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Investigation of Physicochemical Parameters of Soil Irrigated by Waste Water (Sewage) in Sirsa City, Haryana, India

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Abstract

The current study in present paper has developed a correlative dynamics of sewage irrigation and biochemical alteration in water of Sirsa city, Haryana. The sewage irrigated crops and vegetables accumulate the heavy metals and other non biodegradable compounds in their body, especially in harvestable part which pose the risk to human population. In present discourse of study determine the physicochemical parameter along with some macronutrients in water, accumulation in edible part of plants due to sewage irrigation by using heavy metal profiling methods.

Keywords: Sewage Farming, physicochemical parameters, soil.

Introduction

The sewerage network has been built all over the city within the administrative boundary of Sirsa, which is home to 98% of the city's people. There are 4 STPs that are working, and together they can treat 45 MLD. Two of them are at Shamsabad Patti, near Kelniyan. They have 15 MLD and 20 MLD capacities, respectively. The other two are outside of the city in Nattar. Each of them can hold 5 MLD. Since March 2020, the 20 MLD STP has been working. The application of wastewater in the form of sewage and effluent into agricultural lands is a common practice throughout the world. Globally, 2 million sq km of land are irrigated with wastewater[1].

It is most evident in the peri-urban and suburban areas in developing countries. Furthermore, long-term irrigation with effluents is known to significantly contribute to elements such as Cd, Cu, Zn, Cr, Pb, and Mn in the surface soil of agricultural fields as well as enrich the physico-chemicals properties of soil[2].

The availability of nutrients and various elements in vegetables depends on soil properties like pH, organic carbon, and cation exchange capacity[3].

Materials and Methods

The study includes the effect of wastewater (sewage) irrigation practices in the Sirsa district of Haryana on the soil and grown vegetable crops. Precisely, in the study, the soil quality parameter of the irrigated agricultural land, and nutrients and heavy metal contents in the grown selected vegetable crops. The study took two selective sampling sites from the study area including a reference site (Site-R) and a wastewater irrigated site (Site-W). The (Table-1) showing the name of the sampling sites, its code, location, and GPS coordinates.

Table-1: The sampling sites and their GPS Coordinates.

Name of the Site	Code	GPS Co-ordinates
Reference Site (Chamal Catchment Area)	Site-R	29.586669, 74.965139
Wastewater Irrigated Site (Kelnia Catchment Area)	Site-W	29.534063, 74.963019

Soil Sample: The soil samples of the crop surrounding were taken by the soil sampling probe within the depth of 20 cm. From each sampling site 3 replicative soil samples were taken for the statistical significance.

Physico-chemical Properties: The physico-chemical properties of the soil were analysed by the standard methods given in the literature. The list of the physico-chemical parameters and its standard method is given in the Table-2. All these parameters are calculated as per stipulated methods mentioned in the manual, hand book[4].

Table-2: Physico-chemical parameters and its standard method for soil.

Physico-chemical parameters	Standard Method/Reference
pH	Digital pH Meter
Conductance	Digital Conductivity Meter
Bulk Density	5
Porosity	5
Particle Density	5

Water Holding Capacity	6
Salinity	7
Total Organic Carbon	8
Available Phosphorus	9
Available Nitrogen	10
Cation Exchange Capacity	8
Na Content (ppm)	11
K Content (ppm)	11
Ca Content (ppm)	11
Mg Content (ppm)	11

Table-3: Estimated light metal and its entangled emission reading wavelengths.

Metal	Emission Reading Wavelength
Sodium (Na)	589 nm
Potassium (K)	767 nm
Calcium (Ca)	422.7nm
Magnesium (Mg)	531 nm

Results and Discussions

The current study considered the three entities such as wastewater (sewage), cropland soil and vegetable crops; therefore the results of the analysis of these entities with standard methods and sampling techniques are represented.

The study found the significant variation among the different parameters of the water land. The results are systematically discussed in the successive appropriate headings.

Cropland Soil: Similarly, during the study, the samples of the wastewater (sewage) farming such as cropland soil (0-20 cm and 20-40 cm depths) were taken along the wastewater samples after every 15 days and analysed for the specified/given physico-chemical parameter. Likewise, the soil sampling was begun as the crops was initiated for farming and continued till the harvest was taken for sampling. It also took an almost four months duration. To know the impact on the broader scale and to get the consolidated value, the average value for each parameter was calculated for both the sampling sites separately. The physico-chemical parameters of soil (Average value) are presented in the table.

Table-4: Magnitude of various physico-chemical parameters in cropland soil.

