Impact of chemical fertilizers on water quality in selected agricultural areas of Mysore district, Karnataka, India

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ABSTRACT

Chemical fertilizers are used extensively in modern agriculture, in order to improve crop yield. However, nutrient leaching from agricultural soil into ground water and surface water cause a major environmental and public health concern. During present investigation, 24 water samples were collected from selected agricultural lands of Mysore District. The water samples were analyzed for fertilizer residues and physico-chemical characteristics. From the study it is concluded that, application of chemical fertilizers has severe impact on water quality. The pH of the ground water was found to be alkaline in some of the water samples. Nitrate and phosphate concentrations were found to be higher than the permissible limits of WHO standards, due to leaching and surface run off of chemical fertilizers from agricultural lands. In order to overcome water pollution problems, effective management of chemical fertilizers has to be implemented.

Keywords: Chemical fertilizers, Ground water, Lake water, Channel water, Nitrate, Phosphate.

1. Introduction

Agriculture is the single largest user of fresh water on a global basis, which is one of the route cause to degradation of surface and ground water through leaching and surface run off of nutrients from agricultural farm lands. Most of the current concern with regard to environmental quality is focused on water, because of its importance in maintaining the health of human and aquatic ecosystem. The addition of various kinds of pollutants and nutrients through the agricultural run off in to the water bodies brings about a series of changes in the physico-chemical characteristics of water. The composition of surface and groundwater is dependent on natural factors such as geological, topographical, meteorological, hydrological and biological factors which vary with, seasonal difference in run off volumes and weather conditions. Agricultural practices releases residues which may degrade the quality of the water resource. The extent and magnitude of the degradation is difficult to assess because of its non point source in nature. There is an extensive literature, which stress deterioration of water quality particularly due to application of chemical fertilizers. The present study carried out in the selected agricultural farm lands of Mysore District with the objective to assess the effect of chemical fertilizers like urea and diammonium phosphate to agriculture farm lands on surface and ground water quality.

2. Materials and Method

2.1 Study Area
Agriculture is one of the major occupations in Mysore District, which is located between latitude 11°45’ to 12°40’ N and longitude 75°57’ to 77°15’ E with annual rain fall of 782.0 mm. The total geographical area of the Mysore district covers about 6,76,382 hectares, out of which 3,42,852 hectares of land is used for agricultural purpose. During the past 15 years, the consumption of chemical fertilizers in Mysore was about 83,353 metric tones per year, out of which 50% contribution was from nitrogenous fertilizers, particularly urea. The commonly used chemical fertilizers in the study area are urea and diammonium phosphate, in addition to this, farmyard manures is also used. The average annual application rate of nitrogenous and phosphorous fertilizers is over 200-300 kg/ha of urea and 150-200 kg/ha of diammonium phosphate per cropping season, particularly in paddy cultivations. The soil types, which are predominant in the study, were found to be sandy clay loam, clay loam and sandy loam.

Table 1: Chemical fertilizer residues in water samples

| Sample No | Urea | DAP  | Sample No | Urea | DAP  | Sample No | Urea | DAP  |
|-----------|------|------|-----------|------|------|-----------|------|------|
| G-1       | 0.3  | 3.54 | L-1       | 3.4  | 5.07 | C-1       | 0.1  | 6.67 |
| G-2       | 1.2  | 3.77 | L-2       | 4.17 | 5.07 | C-2       | 0.4  | 5.70 |
| G-3       | 0.6  | 5.18 | L-3       | 4.86 | 5.07 | C-3       | 9.45 | 5.70 |
| G-4       | 2.6  | 5.89 | L-4       | 4.31 | 5.07 | C-4       | 8.48 | 5.70 |
| G-5       | 3.8  | 4.0  | L-5       | 5.42 | 5.07 | C-5       | 5.97 | 5.70 |
| G-6       | 4.2  | 5.18 | L-6       | 3.05 | 5.07 | C-6       | 3.33 | 5.70 |
| G-7       | 1.8  | 4.71 | L-7       | 2.92 | 5.07 | C-7       | 6.39 | 5.70 |
| G-8       | 1.5  | 3.06 | L-8       | 3.61 | 5.07 | C-8       | 3.05 | 5.70 |

