (Toze, 2006). When cities are expanding, land use is considerably modified. Urbanization takes over natural soils as well as those former landfill and industrial sites that are rehabilitated to meet the need of urban development (Qishlaqi et al, 2008). Within the city limits, buildings are sometimes pulled down to develop new transit ways or other amenities, creating new open spaces that are again somewhat vegetated (Puskás et al, 2008).

During last 30 years, all over the world, there has been a massive anthropogenic change in the hydrological cycle of rivers and lakes affecting their quality, their potential as water resources and water budget (Minhas & Samra, 2003). Their spatial and temporal distribution is determined not only by natural climate variations but also by man’s economic activities. In many parts of the world, water resources have become so depleted and contaminated that they are already unable to meet the ever-increasing demands made on them (Bhardwaj & Singh, 2010). Much of irrigation depends on underground water supply, which is being pumped out more rapidly than they are being recharged. Water availability, water use efficiency and associated problems such as ground water depletion, Salinization, pollution, contamination, etc., are going to be serious in this millennium (Singh et al, 2009)

The study area faces the water scarcity problems due to less rainfall. This area comes under semi arid climatic zone with higher ambient temperature recorded in this region of Maharashtra state of India. The Jalgaon is bounded by latitude 21°00’00” to 21°04’30” E and 75° 41’00” to 75°50’00” N longitude (Figure 1). The area of Jalgaon city including extended Municipal limit is found to be about 13.38 sq. km. The city is situated about 204.20 meters above sea level Girma is the main river in Jalgaon flowing East-West direction. The maximum mean temperature 42.4 °C and minimum mean temperature 30.5 °C of the area under taken. Rainfall of Jalgaon is predominant in the monsoon season from June to September. The average annual rainfall in the region is 670 mm (Patil et al, 2010).

The study area is semi urban area of Jalgaon city. The area is one of the warmest, arid and dry are which having less rainfall and humidity. The total watershed area is 28 sq. km and the study area cover it is 12 sq. km.

The study area is covered by black cotton soil, which is dark black in colour and thickness is 0.40-2.0 meters. This soil has property of swelling up when wet and developing cracks due to shrinkage when dry. This is a very productive soil. The wastewater stream carries pollution load through city and Nala (Urban Stream) flows from the study area.

2. Methodology

The sampling was carried out to study the impact of wastewater on soil and water quality. The sampling locations were selected by considering the human activities and Nala surrounding agricultural field. The wastewater stream called Lendi Nala carries maximum load through the city. The agricultural soil of Mamurabad area is depending on the wastewater which flows from the Lendi Nala. This is due to less rainfall and high temperature in this area. By using this water, the soil and water quality get affected. Due to this activity, soil and water pollution increases day by day.
The soil sampling sites were selected horizontally from nearby wastewater stream. The sampling was done for the agricultural area. The soil samples were collected from at least six different spot keeping minimum 2 km distance in between two samples. During the soil, sampling each site is divided into five parts from, each part at the depth of 30 to 60 cm. The soil was collected and then mixed to obtain a homogeneous mixture. Standard sampling norms suggested by CPCB were followed during the soil sampling and site selection (Biswas, n.d.).

Wastewater sampling locations were selected which are near to the municipal solid waste dumping area in the city. Four water samples were collected from Neri Naka, Baliram Peth, Old Jalgaon City and Mamurabad Road. Standard sampling norms leads down by CPCB were followed during the wastewater sampling and site selection.

The soil and wastewater samples were analyzed in the laboratory immediately after the sampling process. The wastewater analysis was carried out according to Standard Methods by APHA & AWWA (1998) while soil analysis was carried out according to Saxena (1994) method. The soil quality parameters of agricultural soil were analyzed by physico-chemical methods. The parameters includes pH, electrical conductivity, specific gravity, water holding capacity, bulk density, organic carbon, organic matter, available phosphate, total phosphate, inorganic phosphate, nitrate calcium, magnesium, sodium potassium, sulphate, chloride, acidity, carbonate, bicarbonate, Sodium Adsorption Ratio (SAR), sodium percentage, exchangeable sodium percentage, soluble sodium percentage, RSC and permissible index.

