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Assessment of impact of fertilizer intrusion in agricultural land and ground water

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ABSTRACT

The greatest challenge of today's agriculture is to feed the growing population and restore the natural resources. Though by efficacy of artificial fertilizers there is an increase in productivity of crops which also has posed many environmental and health problems. High usage of chemical fertilizers for a long period of time results in adverse toxic effects on the production potential of the land. The intent of this paper is to cover some adverse effects of chemical fertilizers on the agricultural land and their intrusion on ground water also impact of excessive fertilizers on deterioration of soil quality. It is therefore most necessary to reduce the dependence on chemical inputs in agriculture. A particular area in Mannachanallur taluk, Trichirappalli district is chosen as a study area since agriculture was the major occupation which mainly depends upon the chemical fertilizers. The samples were collected every 30 days as the soil samples collected twice in a month for an interval of 15 days and the ground water sample for 30days where the crop cultivation ins made in a routine cycle. The soil characteristics where analyzed in Agricultural Department, Trichirappalli district and the following parameters like NPK content, pH, electrical conductivity, bicarbonate, chloride calcium, potassium, sodium, SAR, (Sodium Adsorption Ratio) irrigation type, etc., were found out for soil and ground water for a period of cultivation of various crops. The nutrient level gets fluctuated on every introduction of fertilizer & run-off happening which leads to the uneven presence of fertilizer and also degrades crop yielding also the soil properties, also majorly increasing the P, K values.

KEYWORDS: chemical fertilizers, groundwater contamination, soil fertility degradation

1. INTRODUCTION

Fertilization increases efficiency and obtains better quality of product recovery in agricultural activities. Non-organic fertilizers mainly contain phosphate, nitrate, ammonium and potassium salts. Fertilizer industry is considered to be source of natural radio nuclides and heavy metals as a potential source. However, in recent years, the consumption of fertilizers has increased exponentially throughout the earth, causing serious environmental problems. Fertilization may affect the accumulation of heavy metals in soil and plant system. On absorbing the fertilizers from the soil; they can enter the food chain. Thus, artificial fertilization practices lead to water, soil and air pollution. Forthcoming, more fertilizer will be used to obtain more products. Large amounts of chemical fertilizers used during the peak season, sounds dangerously polluted well water, especially water resources, crop production quality and quantity of product deteriorates. Due to high level usage of nitrogen based fertilizers sounds increment of amount of nitrate increase in drinking water and rivers. The transport of phosphorous fertilizer with the flow of surface results in the shoot up amount of phosphate may increase in drinking water and rivers. High level of Nitrogen fertilizer used plants grown in soils. It consists of carcinogenic substances such as nitrosamines, especially plants such as lettuce and spinach leaves are eaten. There are harmful accumulations of NO_3 and NO_2 .Large scale ecological losses were reported in crop land, grass land and forest land, such as soil erosion, soil alkalinity and salinity, micronutrient deficiency, water logging and fast depletion and contamination of ground water. As such, the cultivable lands have become sick by over-application of chemicals. Apart from over use of chemicals, equally important issue is imbalance in the application of fertilizers and pesticides which leads to change in soil environment and contribute to the degradation process.

Objective

- Assessing the fertilizer intrusion into the agricultural land and ground water
- Assessing the characterization of contamination sources & suggests remedial measures.

Study area: Tirucirappalli district is located at the center of Tamilnadu. The city consists of 11 taluk and the central coordinate of the district is 10o47'40.56"N and 78o41'6"E and it is located 88mm above the MSL in which Mannachanallur taluk is chosen as the study area since agriculture was the major occupation, which mainly depends upon the chemical fertilizer. A particular area was selected such that the crop production is done for various cultivable crops which made in a cycle.