Note: All values are expressed in ppm

Table-2: Physico-chemical characteristics of water samples collected around selected agricultural areas of Mysore district

Table-2: Ground water samples

| Parameters | WHO Standards | G-1 | G-2 | G-3 | G-4 | G-5 | G-6 | G-7 | G-8 |
|------------|---------------|-----|-----|-----|-----|-----|-----|-----|-----|
| pH         | 7.8-8.5       | 7.43| 7.49| 7.52| 7.09| 7.19| 8.92| 8.88| 8.67|
| EC         | 2500          | 969 | 1688| 980 | 1332.8| 1479| 775.2| 1387.2| 650 |
| TDS        | 500           | 620 | 860 | 520 | 910 | 750 | 560 | 880 | 380 |
| CO$_3$^-   | 50            | 130.8| 152.6| 109 | 109 | 109 | 165.5| 610.4| 109 |
| HCO$_3$^-  | 500           | 675.8| 392.4| 566.8| 457.8| 152.6| 436 | 828.4| 233.8|
| Ca$^{2+}$  | 100           | 172.34| 208.41| 180.36| 68.136| 196.3| 48.09| 56.11| 92.18|
| Mg$^{2+}$  | 150           | 90.82| 161.24| 94.45| 41.42| 103.34| 30.19| 30.19| 59.14|
| Cl         | 250-1000      | 1470.41| 1044.76| 2050.83| 773.9| 1431.71| 309.56| 1199.5| 425.64|
| DO         | 6.0           | 6.56| 7.43| 8.32| 6.32| 7.01| 7.12 | 7.21 | 6.45 |
| COD        | 10            | 14.78| 13.23| 14.28| 12.09| 16.08| 13.12| 10.32| 10.09|
| Na$^+$     | 200           | 440 | 540 | 660 | 390 | 240 | 500 | 680 | 400 |
| K$^+$      | 12            | 12  | 22  | 12  | 16  | 17  | 90  | 14  | 22  |
| NO$_3$^-   | 50            | 1650| 1400| 770 | 390 | 790 | 100 | 550 | 170 |
| PO$_4$^-   | 0.10          | 2.54| 2.71| 3.72| 4.23| 2.87| 3.72 | 3.38 | 2.20|

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Table 2.1: Lake water samples

| Parameters | WHO Standards | L-1 | L-2 | L-3 | L-4 | L-5 | L-6 | L-7 | L-8 |
|-----------|---------------|-----|-----|-----|-----|-----|-----|-----|-----|
| pH        | 7-8.5         | 8.31| 7.92| 8.02| 7.34| 7.98| 8.33| 7.94| 7.61|
| EC        | 2500          | 540.8| 285.9| 601.4| 1455| 1071| 785.7| 240| 970 |
| TDS       | 500           | 320.14| 140| 480| 740| 740| 480| 110| 527 |
| CO₃⁺      | 50            | 109| 65.4| 392.4| 109| 109| 43.6| 21.8|
| HCO₃⁻     | 500           | 414.2| 130.8| 784.8| 719.4| 588.6| 749.6| 196.2| 763 |
| Ca²⁺      | 100           | 20.04| 24.04| 64.12| 116.23| 80.16| 68.13| 36.07| 184.3|
| Mg²⁺      | 150           | 28.2| 14.51| 26.11| 53.29| 31.15| 43.67| 21.13| 75.39|
| Cl⁻       | 250-1000      | 309.56| 349.25| 232.12| 812.59| 889.98| 270.86| 1044.76| 1973.44|
| DO        | 6.0           | 7.32| 8.10| 7.45| 7.12| 7.90| 8.97| 6.43| 5.09|
| COD       | 10            | 10.53| 14.28| 11.43| 14.98| 13.21| 12.78| 6.23| 10.89|
| Na⁺       | 200           | 200| 100| 470| 440| 360| 350| 160| 580 |
| K⁺        | 12            | 60| 60| 80| 14| 14| 16| 90| 25 |
| NO₃⁻      | 50            | 240| 40| 540| 160| 40| 60| 40| 280 |
| PO₄³⁻     | 0.10          | 3.64| 2.99| 3.49| 3.09| 3.89| 2.19| 2.09| 1.87|