3. Results and Discussion

The Nala water quality and soil quality data for sampling stations are summarized in Tables 1-5.

3.1. Sewage Quality Status

The water analysis data indicates that higher concentration of total solids, Ca, Mg, sulphates, phosphates and nitrates in the wastewater streams. Higher amount of chlorides present in wastewater stream indicates the human activity impact on the wastewater stream flowing through the urban areas. The average values of physicochemical parameters of Nala wastewater are presented in Table 1 during sampling it was observed that frequently the solid waste is directly dumped in the urban wastewater streams the result shows great correlation in the characteristics of urban wastewater streams and leachate generated at dump sites of solid waste.

The pH of urban wastewater streams ranged between 7.5 to 8.0. The urban wastewater stream shows hardness in the range of 1010 to 1012 mg/L. The COD of the wastewater ranged between 800 to 960. The lower values of BOD and COD were observed as compare to the pollution load reported in the leachate by Asano & Mills (1990). This may be due to the mixing of domestic wastewater in the leachate generated at the dumpsite. The higher amount of total solids (4960 mg/L) total dissolved solids (3073 mg/L)
and total suspended solids (1886.6 mg/L) were observed in the urban wastewater streams. Chlorides of wastewater ranged between 220 to 290 mg/L. Nitrate concentration in urban wastewater streams was 1 to 2 mg/L. The result shows higher load of pollutants viz. Hardness, BOD, COD, chlorides and nitrates (BIS, 1999 and WHO, 2004) in the urban wastewater streams at location ‘Mamurabad Watershed’. The characteristics of leachate generated at the dumpsite shows high pollution load. The present study reveals that the leachate generated in the dumps of solid waste is carrying large amount of pollution.

### Table 1. Physico-Chemical Characterization of Wastewater

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameters</th>
<th>Unit</th>
<th>W1</th>
<th>W2</th>
<th>W3</th>
<th>W4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>pH</td>
<td></td>
<td>7.92</td>
<td>7.79</td>
<td>7.93</td>
<td>7.84</td>
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<tr>
<td>2</td>
<td>EC</td>
<td>µScm⁻¹</td>
<td>3.67</td>
<td>3.17</td>
<td>3.73</td>
<td>3.79</td>
</tr>
<tr>
<td>3</td>
<td>Alkalinity</td>
<td>mg/L</td>
<td>622.4</td>
<td>641.9</td>
<td>681.8</td>
<td>688</td>
</tr>
<tr>
<td>4</td>
<td>Hardness</td>
<td>mg/L</td>
<td>1010</td>
<td>1110.66</td>
<td>1144.6</td>
<td>1166.6</td>
</tr>
<tr>
<td>5</td>
<td>Calcium</td>
<td>mg/L</td>
<td>117.7</td>
<td>90.33</td>
<td>118.76</td>
<td>92.46</td>
</tr>
<tr>
<td>6</td>
<td>Magnesium</td>
<td>mg/L</td>
<td>78.61</td>
<td>73.9</td>
<td>87.55</td>
<td>47.58</td>
</tr>
<tr>
<td>7</td>
<td>BOD</td>
<td>mg/L</td>
<td>246.3</td>
<td>383</td>
<td>388</td>
<td>253.3</td>
</tr>
<tr>
<td>8</td>
<td>COD</td>
<td>mg/L</td>
<td>823.3</td>
<td>943.3</td>
<td>983.3</td>
<td>958.6</td>
</tr>
<tr>
<td>9</td>
<td>TS</td>
<td>%</td>
<td>3106.6</td>
<td>4960</td>
<td>1706.6</td>
<td>2860</td>
</tr>
<tr>
<td>10</td>
<td>TDS</td>
<td>%</td>
<td>1960</td>
<td>3073.3</td>
<td>726.6</td>
<td>1226.6</td>
</tr>
<tr>
<td>11</td>
<td>TSS</td>
<td>%</td>
<td>1146.66</td>
<td>1886.6</td>
<td>980</td>
<td>1633.3</td>
</tr>
<tr>
<td>12</td>
<td>Chlorides</td>
<td>mg/L</td>
<td>264.63</td>
<td>220.56</td>
<td>333.2</td>
<td>288.73</td>
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<tr>
<td>13</td>
<td>Sulphate</td>
<td>mg/L</td>
<td>80.06</td>
<td>77.33</td>
<td>142.3</td>
<td>82.6</td>
</tr>
<tr>
<td>14</td>
<td>Phosphate</td>
<td>mg/L</td>
<td>15</td>
<td>16.66</td>
<td>13.33</td>
<td>12.33</td>
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<tr>
<td>15</td>
<td>Nitrate</td>
<td>mg/L</td>
<td>1.033</td>
<td>1.533</td>
<td>1.466</td>
<td>1.566</td>
</tr>
<tr>
<td>16</td>
<td>Sodium</td>
<td>mg/L</td>
<td>144.6</td>
<td>108</td>
<td>131.9</td>
<td>133.5</td>
</tr>
<tr>
<td>17</td>
<td>Potassium</td>
<td>mg/L</td>
<td>34.5</td>
<td>37.4</td>
<td>52.7</td>
<td>50.83</td>
</tr>
</tbody>
</table>

