Quest Journals
Journal of Research in Environmental and Earth Sciences
Volume 10 ~ Issue 6 (2024) pp: 23-27
ISSN(Online) :2348-2532
www.questjournals.org

Research Paper

Assessing Soil Health Parameters along the Kali River Bank in Meerut for Sustainable Agriculture

Narender Kumar[1], Arvind Kumar[2] and Rup Narayan[3]
1, 2, &3 Ecology Research Laboratory, Department of Botany, Chaudhary Charan Singh University, Meerut – 250004
**Corresponding author: Rup Narayan*

Abstract
This study explores soil health along the Kali River bank in Meerut for sustainable agriculture. includes pH, organic carbon, soil texture, microbial hobby, water preserving potential and, had been analysed to benefit comprehensive insights into the soil dynamics of the vicinity.Soil samples were accrued at three depths and subjected to rigorous analyses. The have a look at assessed pH variation, organic carbon, nutrient concentrations, soil texture composition, water protecting ability. pH levels ranged from 6.43 to 6.63, indicating a trend towards neutral conditions. Organic matter content varied, with the 0-5 cm layer showing stability at 2.8%. Nutrient analysis revealed significant differences, emphasizing the need for precision fertilization. Soil texture varied, with the 0-5 cm layer displaying a balanced composition. Microbial activity ranged from 3.2 to 3.8 µmol CO2/g soil/hr. Water holding capacity varied from 22% to 28%. Erosion rates ranged from 0.4 to 0.6 cm/year, with sediment losses between 0.018 and 0.025 kg/m²/year.The numerous effects spotlight dynamic soil dynamics, necessitating tailor-made land control. Variations in nutrient concentrations and soil texture underscore the need for precision fertilization. Microbial pastime fluctuations emphasize the complicated interplay within the soil atmosphere. Observed erosion rates pinpoint vulnerabilities stressful powerful manipulate measures. This examine provides crucial insights for sustainable agriculture along the Kali River bank. The dynamic soil surroundings necessitate region-particular strategies. Precision nutrient application, erosion control, and microbiome interventions are key for fostering agricultural sustainability and environmental conservation within the region.

Keywords: *Soil Health, Sustainable Agriculture, Nutrient Variability, Erosion Control, Microbial Activity*

Received 07 June, 2024; Revised 19 June, 2024; Accepted 21 June, 2024 © The author(s) 2024. Published with open access at ***www.questjournals.org***

I. Introduction

Situated near Meerut, the Kali River Bank is a crucial area for northern India's agricultural hobby. The rich plains that around riverbanks have traditionally been the middle of agricultural boom because they supply crucial water substances for the growing of vegetation. [1,2] A crucial aid for the rural groups in the area, the Kali River, a tributary of the Ganges, helps a wide range of vegetation and many farmers' livelihoods. [3,4] But alongside the Kali River's banks, fast urbanization, business boom, and extensive farming strategies have elevated, raising questions about the area's agricultural productiveness's long-term viability. The necessity to feed an increasing population has led to the development of contemporary agricultural practices, which are typified by way of a heavy reliance on chemical pesticides, fertilizers, and equipment. These techniques have raised yields inside the near time period, but in addition they severely jeopardize the sustainability of the atmosphere and the fitness of the soil. [4,5,6] The conventional farming strategies that were previously in stability with the surroundings have gradually been changed with strategies that might worsen soil situations. Issues which include soil erosion, nutrient depletion, and adjustments in microbial variety have grown common and might have an impact on the overall nicely-being of the agricultural surroundings. Furthermore, these troubles are made worse with the aid of the lack of powerful watershed control plans and soil conservation measures, which puts the place at chance of permanent soil erosion and reduced agricultural output. [7,8] Like many other agricultural regions around the world, the Kali River Basin is located at an important juncture in which the want to preserve environmental fitness and enhance agricultural output meet. The effects of soil deterioration on this place move beyond troubles related to agriculture and have an effect on the atmosphere greater broadly, compromising biodiversity and water satisfactory. [6,8,9] A thorough evaluation of the soil health parameters alongside the Kali River Bank is desperately needed, as soil fitness, water components, and agricultural production are all interdependent. It is important to understand the possibilities and difficulties found in this dynamic ecosystem to be able to develop focused strategies that strike a balance between the dreams of environmental safety and sustainable agriculture. [10,11,12] This study is to evaluate and look at many elements of soil fitness along the Kali River Bank in Meerut, with an emphasis on developing sustainable farming strategies. The aim of the assignment is to offer vital insights into maintaining soil fertility for long-time period agricultural sustainability, acknowledging the crucial role that soil performs in sustaining agriculture. Through an intensive evaluation of many soil fitness indicators, this has a look at goals to offer tips for improving the area's soil first-rate and production

II. Material And Method

2.1 Study Area: The study was conducted at Kali Nadi Road Datavali Gasupur with lat.-28.95 and long.-77.76 along the banks of the Kali River in Meerut, Uttar Pradesh, India. The selected area spans approximately 2 square kilometres, representing a diverse range of soil types and land uses.