Table 2.2: Channel water samples

| Parameters | WHO Standards | C-1 | C-2 | C-3 | C-4 | C-5 | C-6 | C-7 | C-8 |
|-----------|---------------|-----|-----|-----|-----|-----|-----|-----|-----|
| pH        | 7-8.5         | 6.98| 7.59| 7.06| 7.47| 7.71| 7.76| 6.34| 6.94|
| EC        | 2500          | 540| 880| 320| 510| 500| 380| 370| 120 |
| TDS       | 500           | 176| 245| 109| 318| 298| 176| 269| 312 |
| CO₃⁺      | 50            | 64.2| 96.8| 114| 56| 197| 146| 36.3| 152.3|
| HCO₃⁻     | 500           | 176.2| 198.6| 214.2| 108.6| 208| 197| 166.2| 216.8|
| Ca²⁺      | 100           | 74.12| 64.65| 24.41| 56.21| 58.01| 92.12| 64.30| 88.11|
| Mg²⁺      | 150           | 36.02| 38.12| 16.41| 29.36| 28.91| 56.61| 46.23| 59.62|
| Cl⁻       | 250-1000      | 35.14| 97.00| 35.14| 23.89| 50.60| 36.55| 33.73| 29.52|
| DO        | 6.0           | 5.09| 6.56| 7.32| 7.23| 8.10| 6.78| 7.67| 6.76|
| COD       | 10            | 13.12| 14.06| 11.28| 11.37| 10.41| 10.08| 9.47| 9.97|
| Na⁺       | 200           | 34| 28| 239| 26| 38| 30| 45| 23 |
| K⁺        | 12            | 8| 5| 45| 4| 9| 7| 11| 15 |
| NO₃⁻      | 50            | 50| 50| 120| 40| 20| 90| 30| 80 |
| PO₄³⁻     | 0.10          | 4.79| 4.09| 6.79| 6.09| 4.29| 2.39| 4.59| 2.19|

Note: All the units are expressed in mg/l, except pH, conductivity (mmhos/cm).

2.2 Collection of water samples

Twenty four water samples were collected from selected agricultural lands of Mysore district, which includes ground water, lake water and channel water. The water samples were collected in pre-sterilized plastic containers. The urea residues were quantified by diacetyl monoxime method and diammonium phosphate residues were calculated by using amount of phosphate present in water sample, considering molecular weight of DAP and atomic weight of phosphate in DAP fertilizer. The pH and EC were measured by using pH meter and conductivity meter. Carboanates and bicarbonates were determined by titrimetric method. Calcium and magnesium were determined titrimetrically using standard EDTA method, sodium and potassium were determined by flame photometric method, chloride was determined by argentometric titration method. Nitrate was determined by phenoldisulphonic acid method.
2.3 Graphical representation of fertilizer residues and physico-chemical characteristics of water samples

1. Variation of Urea and DAP in Ground water

2. Variation of Urea and DAP in lake water

3. Variation of Urea and DAP in channel water

4. Variation of physico-chemical characteristics in ground water

5. Variation of physico-chemical characteristics in Lake water

6. Variation of physico-chemical characteristics in channel water

**Figure 1:** Graphs showing various characteristics of the water samples
2.4 Statistical analysis of physico-chemical characteristics with fertilizer residues.