### Table 2. Characteristics Ratios of Wastewater

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameters</th>
<th>W1</th>
<th>W2</th>
<th>W3</th>
<th>W4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SAR (epm)</td>
<td>1.651</td>
<td>1.709</td>
<td>1.858</td>
<td>2.264</td>
</tr>
<tr>
<td>2</td>
<td>KR (epm)</td>
<td>0.403</td>
<td>0.443</td>
<td>0.438</td>
<td>0.68</td>
</tr>
<tr>
<td>3</td>
<td>Na% (epm)</td>
<td>34.9</td>
<td>32.2</td>
<td>35</td>
<td>45.4</td>
</tr>
<tr>
<td>4</td>
<td>ESP (epm)</td>
<td>11.01</td>
<td>11.72</td>
<td>13.41</td>
<td>14.59</td>
</tr>
<tr>
<td>5</td>
<td>SSP (epm)</td>
<td>28.76</td>
<td>30.72</td>
<td>30.38</td>
<td>4.5</td>
</tr>
<tr>
<td>6</td>
<td>PI (epm)</td>
<td>47.1</td>
<td>51.9</td>
<td>48.1</td>
<td>63.8</td>
</tr>
<tr>
<td>7</td>
<td>RSC (meq/L)</td>
<td>0.309</td>
<td>1.977</td>
<td>1.341</td>
<td>3.45</td>
</tr>
</tbody>
</table>

### 3.2. Soil Quality Status

The climate is the major environmental factor, which can affect the soil quality. Apart from the climate, urbanization is another anthropogenic source, which can affect the soil quality. Keeping these two points in mind, the project topic was selected. The major aim was to evaluate the soil quality in urban area in different climatic zones. The soil quality data shows the higher amount of sulphates and phosphates in the agricultural soil. Concentration of calcium, magnesium, carbonate, bicarbonate and chlorides reveals that these higher values are due to the direct application of untreated sewage water for the irrigation purpose in the agricultural soil. The heavy metals like Cu, Ni, Zn, Fe, Cd, Pb and Mn were found in soil samples. The increase in Cu, Fe, Ni, Zn, Pb and Mn content of the soil can lead to increased plant uptake of metals that may be injurious to human health (Rattan et al, 2005 & Kumar et al, 2007). The sodium percentage (Na %) is calculated by the following equation:

\[
\text{Na} = \frac{\text{Na}}{\text{Ca}+ \text{Mg}+ \text{Na}} \times 100
\]