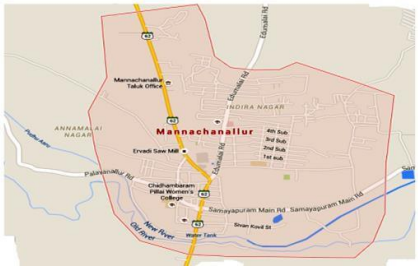

Figure.1.study area

The soil and water samples in that area were collected at a depth of one foot as 18 soil samples & three water samples per month in each 3 areas respectively. The samples were tested in the Agricultural Department, Trichy and the following parameters like nitrogen, phosphorous, and potassium content were analyzed in soil samples. In the ground water pH, electrical conductivity, bicarbonate, chloride calcium, potassium, sodium, SAR, (Sodium Adsorption Ratio) irrigation type, etc., were analyzed for a period of cultivation of various crops.

Observation: The nutrient NPK value such as nitrogen, phosphorous, potassium, were found normal on its barren land. During cultivation of dhal crop only urea is sprayed over and hence the nutrient values get fluctuated. After three months paddy cultivation is done such that urea, Di-Amonium Phosphate, Ammonium Nitrate NH_4NO_3, Urea NH_2CONH_2, Potassium Chloride/Muriate of Potash KCl, Triple Super Phosphate were sprayed on a ratio of 1:2:1 to increase the fertility level. Due to the improper irrigation practices causes cumulative and uneven presence of fertilizers degrading the soil fertility also the crop production. Ground water also affects by the infiltration of fertilizers. The ground water is gradually degrading on the increase amount of fertilizer intrusion could also degrade the drinking water. Excessive fertilization and mindless, but there were soil salinity, heavy metal concurrence, water eutrophication, and accumulation of nitrate to consider in terms of air pollution in the air of gases containing nitrogen sulphur giving and can lead to problems such as greenhouse effect. This study, aimed to unveil the environmental problems caused by improper fertilization. Indiscriminate and disproportion use of chemical fertilizers, especially urea along with in-organic fertilizers and deficiency of organic manures has led to considerable reduction in soil health. Large scale destruction was encountered in agricultural land such as soil erosion, soil salinity, micronutrient unavailability, water logging and contamination of ground water. According to the national remote sensing agency and forest survey 60% of the total area is extensively diminishing on a large part in the form of top soil. Disproportionate use of fertilizers often leads to the decline in soil fertility.

Consequences of conventional agriculture:

- Down turning of soil quality and reduction in agricultural productivity due to nutrient depletion, organic matter losses erosion etc.,
- Pollution of soil due to the high usage of fertilizers
- Soil salinization, depletion of ground water and fresh water resources and reduction of water quality due to unsustainable irrigation practices throughout the world.

Soil degradation is the major concern on the usage of the chemical fertilizers ie., conventional agriculture which leads to a sequence of degradation process such as erosion, soil contamination majorly due to fertilizers, heavy metals, excessive phosphate and nitrate, also loss of soil fertility mainly occur due to inappropriate use of fertilizers, water irrigation methods, application of fertilizers which leads to environmental pollution, also prolonged use of fertilized on high dosage results to deprive the soil also change the fertile into acidic nature.

Though the fertilizers increase the soil fertility at some cost and gives high yielding initially, the use of agro chemicals has also been with some important environmental and ecological damages. Improper and in appropriate use of chemical fertilizers also advances to soil deterioration. Imbalanced or excessive application of fertilizers is the main equitable for the ground water contamination.

Environmental risk due to soil pollution is of particular importance of agricultural areas, as extensive reliance on fertilizers for cultivation of crops have immensely resulted in the accumulation of various levels of heavy metals (Cd & Cu). In addition to that, larger usage of fertilizer to multiply the crop yielding out coming leaching to aquifer thereby pollutes the ground water. Nitrate can reach both surface water and ground water as an indiscriminant and faulty use of fertilizers the conflicts like soil salinity and alkalinity was formed.

2. RESULTS AND DISSCUSSIONS

Soil nutrient-nitrogen value: Available nitrogen status varied from 40.6(kg/ha)-124(kg/ha) which is low (see table.1) the sample values are represented in (chart.1) Low nitrogen status in the soils could be due to low amount of organic carbon in the soils.