### Table 3: Correlation matrix for Urea and DAP in ground water

|                     | Urea  | DAP   | EC   | pH   | TDS  | CO₂⁺ | HCO₃⁻ | Ca²⁺ | Mg²⁺ | Cl⁻ | DO   | COD  | Na⁺ | K⁺ | NO₂⁻ | PO₄³⁻ |
|---------------------|-------|-------|------|------|------|------|-------|------|------|-----|------|------|-----|----|------|-------|
| Urea 1              |  1    |  1    |  1   |  1   |  1   | -0.389|  0.944|  1   |  1   |  1   |  1   | -0.419|  1   |  1  |  1   |  1    |
| DAP 0.384           |  1    |  1    |  1   |  1   |  1   |  1   |  1    |  1   |  1   |  1   |  1   |  1   |  1   |  1  |  1   |  1    |
| pH 0.0030/1,911      |  1    |  1    |  1   |  1   |  1   |  1   |  1    |  1   |  1   |  1   |  1   |  1   |  1   |  1  |  1   |  1    |
| EC -0.369           |  1    |  1    |  1   |  1   |  1   |  1   |  1    |  1   |  1   |  1   |  1   |  1   |  1   |  1  |  1   |  1    |
| TDS -0.490          |  1    |  1    |  1   |  1   |  1   |  1   |  1    |  1   |  1   |  1   |  1   |  1   |  1   |  1  |  1   |  1    |
| CO₂⁺ -0.425         |  1    |  1    |  1   |  1   |  1   |  1   |  1    |  1   |  1   |  1   |  1   |  1   |  1   |  1  |  1   |  1    |
| HCO₃⁻ -0.932        |  1    |  1    |  1   |  1   |  1   |  1   |  1    |  1   |  1   |  1   |  1   |  1   |  1   |  1  |  1   |  1    |
| Ca²⁺ -0.892         |  1    |  1    |  1   |  1   |  1   |  1   |  1    |  1   |  1   |  1   |  1   |  1   |  1   |  1  |  1   |  1    |
| Mg²⁺ -0.892         |  1    |  1    |  1   |  1   |  1   |  1   |  1    |  1   |  1   |  1   |  1   |  1   |  1   |  1  |  1   |  1    |
| Cl⁻ -0.152          |  1    |  1    |  1   |  1   |  1   |  1   |  1    |  1   |  1   |  1   |  1   |  1   |  1   |  1  |  1   |  1    |
| DO -0.419           |  1    |  1    |  1   |  1   |  1   |  1   |  1    |  1   |  1   |  1   |  1   |  1   |  1   |  1  |  1   |  1    |
| COD -0.939          |  1    |  1    |  1   |  1   |  1   |  1   |  1    |  1   |  1   |  1   |  1   |  1   |  1   |  1  |  1   |  1    |
| Na⁺ 0.393           |  1    |  1    |  1   |  1   |  1   |  1   |  1    |  1   |  1   |  1   |  1   |  1   |  1   |  1  |  1   |  1    |
| K⁺ 0.487            |  1    |  1    |  1   |  1   |  1   |  1   |  1    |  1   |  1   |  1   |  1   |  1   |  1   |  1  |  1   |  1    |
| NO₂⁻ 0.500          |  1    |  1    |  1   |  1   |  1   |  1   |  1    |  1   |  1   |  1   |  1   |  1   |  1   |  1  |  1   |  1    |
| PO₄³⁻ 0.247         |  1    |  1    |  1   |  1   |  1   |  1   |  1    |  1   |  1   |  1   |  1   |  1   |  1   |  1  |  1   |  1    |
Similarly graphical representation of physico-chemical characteristics of different water samples are presented in graphs 4, 5, 6.

2.5.1. Urea: Urea is one of the nitrogenous fertilizers that have received wider attention in agriculture, because of its potential role for seedling damage, ammonia volatilization and water pollution problems. Urea enters surface and ground water through leaching and surface run off from agricultural lands. Its entry into ground water depends on physical properties of soil like texture. During the present investigation, in ground water, the urea residues ranged from 0.3 to 4.2 ppm, in lake water from 0.6 to 3.4 ppm and in channel water 0.1 to 0.12 ppm. Highest concentration of urea was reported in ground water and lowest in channel water.

