ISSN 2277 – 8322

INVESTIGATING THE IMPACT OF SEWAGE FARMING ON GROUNDWATER AND AGRICULTURAL SOIL

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Abstract: Sewage farming, as a method of wastewater reuse in agriculture, presents both potential benefits for irrigation and concerns regarding its impact on groundwater and agricultural soil. To investigate the difficulties of sewage farming on groundwater quality and agricultural soil health. Through a combination of field observations, laboratory analyses, and statistical modeling, this research assesses the extent of contamination, identifies key pollutants, and evaluates their impact on soil fertility and groundwater quality. Through rigorous analysis and interpretation, this research provides valuable insights into the complex interactions between sewage farming, groundwater quality, and agricultural soil health. The findings underscore the need for improved management practices and regulatory measures to mitigate the adverse effects of sewage farming while promoting sustainable agricultural development. Additionally, recommendations are proposed for future research directions and policy interventions aimed at safeguarding water resources and enhancing soil productivity in regions practicing sewage farming.This study investigates the impact of sewage farming on groundwater quality and agricultural soil health. Utilizing wastewater for irrigation has become increasingly common due to water scarcity, yet its long-term effects on the environment and agriculture require thorough examination. This research evaluates groundwater and soil samples from regions practicing sewage farming, analyzing key parameters such as heavy metal concentration, nutrient levels, and microbial contamination. The findings reveal significant alterations in soil chemistry, including increased nutrient content and heavy metal accumulation, which pose potential risks to crop quality and human health. Groundwater analysis indicates varying degrees of contamination, highlighting the need for stringent monitoring and management practices. This study underscores the necessity for sustainable wastewater reuse strategies to precaution environmental and agricultural health, promoting a balance between resource utilization and ecological preservation.

Keywords: Sewage farming, Ground water, Agriculture soil health and Water pollution.

I. INTRODUCTION

Sustainable water resource management is increasingly crucial in addressing global challenges such as water scarcity and food safety. Some areas facing water shortage, the preparation of sewage farming, or utilize the treated wastewater for agricultural irrigation, has gained traction is potential solution to lessen water shortages and fulfill agricultural demands. However, the utilization of sewage for irrigation purposes raises concerns regarding its potential impact on groundwater quality and agricultural soil health.Sewage farming involves the application of wastewater, which contains various contaminants derived from domestic, industrial, and agricultural sources, onto agricultural lands. While wastewater irrigation offers an alternative water source for crop cultivation, it also introduces pollutants and nutrients into the soil ecosystem, potentially leading to soil degradation, groundwater contamination, and adverse effects on human health.The concerns of sewage farming on groundwater and agricultural soil are essential to fulfilling effective management strategies and ensuring the sustainability of agricultural practices.

Sewage

Sewage refers to wastewater containing a mixture of domestic, industrial, and commercial liquid and solid wastes, typically discharged from households, businesses, and institutions. It includes waterborne wastes from toilets, sinks, showers, washing machines, and industrial processes, as well as storm water runoff from streets and urban areas. Sewage may contain various contaminants such as organic matter, pathogens, nutrients (e.g., nitrogen and phosphorus), heavy metals, pharmaceuticals, and synthetic chemicals. Proper treatment of sewage is essential to remove or reduce these contaminants before discharge into water bodies or reuse for purposes such as irrigation, industrial processes, or groundwater recharge.

Sewage farming

Sewage farming, also known as wastewater irrigation or reclaimed water use in agriculture, is a practice where treated or untreated wastewater is utilized for irrigation purposes in agricultural lands. This approach has gained attention as a potential solution to address water scarcity challenges and meet the increasing demand for agricultural water. In sewage farming, treated wastewater from various sources, including domestic, industrial, and commercial activities, is applied to agricultural fields for crop cultivation. The wastewater may undergo treatment processes to remove contaminants and pathogens, or it may be used in its untreated form, depending on local regulations and treatment capabilities. The concept of sewage farming dates back centuries, with historical records indicating its use in ancient civilizations such as Mesopotamia and Egypt. However, modern sewage farming practices incorporate advanced technologies for wastewater treatment and management to ensure the safety of agricultural produce and minimize environmental impacts.