Available nutrient status in the soils is generally classified as low, medium and high which are generally followed at the National level (Table-1).

Table.1.available nutrient status in soil

Soil Nutrients	Soil Fertility Ratings		
	Low	Medium	High
Organic carbon as a measure of available Nitrogen (%)	<0.5	0.5-0.75	>0.75
Available N as per alkaline permanganate method(kg/ha)	<280	280-560	>560
Available P by Olsen's method(kg/ha)in Alkaline soil	<10	10-24.6	>24.6
Available K by Neutral N, ammonia acetate method (kg/ha)	<108	108-280	>280

Soil nutrient-phosphorous value: The available phosphorus content varied from 1(kg/ha) – 28.5(kg/ha). According to table 1 40% of the sample values are in low category, also 50% in medium category and 10% in high category which does not give more effect to the soil. And it is represented in chart.2 Soil nutrient potassium Status of available potassium in the soils ranged between 61(kg/ha)-158 (kg/ha) and it is represented in chart.3. Most of the soil samples (64 %) were found under medium (108-240 (kg/ha)) range. And 36% of the sample are under low category. These low potassium leads to the low productivity of the crops. Test for pH the degree of acidity or alkalinity of water can be described by a pH value which ranges from 6.5-8.4 the covetable range of water pH is between 6.0 and 7.0 for irrigation. When the pH is outside of this range, it indicates that significant actions may need to be taken to improve crop performance.

Test for electrical conductivity (EC): EC is a measure of the degree in which water conducts electricity. It is determined by passing an electrical current through a water sample and recording the resistance in mmhos/cm or dS/m and it ranges from 0.85dS/m -1.12dS/m which is significant also, can increase to severe shortly. EC is used to estimate the concentration of TDS in water.

Test for Bicarbonate (HCO_3): Bicarbonate ($\mathbf{HCO_3^{-1}}$) and carbonate (CO_3^{-2}) are common constituents of irrigation water, and ranges from 5.2-6.9 me/l which is in severe condition. Bicarbonate levels above 3.3 me/l (200 ppm) will cause lime (calcium and magnesium carbonate) to be accumulating on foliage when inundated with overhead sprinklers. If bicarbonate and/or carbonate levels are high, these ions can react with calcium and magnesium in the soil to form insoluble calcium carbonate and magnesium carbonate (lime). This reaction scale down the amount of free calcium and magnesium in soil, allowing sodium to strive for and occupy negatively-charged exchange sites on clay particles.

Test for Chloride: Chloride subsidizes to salinity of irrigation water, and when concentrations are high enough, can be pernicious to plants. The sample values of chloride content which ranges from 2.1-4.9 meq/l ie., 74.5 ppm-173.95 ppm which is increasing significantly aim for reaching the higher value.

Test for Calcium: Calcium is the major component for the presence of hardness in water in which ranges from 2-5.8 meq/l ie. 40ppm -116 ppm which touches the high line

Test for sodium: Sodium in irrigation water can be absorbed by roots and foliage, and foliar burning can occur if sufficient amounts accumulate in leaf tissue. The sodium (Na+) cation is often found in natural waters due to its high solubility. When linked to chloride (Cl) and sulfide (SO4), sodium is often associated with salinity problems. High concentrations in the soil can adversely affect crops. Poor soil physical properties for plant growth will result as a consequence of continued use of water with high sodium levels. 0 – 50 ppm desired range. The sample values ranges from 1.2-4.17meq/l ie. 27.6 ppm -95.91 ppm which is above the desired range.