2.5.2 Diammonium phosphate residues: The DAP residues in ground water range from a minimum of 3.06 ppm to a maximum of 5.18 ppm. In lake water, the DAP residues were from 2.92 to 5.42 ppm. In channel water the DAP residues were 3.05 to 9.45 ppm. Highest amount of DAP was reported in channel water, which is due to excessive run off of fertilizer from agricultural lands to near-by channels.

2.5.3 pH: pH is the measure of acidity or alkalinity of water. During the present study, pH of ground water samples ranged from a minimum of 7.09 to a maximum of 8.88. Similarly, in lake water, the variation of pH ranged from 7.34 to 8.51. In case of channel water, the pH values recorded were from 6.34 to 7.76. During the present investigation, the variation in values of pH was noticed, for both ground and lake water samples. Except G (6), (7), (8) and L (1), rest of water samples were found to be within the permissible limits of WHO standards. The results also show that, the alkaline pH is particularly due to presence of cations like Calcium, Magnesium and Sodium. This was in conformity with the findings of Azeez et.al (2000).

2.5.4 Electrical conductivity: Electrical conductivity is to measure capacity of water to carry electric current. It signifies the amount of total dissolved salts present in solution. During the present study, electrical conductivity of ground water ranged from a minimum of 650 to a maximum of 1688 mmhos/cm. Similarly, in lake water, the variation of EC was from 240 to 1455 mmhos/cm. In case of channel water the EC values were from 120 to 880 mmhos/cm. The EC values in all the water samples were found to be within the permissible limits of WHO Standards.

2.5.5 Total dissolved solids: The TDS of ground water ranged from a minimum of 380 to a maximum of 910 mg/l. In lake water, the variation of TDS was from 110 to 740 mg/l. In case of channel water, the TDS values were from 36.3 to 197 mg/l. High TDS values were reported in ground water and lowest for channel water.

2.5.6 Carbonates and bicarbonates: Alkalinity of water is the capacity to neutralize a strong acid and it is normally due to the presence of carbonates, bicarbonates and hydroxides of calcium and magnesium. The carbonate values in ground water ranged from a minimum of 109 to a maximum of 610.4 mg/l. In lake water, the variation of carbonates was from 21.8 to 392 mg/l. In case of channel water, the carbonate values recorded were from 36.3 to 197 mg/l. The bicarbonate values in ground water were from, a minimum of 152.6 to a maximum of 828.4 mg/l. Similarly, in lake water, the variation of bicarbonates was from 130.8 to 784.8 mg/l. In case of channel water, the bicarbonate value was from 98.7 to 216.8 mg/l. The total alkalinity values for all the water samples were found to be higher except L (7), (8) and C (7).
In case of bicarbonate values except G (1), (3), (7) and L (3), (4), (5), (6), (8) all water samples were found to be within the permissible limits.

2.5.7 Calcium and magnesium: Calcium and magnesium are directly related to hardness in water. The calcium and magnesium of ground water ranged from, a minimum of 48.09 to a maximum of 208.4 mg/l and 30.19 to 161.24 mg/l respectively. Similarly, in lake water calcium and magnesium ranged from 20.04 to 184.36 mg/l and 14.51 to 75.39 mg/l. In case of channel water, the values recorded were from 24.41 to 92.1 mg/l and 16.41 to 59.62 mg/l. The high concentration of calcium and magnesium in the above water samples was due to the dissolution of lime stone. During the present investigation except G (1), (2), (3), (5) and L (4), (8), all water samples were found to be within WHO standards. In G (2) the magnesium concentration was found to be above the permissible limits of WHO standards.