Groundwater Quality

In addition to supplying billions of people with their main source of drinking water, groundwater is essential to many ecosystems and farms. Many both artificial and natural components, including land use patterns, hydrology, geology, and pollution sources, have an impact on groundwater. With the goal of protecting aquatic systems, public health, and the supply of safe and drinkable water sources, it is essential to have extensive knowledge of groundwater quality.Geological formations, hydrological processes, and the chemical composition of underlying rock formations influence the natural quality of groundwater. Factors such as pH, hardness, alkalinity, and mineral content vary depending on geological conditions and groundwater recharge mechanisms. Groundwater quality may also be affected by natural contaminants such as arsenic, fluoride, and radionuclides, which can exceed safe drinking water standards in certain regions.Human activities, including agriculture, industry, urbanization, and waste disposal, significantly impact groundwater quality through the release of pollutants into the environment. Common contaminants found in groundwater include nitrates, pesticides, heavy metals, industrial chemicals, and drugs. It could result from indirect sources like urban storm water and agricultural runoff or from specific sources like treatment plants for sewage and industrial discharge.

Wastewater Irrigation

Wastewater irrigation is a practice where treated or untreated wastewater is used for agricultural purposes, primarily irrigation. This practice has become increasingly common in regions facing water scarcity as a means to supplement traditional water sources and sustain agricultural production. Because wastewater contains toxins, irrigation using it represents serious risks for the environment and human well-being, in addition to potential advantages for the purposes of agricultural productivity and water conservation.Wastewater irrigation helps alleviate pressure on freshwater resources by providing an alternative water source for agriculture. In water-stressed regions, where conventional water sources are limited or overexploited, treated wastewater can be a valuable resource for sustaining crop production and supporting rural areas. When used for irrigation, wastewater can serve as a source of nutrients, lowering the need for chemical manures for improving soil fertility. However, excessive nutrient application can lead to nutrient disparities in soil and water bodies, causing environmental problems such as eutrophication and algal blooms.

II. OBJECTIVES

- To investigate the soil parameters essential for farming that are affected by sewage water.
- To analyze the groundwater parameters impacted by sewage farming.
- To identify the key parameters that significantly influences groundwater properties.
- To examine the sewage generated from different locations of jaipur (Padampura, Barala and Muhana village).

III. METHODOLOGY

In this research work select three different locations to collect water samples from three different villages first is Padampura, second is Barala and last is muhana village. From each study area three different water sample point choose first location situated 1km away from center of sewage area, second location 10km away from sewage point and third one located at 20km away from sewage location.