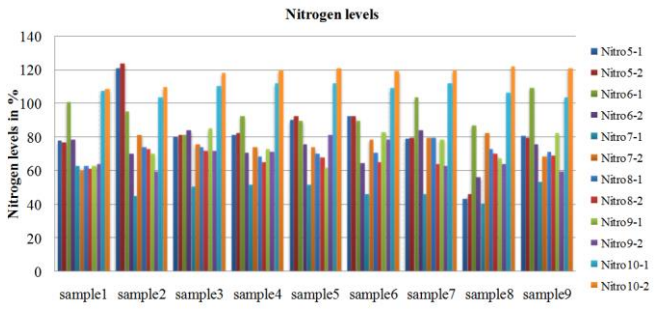

Chart.1.Test for nitrogen content in soil

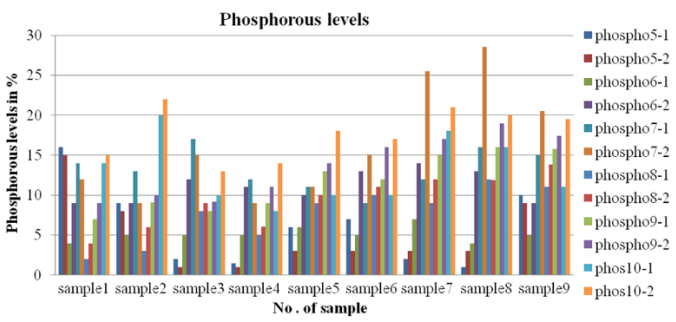

Chart.2.Test for phosphorous content in soil

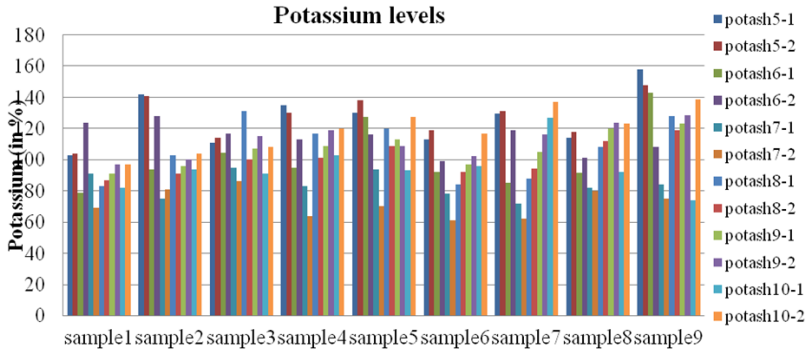

Chart.3.Test for potassium content in soil

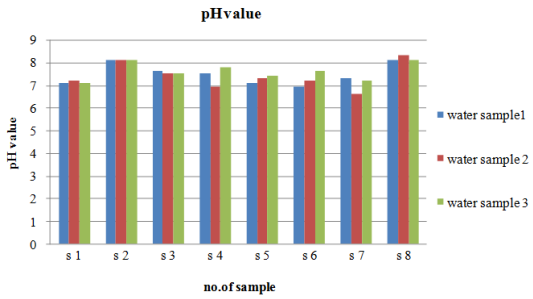

Chart.4.Test of pH value for water

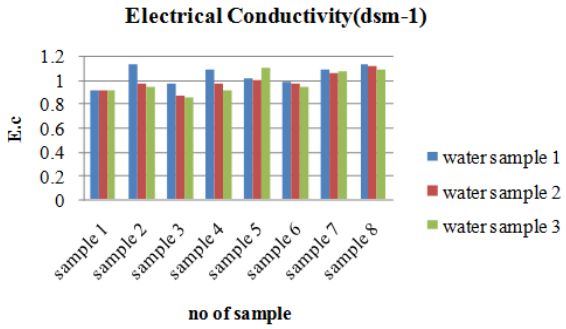

Chart.5.Test for EC for water

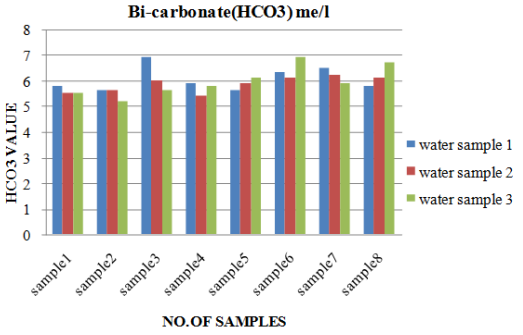

Chart.6.Test For (HCO3 -) FOR WATER

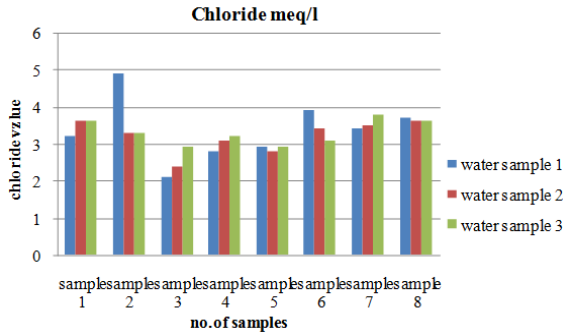

Chart.7.Test for Chloride for water

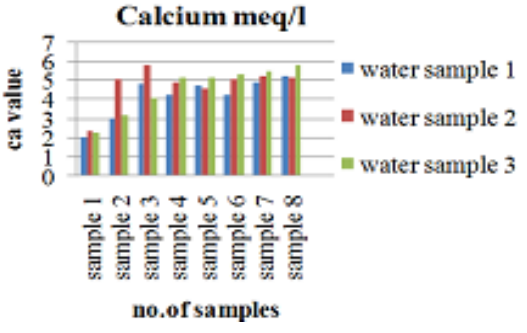

Chart.8.Test for calcium for water

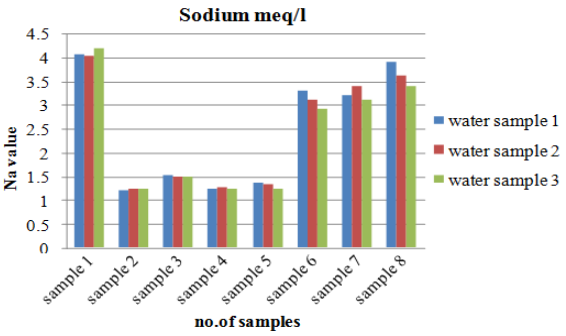

Chart.9.Test for sodium for water

3. CONCLUSION

From this study, the result of the collected sample indicates that on every introduction of fertilizer the nutrient content in the soil get fluctuated. Mainly phosphorous and potassium content in the soil has high values and goes on increasing in the soil causing increase in cadmium, fluoride, also lead, arsenic, mercury, chromium, nickel also left as residues in the soil. Decreasing concentration of elements such as iron, zinc, copper and magnesium in many foods over the last 50–60 years. Intensive irrigation practices, including the use of inorganic fertilizers are frequently

propounded as reasons for these backsliding and organic farming is often suggested as a solution. Although improved crop yields resulting from NPK fertilizers are known to dilute the concentrations of other nutrients in plants, much of the measured decline can be attributed to the use of deliberately higher-yielding crop varieties On irrigation to the cultivation land the fertilizers gets run-off which leads to the un-even or cumulative presence of fertilizer which reduces the crop yielding and the soil properties, which also intrude into the ground water table and change the properties if the ground water. Though the usage of fertilizers is essential in the agricultural technology for higher crop yielding on the occurrence of high amount of fertilizers will lead to the soil contamination and high environmental problems. For instance, increase in the greenhouse gases by n2o emissions etc., leaching of fertilizers also leads to in-filtration of fertilizers on the ground water table. Also improper introduction fertilizer without properratio and unsteady irrigation also contaminates the water sources nearby. The contribution to the contamination of ground water is the application of fertilizers to agricultural land and so the potential of the soil leach to ground wateron an element changes the water properties. On long term usage of fertilizers will gradually increases the elements in the water which exfoliate the soil and water quality also decrement the crop yield.

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