Physico-chemical parameters	Site-R	Site-W
pH	8.8	8.1
Conductance (µS/cm)	790	840
Bulk Density (gm.cm^2)	1.42	1.15
Porosity	0.43	0.66
Particle Density (gm.cm^2)	2.24	1.85
Water Holding Capacity (%)	26.5	41.5
Salinity (gm/litre of Soil-water extract)	2.1	2.3
Total Organic Carbon (gm/kg)	19.5	32.5
Available Phosphorus (mg/kg)	14.6	29.8
Available Nitrogen (mg/kg)	20.5	26.2
Cation Exchange Capacity (cmol/kg)	12.1	16.3
Na Content (mg/kg)	440.5	520.0
K Content (mg/kg)	15.5	17.1
Ca Content (mg/kg)	3410	3420
Mg Content (mg/kg)	280.0	291.5

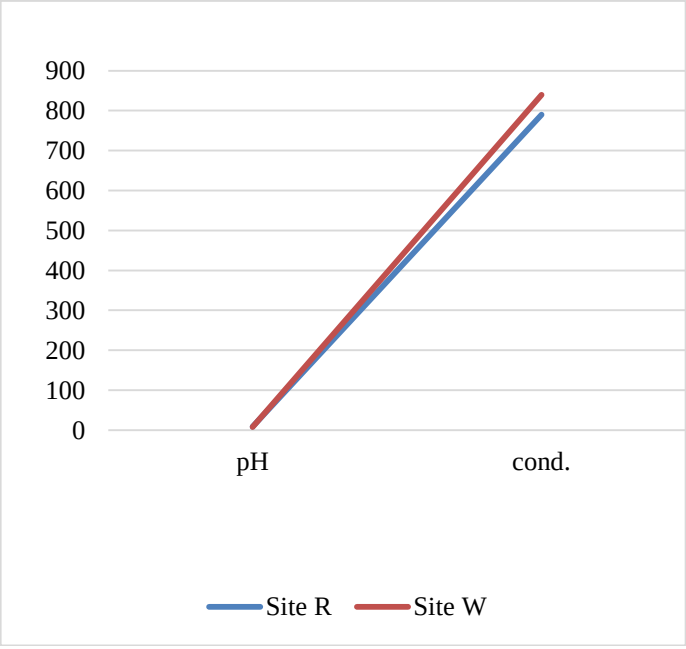

Figure-5: Magnitude of pH and conductance in cropland soil.

Figure-6: Magnitude of various soil quality parameters in cropland soil.

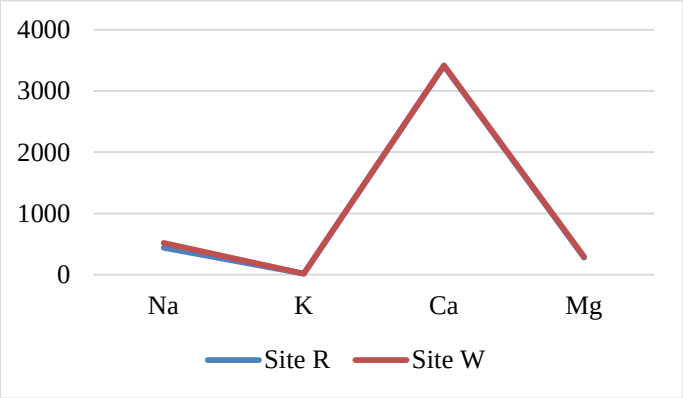

Figure-7: Magnitude of macronutrient metals in cropland soil.

pH: The investigation of the pH of the cropland soils of the both sampling sites, reveals that the soil of the canal water irrigated cropland (Site-R) holds the higher value of pH (8.8) and soil of the wastewater irrigated cropland (Site-W) holds the lower value of pH (8.1) (Table-4, Figure-5). The value of the pH of both sites are under the permissible range (Permissible-7 to 8.5).

Conductance: The investigation of the Conductance of the cropland soils of the both sampling sites, reveals that the soil of the canal water irrigated cropland (Site-R) holds the slightly lower value of Conductance (790µS/cm) and soil of the wastewater irrigated cropland (Site-W) holds the slightly higher value of Conductance (840µS/cm) (Table-4, Figure-5). The value of the conductance of wastewater irrigated cropland (Site-W) is higher than the permissible range (110-570µS/cm).

Bulk Density: The investigation of the Bulk Density of the cropland soils of the both sampling sites, reveals that the soil of the canal water irrigated cropland (Site-R) holds the higher value of Bulk Density (1.42 gm.cm^2) and soil of the wastewater irrigated cropland (Site-W) holds the slightly lower value of Bulk Density (1.15gm.cm^2) (Table-4, Figure-6).