The Na % in the area ranges from 32.2-45 % in the sewage water sample and in soil the Na % varies from 95.49-98.5 %. A high Na % causes de-flocculation and impairment of the tilth and permeability of soil. As per the Indian standards (BIS, 1999), maximum sodium recommended for irrigation water is 60%. The plot of analytical data in the Wilcox (1955) diagram (Figure 2) relating EC and Na % shows that the quality of water in study area is good to permissible level.
The total concentration of soluble salts in irrigation water can be categorized as low (EC ≤ 250 µScm⁻¹), medium (250-750 µScm⁻¹) high (75-2250 µScm⁻¹) and very high (2250-5000 µScm⁻¹). High salt concentration in water leads to formation of saline soil and high sodium concentration in water leads to development of alkaline soil. Excessive solutes in irrigation water are common problem in semi-arid areas, where water loss through evaporation is high. Salinity problems are common where drainage is poor and water table is close to the root zones of the plants. The sodium salts accumulate in the soil through capillary rise and evaporation. Sodium or alkali hazard in the use of water for irrigation is determined by the absolute relative concentration of cations and is expressed in terms of SAR estimated by the formula:

$$Na = \frac{SAR}{\sqrt{(Ca + Mg)/2}}$$

There is a significant relationship between SAR values of irrigation water and the extent to which sodium is adsorbed by the soils. If water used for irrigation is high in sodium and low in calcium the cation exchange complex may be saturated with sodium. This can destroy the soil structure due to the dispersion of clay particles. The calculated values of SAR in the sewage was in the range of 1.6-2.2 epm whereas soil of study area varies from 14.71-45.00 epm.

### 3.3. Residual Sodium Carbonate

The quantity of bicarbonate and carbonate in excess of alkaline sediments (Ca and Mg) also influence the suitability of water for irrigation purpose (Piper, 1953). When sum of the carbonates and bicarbonates is in excess of calcium and magnesium, it may be the possibility of complete precipitation of Ca and Mg (Raghunath, 1987).