2.5.8 Chloride: Chloride occurs naturally in all types of water samples. Chloride in natural water results from agricultural activities or some times, it could be due to dissolution of chloride from chloride containing rocks. During the present study, the chloride values in ground water were from a minimum of 309.56 to a maximum of 2050.83 mg/l. Similarly, in lake water the variation of chloride were from 232.12 to 1973.44 mg/l. In case of channel water, the chloride concentration was from 20.89 to 97.00 mg/l. Except G (4), (6), (8), in all the water samples chloride was found to be above the permissible limits. In lake water, except L (7), (8), all water samples were found to be above the permissible limits.

2.5.9 Dissolved oxygen: During the present investigation the dissolved oxygen of ground water were from a minimum of 6.32 to a maximum of 8.32 mg/l. Similarly the dissolved oxygen in lake water were from a minimum of 5.09 to a maximum of 8.97 mg/l. The variation of dissolved oxygen of channel water was found to be from 5.09 to 8.10 mg/l. In all the sampling places, the dissolved oxygen content was found to be higher than the permissible limits, which indicates the presence of high oxygen content in water samples. The higher level of nutrient load and other factors result in decreased level of dissolved oxygen in water samples.

2.5.10 Chemical oxygen demand: Chemical oxygen demand determines the oxygen required for chemical oxidation of organic matter. During the present study, the COD in ground water were from a minimum of 10.09 to a maximum of 16.08 mg/l. Similarly, in lake water, the variation of COD values were from 6.23 to 14.98 mg/l. In case of channel water the COD concentration recorded were from 9.47 to 14.06 mg/l. COD conveys the amount of dissolved oxidisable organic matter including the non biodegradable matters present in it. The minimum values of COD in different water samples indicates low organic pollutants, while maximum concentration indicates higher concentration of pollutants.

2.5.11 Sodium and potassium: The sodium and potassium concentration in ground water ranged from a minimum of 240 to a maximum of 680 mg/l and 12 to 90 mg/l respectively. In lake water, the variation of sodium and potassium was from, 100 to 580 mg/l and 14 to 90 mg/l. In case of channel water, the sodium and potassium concentrations were from 23 to 239 mg/l and 4 to 49 mg/l respectively.

In Ground water and surface water, the potassium contamination can result from the application of potassium fertilizers greater than the required concentration. Potassium leaching from the soil is important from the perspective of plant nutrition. If fertilizer use and application to irrigation water exceeds the crop requirement, excess water will carry with it,
soluble salts including potassium, which were shown from, a significant correlation between urea and potassium for both ground and lake water with r-0.648 and r-0.806. This implies that, enrichment of potassium in surface and ground water is due to influence of urea fertilizers.

2.5.12 Nitrate: The nitrate concentration in ground water was from a minimum of 100 to a maximum of 1650 mg/l. In lake water, the variation of nitrate was from 40 to 540 mg/l. In case of channel water, the concentration recorded were from 20 to 120 mg/l. Except C (5) and (7) in all the water samples, nitrate concentration was found to be above the permissible limits. In the soil, when urea is applied, it gets transformed to ammonium (NH₄⁺) by soil enzymes, which tends to be strongly adsorbed on soil particles. This adsorption inhibits the movement of ammonium through the soil. Ammonium is an energy rich substance and certain soil bacteria can utilize this energy by decomposing the ammonium to nitrate (NO₃⁻). Unlike ammonium, nitrate is not adsorbed on soil particles and therefore, moves readily with water in the soil. Nitrate that is not taken up by plant roots or soil micro-organisms can be transported to ground and surface water by a variety of mechanisms.

2.5.13 Phosphate: The phosphate content in ground water was from a minimum of 2.20 to a maximum of 4.23 mg/l. In lake water, 1.87 to 3.89 mg/l of phosphate concentration was observed. In channel water from a minimum of 2.19 to a maximum of 6.79 mg/l. In the studied area, intensive crop production, continuous application of phosphate fertilizer and farmyard manure have been used at levels exceeding crop requirements. Highest phosphate concentration was reported in channel water, which indicated that, diammonium phosphate is the major source of enrichment of phosphate in water samples.