Porosity: The investigation of the Porosity of the cropland soils of the both sampling sites, reveals that the soil of the canal water irrigated cropland (Site-R) holds the slightly lower value of Porosity (0.43) and soil of the wastewater irrigated cropland (Site-W) holds the slightly higher value of Porosity (0.66) (Table-4, Figure-6).

Particle Density: The investigation of the Particle Density of the cropland soils of the both sampling sites, reveals that the soil of the canal water irrigated cropland (Site-R) holds the higher value of Particle Density (2.24 gm.cm^2) and soil of the wastewater irrigated cropland (Site-W) holds the lower value of Particle Density (1.85 gm.cm^2) (Table-4, Figure-6).

Water Holding Capacity: The investigation of the Water Holding Capacity of the cropland soils of the both sampling sites, reveals that the soil of the canal water irrigated cropland (Site-R) holds the lower value of Water Holding Capacity (26.5%) and soil of the wastewater irrigated cropland (Site-W) holds the slightly higher value of Water Holding Capacity (41.5%) (Table 4, Figure-6).

Salinity: The investigation of the Salinity of the cropland soils of the both sampling sites, reveals that the soil of the canal water irrigated cropland (Site-R) holds the slightly lower value of Salinity (2.1 gm/l) and soil of the wastewater irrigated cropland (Site-W) holds the slightly higher value of Salinity (2.3 gm/l) (Table-4, Figure-6).

Total Organic Carbon: The investigation of the Total Organic Carbon of the cropland soils of the both sampling sites, reveals that the soil of the canal water irrigated cropland (Site-R) holds the lower value of Total Organic Carbon (19.5 gm/kg) and soil of the wastewater irrigated cropland (Site- W) holds the higher value of Total Organic Carbon (32.5 gm/kg) (Table-4, Figure-6).

Available Phosphorus: The investigation of the Available Phosphorus of the cropland soils of the both sampling sites, reveals that the soil of the canal water irrigated cropland (Site-R) holds the lower value of Available Phosphorus (14.6 mg/kg) and soil of the wastewater irrigated cropland (Site- W) holds the higher value of Available Phosphorus (29.8 mg/kg) (Table-4, Figure-6).

Available Nitrogen: The investigation of the Available Nitrogen of the cropland soils of the both sampling sites, reveals that the soil of the canal water irrigated cropland (Site-R) holds the lower value of Available Nitrogen (20.5 mg/kg) and soil of the wastewater irrigated cropland (Site-W) holds the higher value of Available Nitrogen (26.2 mg/kg) (Table-4, Figure-6).

Cation Exchange Capacity: The investigation of the Cation Exchange Capacity of the cropland soils of the both sampling sites, reveals that the soil of the canal water irrigated cropland (Site-R) holds the lower value of Cation Exchange Capacity

(12.1 cmol/kg) and soil of the wastewater irrigated cropland (Site-W) holds the higher value of Cation Exchange Capacity (16.3 cmol/kg) (Table-4, Figure-6).

Na Content: The investigation of the Sodium content of the cropland soils of the both sampling sites, reveals that the soil of the canal water irrigated cropland (Site-R) holds the lower value of Sodium content (440.5 mg/kg) and soil of the wastewater irrigated cropland (Site-W) holds the higher value of Sodium content (520.0 mg/kg) (Table-4, Figure-7).

K Content: The investigation of the Potassium content of the cropland soils of the both sampling sites, reveals that the soil of the canal water irrigated cropland (Site-R) holds the lower value of Potassium content (15.5 mg/kg) and soil of the wastewater irrigated cropland (Site-W) holds the slightly higher value of Potassium content (17.1 mg/kg) (Table-4, Figure-7).

Ca Content: The investigation of the Calcium content of the cropland soils of the both sampling sites, reveals that the soil of the canal water irrigated cropland (Site-R) holds the almost similar value of Calcium content (3410 mg/kg) with wastewater irrigated cropland (Site-W) (3420 mg/kg) (Table-4, Figure-7).

Mg Content: The investigation of the Magnesium content of the cropland soils of the both sampling sites, reveals that the soil of the canal water irrigated cropland (Site-R) holds the lower value of Magnesium content (280.0 mg/kg) and soil of the wastewater irrigated cropland (Site-W) holds the slightly higher value of Magnesium content (291.5 mg/kg) (Table-4, Figure-7).

Conclusion

The wastewater (sewage) irrigation practices in the Sirsa district of Haryana on the soil and grown vegetable crops by estimating the physico-chemical parameters and of the wastewater (Sewage) and cropland soil, properties of the soil in the grown selected vegetable crops magnitude of the Physico-chemical parameters in the wastewater that is used for irrigation in study area were found higher than the canal water. The magnitude of the Physico-chemical parameters in the soil of the wastewater irrigation cropland in study area were found higher than the canal water irrigation croplands.

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