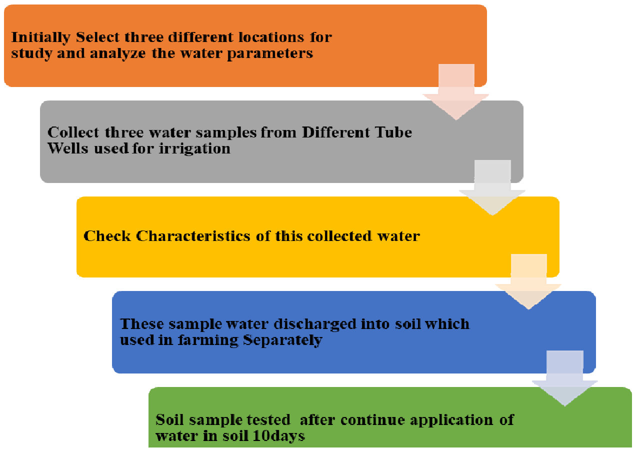

Figure 1. Flow chart of sample collection steps

Figure 2. Water sources situated in padampura village

Figure 3. Water sources situated in Barala village

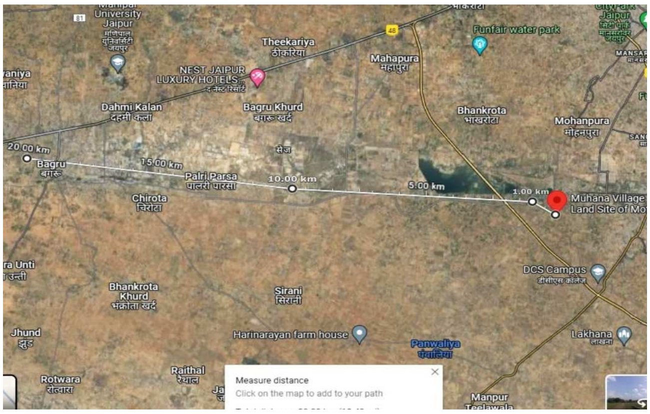

Figure 4. Water sources situated in Muhana village

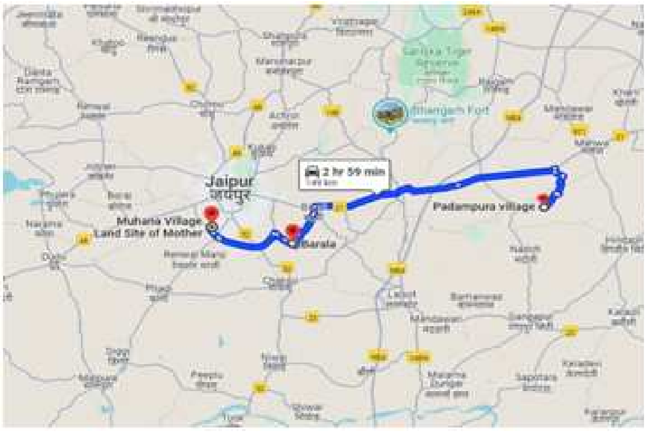

Figure 5. Area measurement of all three sites

Proposed Study

Sewage sludge may constitute nutrients that can be used as fertilizers to help plants grow more rapidly. Nitrogen, phosphorous, potassium, and sulphur are the significant nutrients found in sewage sludge, which may also contain some micronutrients. Though the utilization of sewage sludge will overcome the issue of STP sludge disposal, it can also be used to establish green belts in the STP's facilities and surrounding areas.The proposed study aims to investigate the impact of sewage farming on groundwater quality and agricultural soil health. By analyzing samples from areas practicing sewage farming, the research will assess the levels of contaminants, including heavy metals and pathogens, in both groundwater and soil. The study will also evaluate changes in soil properties such as nutrient content, pH, and microbial activity. Through a combination of field surveys, laboratory analyses, and comparative studies with non-sewage farming areas, the research seeks to provide a comprehensive understanding of the environmental and health implications of using treated sewage water for irrigation. The findings will offer valuable insights for policymakers and farmers regarding sustainable practices and potential risks associated with sewage farming.

Table 1. Sample of Soil used for testing

Sample	Details
Standard	Soil Without any addition
Soil Mix-1	Soil + Water from WS-1
Soil Mix-2	Soil + Water from WS-2
Soil Mix-3	Soil + Water from WS-3
Soil Mix-4	Soil + Water from WS-4
Soil Mix-5	Soil + Water from WS-5
Soil Mix-6	Soil + Water from WS-6
Soil Mix-7	Soil + Water from WS-7
Soil Mix-8	Soil + Water from WS-8
Soil Mix-9	Soil + Water from WS-9

Here, WS-1 = 1km Located in Padampura Village, WS-2 = 10km Away from Padampura Village, WS-3 = 20km Away from Padampura Village, WS-4 = 1km Located in Barala Village, WS-5 = 10km Away from Barala Village, WS-6 = 20km Located in Barala Village, WS-7 = 1km Located in Muhana Village, WS-8 = 10km Away from Muhana Village and WS-9 = 20km Away from Muhana Village.