### Table 3. Physico-Chemical Characterization of Soil

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Parameters</th>
<th>Unit</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
<th>S5</th>
<th>S6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bulk Density</td>
<td>gm/cm³</td>
<td>1.044</td>
<td>1.007</td>
<td>1.006</td>
<td>1.071</td>
<td>0.126</td>
<td>1.126</td>
</tr>
<tr>
<td>2</td>
<td>Specific Gravity</td>
<td>gm/cm</td>
<td>1.036</td>
<td>1.07</td>
<td>1.074</td>
<td>0.9</td>
<td>1.11</td>
<td>1.04</td>
</tr>
<tr>
<td>3</td>
<td>Moisture Content</td>
<td>%</td>
<td>3.29</td>
<td>2.47</td>
<td>3.78</td>
<td>2.96</td>
<td>2.80</td>
<td>3.35</td>
</tr>
<tr>
<td>4</td>
<td>W H C</td>
<td>%</td>
<td>0.858</td>
<td>1.603</td>
<td>0.135</td>
<td>0.053</td>
<td>0.115</td>
<td>0.064</td>
</tr>
<tr>
<td>5</td>
<td>pH</td>
<td></td>
<td>7.2</td>
<td>8.4</td>
<td>7.69</td>
<td>7.89</td>
<td>8.06</td>
<td>7.7</td>
</tr>
<tr>
<td>6</td>
<td>EC</td>
<td>µScm⁻¹</td>
<td>0.216</td>
<td>0.17</td>
<td>0.25</td>
<td>0.223</td>
<td>0.212</td>
<td>0.254</td>
</tr>
<tr>
<td>7</td>
<td>Organic carbon</td>
<td>%</td>
<td>1.38</td>
<td>2.44</td>
<td>0.33</td>
<td>1.41</td>
<td>1.38</td>
<td>1.05</td>
</tr>
<tr>
<td>8</td>
<td>Organic matter</td>
<td>%</td>
<td>2.37</td>
<td>4.2</td>
<td>0.56</td>
<td>2.43</td>
<td>2.37</td>
<td>1.81</td>
</tr>
<tr>
<td>9</td>
<td>In Phosphate</td>
<td>mg/gm</td>
<td>145.35</td>
<td>168.3</td>
<td>192.78</td>
<td>175.95</td>
<td>154.53</td>
<td>105.57</td>
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<tr>
<td>10</td>
<td>Total Phosphate</td>
<td>mg/gm</td>
<td>175.35</td>
<td>153</td>
<td>160.65</td>
<td>169.83</td>
<td>151.47</td>
<td>153</td>
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<td>11</td>
<td>Ava Phosphate</td>
<td>mg/gm</td>
<td>0.03</td>
<td>0.048</td>
<td>0.084</td>
<td>0.043</td>
<td>0.044</td>
<td>0.025</td>
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<td>12</td>
<td>Nitrate</td>
<td>mg/gm</td>
<td>12.6</td>
<td>1.47</td>
<td>8</td>
<td>9</td>
<td>6.5</td>
<td>11.5</td>
</tr>
<tr>
<td>13</td>
<td>Calcium</td>
<td>mg/gm</td>
<td>1.67</td>
<td>1.47</td>
<td>1.68</td>
<td>1.56</td>
<td>1.48</td>
<td>1.56</td>
</tr>
<tr>
<td>14</td>
<td>Magnesium</td>
<td>mg/gm</td>
<td>0.09</td>
<td>0.84</td>
<td>0.02</td>
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<td>0.2</td>
<td>0.14</td>
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<tr>
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<td>41.4</td>
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<td>16</td>
<td>Potassium</td>
<td>mg/gm</td>
<td>23.49</td>
<td>31.32</td>
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<td>70.48</td>
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<td>Sulphate</td>
<td>mg/gm</td>
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<td>17.8</td>
<td>24.8</td>
<td>14.18</td>
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<td>18</td>
<td>Chloride</td>
<td>mg/gm</td>
<td>21.3</td>
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<td>19</td>
<td>Phe. Acidity</td>
<td>mg/gm</td>
<td>184</td>
<td>360</td>
<td>136</td>
<td>224</td>
<td>308</td>
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<td>20</td>
<td>Total Acidity</td>
<td>mg/gm</td>
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<td>680</td>
<td>292</td>
<td>272</td>
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<tr>
<td>21</td>
<td>Carbonate</td>
<td>mg/gm</td>
<td>110.4</td>
<td>216</td>
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<td>134.4</td>
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<td>146.4</td>
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<td>22</td>
<td>Bicarbonate</td>
<td>mg/gm</td>
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<td>439.2</td>
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<td>273.2</td>
<td>375.7</td>
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<td>Texture: Silt</td>
<td>%</td>
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<td>16.1</td>
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<tr>
<td>24</td>
<td>Sand</td>
<td>%</td>
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<td>55</td>
<td>51.5</td>
<td>54.8</td>
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<td>55</td>
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<td>25</td>
<td>Gravel</td>
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<td>37.6</td>
<td>25</td>
<td>15.5</td>
<td>30</td>
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To quantify the effects of carbonates it is essential to highlight the results of Residual Sodium Carbonate (RSC) has been computed by the equation:

$$RSC = (HCO_3^- + CO_3^{2-}) - (Ca^{2+} + Mg^{2+})$$

Table 5. Heavy Metal Status in Soil Samples

<table>
<thead>
<tr>
<th>S. No</th>
<th>Metals (ppm)</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Copper</td>
<td>0.10</td>
</tr>
<tr>
<td>2</td>
<td>Nickel</td>
<td>0.25</td>
</tr>
<tr>
<td>3</td>
<td>Chromium</td>
<td>BDL</td>
</tr>
<tr>
<td>4</td>
<td>Zinc</td>
<td>0.12</td>
</tr>
<tr>
<td>5</td>
<td>Mercury</td>
<td>BDL</td>
</tr>
<tr>
<td>6</td>
<td>Arsenic</td>
<td>BDL</td>
</tr>
<tr>
<td>7</td>
<td>Iron</td>
<td>0.80</td>
</tr>
<tr>
<td>8</td>
<td>Cobalt</td>
<td>BDL</td>
</tr>
<tr>
<td>9</td>
<td>Cadmium</td>
<td>0.034</td>
</tr>
<tr>
<td>10</td>
<td>Manganese</td>
<td>0.33</td>
</tr>
<tr>
<td>11</td>
<td>Selenium</td>
<td>BDL</td>
</tr>
<tr>
<td>12</td>
<td>Lead</td>
<td>0.99</td>
</tr>
</tbody>
</table>