3. Statistical analysis

In this study, correlation analysis between various attributes of ground, lake and channel water with Urea and DAP residues were done and presented in Table 3, 4, 5.

A Correlation analysis is a bivariant method applied to describe the relation between two different parameters. Inter relationship between two parameters was carried out using Pearson correlation. A high correlation co-efficient (near +1 or -1) means a good relation between two variables, and its concentration around zero means no relationship between them at a significant level of 0.05 % level, it can be strongly correlated, if r≥0.7, where as r values between 0.5 to 0.7 shows moderate correlation between two different parameters.

In ground water samples, the Urea residues were strongly correlated with calcium and a moderate correlation with potassium and nitrate. A significant correlation was noticed between DAP and Phosphate which clearly implies that, phosphate enrichment is mainly due to phosphatic fertilizers. pH is moderately correlated with carbonates, chloride, COD, potassium, nitrate. Electrical conductivity strongly correlated with TDS, which indicates dissolved ions in ground water are responsible for EC. Carbonates moderately correlated with bicarbonates, COD and sodium, bicarbonates with sodium. Calcium is moderately correlated with magnesium and COD strongly correlated with dissolved oxygen, which indicates accumulation of pollutants, will affect dissolved oxygen level in water.

In lake water, Urea residues were strongly correlated with potassium and nitrate. DAP with phosphate, pH with conductivity, calcium, chloride. Conductivity and TDS with bicarbonates, calcium, magnesium, sodium, potassium. A strong correlation was noticed between carbonates and nitrate, bicarbonate with calcium, magnesium, sodium. Calcium moderately
correlated with magnesium, chloride, dissolved oxygen. Sodium was strongly correlated with calcium, magnesium was correlated with chloride, dissolved oxygen with sodium and potassium. Chloride and potassium are strongly correlated with DO.

In channel water, a moderate correlation was observed between calcium and dissolved oxygen which are strongly correlated with urea. Nitrate is moderately correlated with urea, calcium, magnesium and for sodium. A moderate correlation was reported chloride and nitrate with conductivity, TDS with sodium, potassium, nitrate, carbonates, and bicarbonates. Bicarbonates with calcium, magnesium, sodium, potassium and phosphate with magnesium. A moderate correlation was reported between DO and chloride. Sodium is strongly correlated with potassium, nitrate and phosphate. Potassium was strongly correlated with nitrate.

From the statistical analysis, it can be concluded that, cations like, calcium, magnesium, potassium and anions like phosphate and nitrate are found to be highly correlated with Urea and DAP. In Urea applied soil, nitrate ions were formed as end product after hydrolysis of Urea, which are not strongly adsorbed by the soil particles and will move down through soil profile. The negatively charged nitrate ions will carry positively charged basic cations, such as calcium, magnesium, sodium, and potassium in order to maintain electric charge on soil particles which will be ultimately leached to ground and surface water.

4. Conclusion

The present study confirms that, the application of chemical fertilizers has greater influence on water quality. Except L (7) and C (3), in all the water samples Urea residues were detected. Highest Urea residues was detected in G (10). In case of DAP residues, highest concentration was recorded in C(4). From the statistical analysis, it concluded that, for all the water samples nitrate was strongly correlated with urea, which indicates surface and ground water contamination is mainly due to nitrogenous fertilizers. Similarly phosphate was highly correlated with DAP; which indicates that DAP was the major source to enrich phosphate in surface and ground water. In case of physico-chemical characteristics, in majority of the water samples, total dissolved solids, carbonates, bicarbonates, calcium, magnesium, chemical oxygen demand, sodium and potassium were found to be in high concentration. In order to overcome water pollution problems, introduction of legislation by the state government restricting the application of chemical fertilizers, splitting of fertilizer dose at required concentration will help to reduce pollution of surface and ground water.

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