IV. RESULTS AND DISCUSSION

Measurement of Water parameters

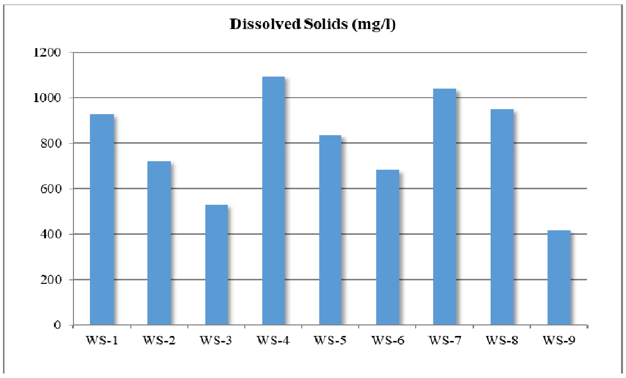

Figure 6. Dissolved solids in collected water samples from different locations

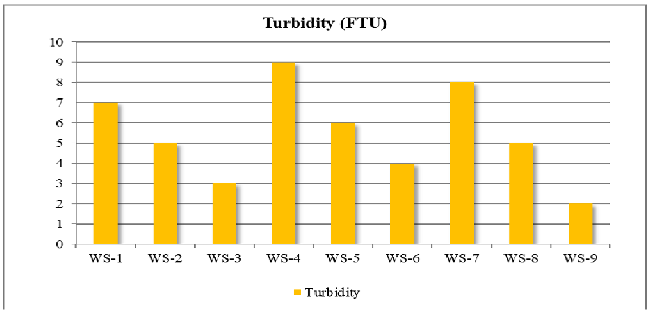

Figure 7. Turbidity of collected water samples from different locations

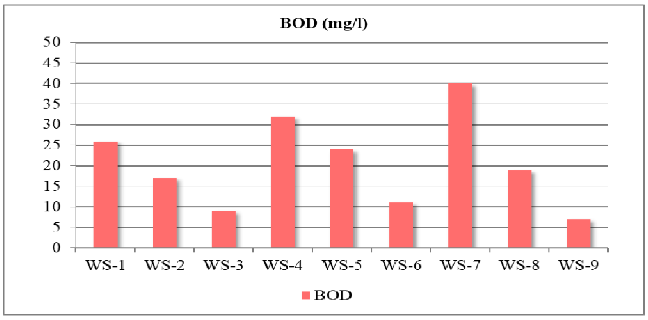

Figure 8. BOD of collected water samples from different locations

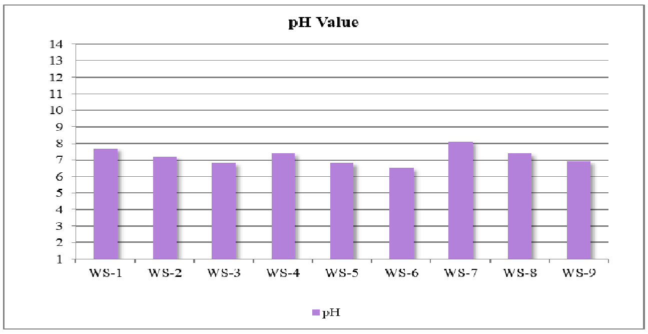

Figure 9. pH value of collected water samples from different locations

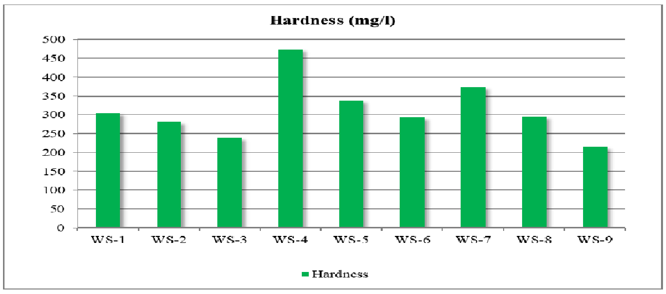

Figure 10. Hardness of collected water samples from different locations

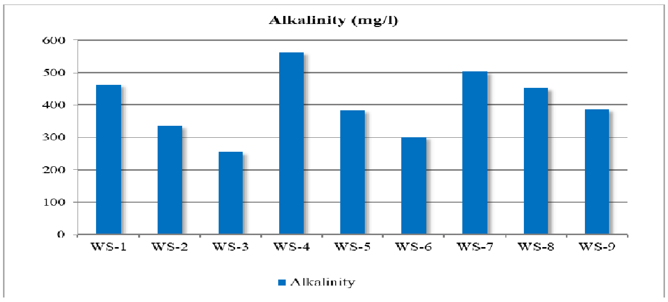

Figure 11. Alkalinity of collected water samples from different locations

Measurement of Soil parameters

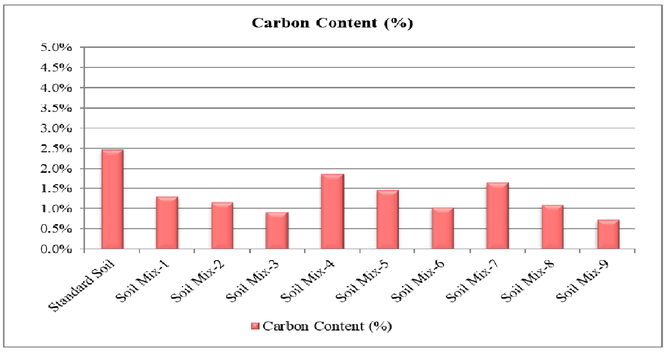

Figure 12. Presence of Carbon content in different soil samples

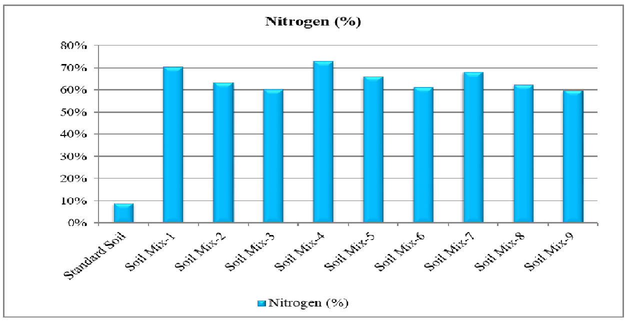

Figure 13. Presence of Nitrogen in different soil samples

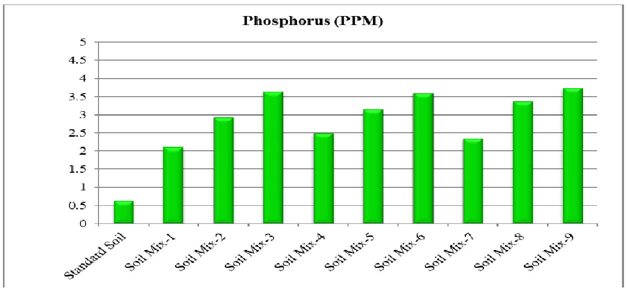

Figure 14. Presence of Phosphorus in different soil samples

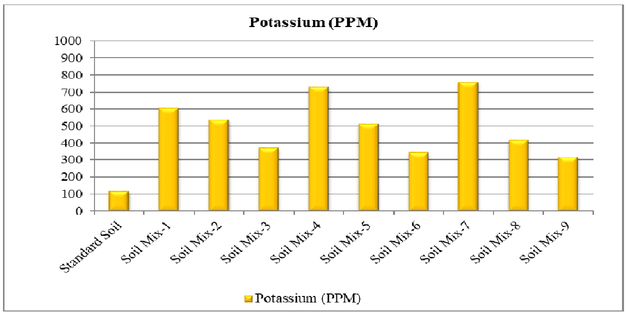

Figure 15. Presence of Potassium in different soil samples

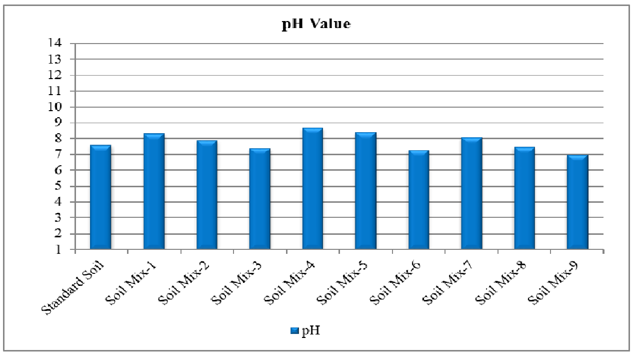

Figure 16. pH value in different soil samples

V. CONCLUSION

Water sample Parameters

- The highest concentration of dissolved solids, 928mg/liter, is found in water source-1, located 1km from the Padampura research area. The lowest concentration, 531mg/liter, is in water source-3, situated 20km away. Water source-2, positioned 10km from Padampura, has a concentration of 723mg/liter.
- Water source-1, 1km from Padampura, has the highest turbidity at 7FTU. The lowest turbidity, 3FTU, is recorded in water source-3, 20km away. Water source-2, 10km from Padampura, shows a turbidity level of 5FTU.