The high value of RSC in sewage water leads to an increase in adsorption of sodium in soil (Eaton, 1950). Water having RSC values greater than 5 meq/L are considered to harmful for the growth of the plants, while water with RSC values greater than 2.5 meq/L is not considered suitable for irrigation purpose. Most of the sewage water samples in study area are under the prescribed limit but one sewage sample having 3.45 meq/L RSC value was not suitable for the irrigation purpose.

From the Piper Trilinear Diagram (Figure 3), it is evident that all soil samples were falls in (HCO$_3^-$, CO$_3^{2-}$, Na$^+$, K$^+$) field and all water samples falls in the (Ca$^{2+}$, Mg$^{2+}$, Na$^+$, K$^+$) field.

Water and soil analysis data obtained have been study the understanding of suitability of water and soil for agriculture purpose. Some parameters like SAR, KR (Kelly’s Ratio), RSC, ESP (Exchangeable Sodium Percentage), PI (Permeability Index), SSP and Na% use for determine the water and soil quality for irrigation. SAR, KR, RSC, ESP values vary and more than limit so the soil and water is not suitable for irrigation purpose. Higher values of ESP indicate that cation and anion of soil are not in a steady state. This is due to precipitation of calcium and magnesium salts during evaporation process.

Correlation Coefficient matrix analysis shows the correlation between wastewater and soil.

The keen observation of the Nala water quality shows that there is strong evidence of migration of some anthropogenic parameters from Nala water such as calcium, magnesium, chlorides, sulphate, phosphate, nitrate, sodium, potassium to neighbourhood soil medium. The matrix reveals positive correlation in all the parameters. Table 6 clearly indicates that there is a strong correlation in phosphate and nitrates from Nala water to soil medium, followed by sodium, potassium, chlorides, calcium and magnesium.

4. Conclusion

The analysis of the fertile soil and untreated sewage water in the study area is the first kind of attempt to highlight the pollutional level. The result obtained from the preliminary study shows that, use of untreated sewage for irrigation purpose in the study area lead to change in the soil quality, in terms of pH, EC and cation exchange probably pose the potential health risk through consumption of affected food and vegetables. The soil quality is also differing due to municipal waste. The heavy metal concentration is also differing from place to place. The iron, copper and manganese are observed in soil samples. Thus some of little concentration of copper is observed in soil samples. The characteristics and indices reflect the soil and water quality for agricultural purpose. Thus soil of the area under study is somewhat problematic due to pollution status of Lendi Nala. The phosphate is also tending towards high concentration due to fertilizer and municipal waste. The
soil from the area is used for agricultural purpose. Thus soil and water quality pollution is increases day by day due to impact of human activities. Although the present severity of this situation is moderate but the long term application of untreated sewage will maximize soil contamination and low fertility problems of the agricultural soil in the study area.

The Correlation Coefficient between the soil and Nala water of the some major anthropogenic parameters shows the positive correlation.

So in the present scenario, it is very essential to minimize the negative impacts of untreated sewage in the study area, it is essential to implement the hard legislative standards

Figure 2. Wilcox Diagram

Figure 3. Sodium Adsorption Ratio (SAR)
for the irrigation purpose. Installation of integrated sewage treatment and recycling of sewage needs to be developed. In order to minimize the practices of application of untreated sewage for the irrigation purpose among the farmers, must have to remove the pumps along the bank of sewage streams coming out of the city areas.

References