- The highest BOD level, 26mg/liter, is observed in water source-1, 1km from Padampura. The lowest BOD level, 17mg/liter, is found in water source-3, located 20km away. Water source-2, 10km from Padampura, has a BOD level of 9mg/liter.
- Water source-1, 1km from Padampura, has the highest pH value of 7.7. The lowest pH value, 6.8, is found in water source-3, situated 20km away. Water source-2, 10km from Padampura, records a pH value of 7.2.
- The highest hardness, 304mg/liter, is present in water source-1, 1km from Padampura. The lowest hardness, 238mg/liter, is in water source-3, located 20km away. Water source-2, 10km from Padampura, has a hardness value of 281mg/liter.
- Water source-1, 1km from Padampura, has the highest alkalinity at 462mg/liter. The lowest alkalinity, 254mg/liter, is observed in water source-3, situated 20km away. Water source-2, 10km from Padampura, shows an alkalinity value of 335mg/liter.
- The highest concentration of dissolved solids, 1096mg/liter, is found in water source-4, located 1km from the Barala research area. The lowest concentration, 682mg/liter, is recorded in water source-6, situated 20km away. Water source-5, positioned 10km from Barala, has a concentration of 835mg/liter.
- Water source-4, 1km from Barala, has the highest turbidity at 9FTU. The lowest turbidity, 4FTU, is observed in water source-6, 20km away. Water source-5, 10km from Barala, shows a turbidity level of 6FTU.
- The highest BOD level, 32mg/liter, is observed in water source-4, 1km from Barala. The lowest BOD level, 11mg/liter, is found in water source-6, located 20km away. Water source-5, 10km from Barala, has a BOD level of 24mg/liter.

- Water source-4, 1km from Barala, has the highest pH value of 7.4. The lowest pH value, 6.5, is found in water source-6, situated 20km away. Water source-5, 10km from Barala, records a pH value of 6.8.

- The highest hardness, 474mg/liter, is present in water source-4, 1km from Barala. The lowest hardness, 292mg/liter, is observed in water source-6, located 20km away. Water source-5, 10km from Barala, has a hardness value of 338mg/liter.

- Water source-4, 1km from Barala, has the highest alkalinity at 563mg/liter. The lowest alkalinity, 301mg/liter, is found in water source-6, situated 20km away. Water source-5, 10km from Barala, shows an alkalinity value of 383mg/liter.

- The highest concentration of dissolved solids, 1041mg/liter, is found in water source-7, located 1km from the Muhana research area. The lowest concentration, 416mg/liter, is recorded in water source-9, situated 20km away. Water source-8, positioned 10km from Muhana, has a concentration of 949mg/liter.

- Water source-7, 1km from Muhana, has the highest turbidity at 8FTU. The lowest turbidity, 2FTU, is observed in water source-9, 20km away. Water source-8, 10km from Muhana, shows a turbidity level of 5FTU.

- The highest BOD level, 40mg/liter, is observed in water source-7, 1km from Muhana. The lowest BOD level, 7mg/liter, is found in water source-9, located 20km away. Water source-8, 10km from Muhana, has a BOD level of 19mg/liter.

- Water source-7, 1km from Muhana, has the highest pH value of 8.1. The lowest pH value, 6.9, is found in water source-9, situated 20km away. Water source-8, 10km from Muhana, records a pH value of 7.4.

- The highest hardness, 373mg/liter, is present in water source-7, 1km from Muhana. The lowest hardness, 214mg/liter, is observed in water source-9, located 20km away. Water source-8, 10km from Muhana, has a hardness value of 395mg/liter.

- Water source-7, 1km from Muhana, has the highest alkalinity at 503mg/liter. The lowest alkalinity, 387mg/liter, is found in water source-9, situated 20km away. Water source-8, 10km from Muhana, shows an alkalinity value of 452mg/liter.

Soil sample parameters

- The carbon content in a standard soil sample is 2.46%, but it decreases after the addition of sewage water. When mixed with sewage water from Padampura, the lowest organic carbon percentage is 0.92% in soil mix-3. When mixed with sewage water from Barala, the lowest organic carbon percentage is 1.04% in soil mix-6. When mixed with sewage water from Muhana, the lowest organic carbon percentage is 0.74% in soil mix-9.

- The nitrogen content in a standard soil sample is 9%, but it increases after the addition of sewage water. When mixed with sewage water from Padampura, the highest nitrogen percentage is 70.51% in soil mix-1. When mixed with sewage water from Barala, the highest nitrogen percentage is 73.11% in soil mix-4. When mixed with sewage water from Muhana, the highest nitrogen percentage is 68.03% in soil mix-7.

- The phosphorus content in a standard soil sample is 0.63ppm, but it decreases after the addition of sewage water. When mixed with sewage water from Padampura, the highest phosphorus percentage is 3.64ppm in soil mix-3. When mixed with sewage water from Barala, the highest phosphorus percentage is 3.59ppm in soil mix-6. When mixed with sewage water from Muhana, the highest phosphorus percentage is 3.74ppm in soil mix-9.

- The potassium content in a standard soil sample is 118ppm, but it increases after the addition of sewage water. When mixed with sewage water from Padampura, the highest potassium percentage is 607ppm in soil mix-1. When mixed with sewage water from Barala, the highest potassium percentage is 731ppm in soil mix-4. When mixed with sewage water from Muhana, the highest potassium percentage is 759ppm in soil mix-7.

- The pH value in a standard soil sample is 7.6, but it increases after the addition of sewage water. When mixed with sewage water from Padampura, the highest pH value is 8.3 in soil mix-1. When mixed with sewage water from Barala, the highest pH value is 8.7 in soil mix-4. When mixed with sewage water from Muhana, the highest pH value is 8.1 in soil mix-7.

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