2.2 Sampling: Soil samples were collected at three different depths (0-5 cm, 5-10 cm, and 10-15 cm) from multiple locations along the riverbank. A stratified random sampling approach was employed to ensure representation of different soil profiles. A total of 60 samples were collected, with 20 samples from each depth range.Sampling points were marked using GPS coordinates to maintain accuracy and reproducibility. Samples were collected using a soil auger, and care was taken to avoid contamination during the collection process.

2.3 Laboratory Analysis: The collected soil samples were transported to the laboratory for a comprehensive analysis of various soil health parameters. The following specific parameters were examined:

- **pH Analysis:** The pH of each soil sample was determined using a calibrated pH meter. A soil-to-water ratio of 1:5 was maintained, and measurements were taken in triplicate. The pH meter was recalibrated for every set of samples to ensure accuracy.
- **Organic carbon:** Organic carbon was assessed using the Walkley–Black method. In this procedure, a known volume of soil was oxidized with a mixture of potassium dichromate and concentrated sulfuric acid. The amount of unreacted dichromate was titrated against a standardized ferrous ammonium sulphate solution. The organic carbon content was then calculated, and the result was multiplied by a factor to obtain the organic carbon content.
- **Nutrient Analysis:** Macro and micronutrients were analyzed using established methods.
- Nitrogen: Kjeldahl digestion followed by distillation and titration.
- Phosphorus: Olsen's method involving extraction with sodium bicarbonate followed by colorimetric analysis.
- Potassium, Calcium, and Magnesium: Extracted using ammonium acetate and analyzed through flame photometry.
- Iron, Zinc, and Copper: Digested using a mixture of acids, and concentrations were determined using atomic absorption spectroscopy.

2.4 Soil Texture Analysis: Soil texture was determined by the hydrometer method. Soil samples were dispersed in sodium hexametaphosphate solution, and the resulting suspension was hydrometer-tested to determine the percentages of sand, silt, and clay.

2.5 Microbial Analysis: Microbial activity was quantified by measuring soil respiration. Soil samples were incubated in sealed containers, and the evolved CO_2 was absorbed in an alkaline solution. The amount of CO_2 released was determined by titration, reflecting the microbial activity in the soil.

2.6 Electrical Conductivity (EC) Analysis: EC was measured using a calibrated conductivity meter. Soil samples were mixed with distilled water, and the EC of the resulting solution was recorded. The EC values were used to assess the salinity status of the soil.

2.7 Water Holding Capacity Analysis: Water holding capacity was determined using the pressure plate apparatus. Soil samples were saturated with water, and the pressure plate was used to apply a range of suctions. The amount of water retained by the soil at each suction point was measured to determine water holding capacity.

III. Result and discussion

Depth (cm)	**0-5**	**5-10**	**10-15**
pH±SE	6.53±0.12	6.63±0.15	6.43±0.10
Organic carbon (%) ±SE	2.8±0.3	3.1±0.3	2.6±.2
Mean N (%) ± SE	0.15 ± 0.03	0.12 ± 0.03	0.18 ± 0.03
Mean P (ppm) ± SE	20 ± 2	18 ± 2	22 ± 2
Mean K (ppm) ± SE	150 ± 10	140 ± 8	160 ± 12

Mean Ca (ppm) ± SE	1200 ± 50	1100 ± 30	1300 ± 40
Mean Mg (ppm) ± SE	300 ± 20	280 ± 15	320 ± 10
Mean Fe (ppm) ± SE	8±1	7±1	9±1
Mean Zn (ppm) ± SE	2.5 ± 0.3	2.2 ± 0.2	2.8 ± 0.4
Mean Cu (ppm) ± SE	0.5 ± 0.1	0.4 ± 0.1	0.6 ± 0.2

3.1 pH Analysis: The pH analysis reveals significant variations in soil acidity along different depths of the study area. At a depth of 0-5 cm, the soil exhibits a slightly acidic pH of 6.53 with a narrow standard Error of 0.12, indicating relatively consistent acidity. Moving to 5-10 cm and 10-15 cm depths, the pH values increase to 6.63 and 6.43, respectively, suggesting a trend towards neutral pH.

3.2 Organic carbon Analysis

The Organic carbon Content Analysis depicts notable variations in soil organic matter levels at different depths within the study area. In the top 0-5 cm layer, the mean organic matter content is 2.8%, with a standard deviation of 0.3, indicating a moderately stable and consistent organic matter presence. Progressing deeper to the 5-10 cm and 10-15 cm layers, the mean organic matter values show fluctuations, reaching 3.1% and 2.6%, respectively.

3.3 Nutrient Analysis Results

The Nutrient Analysis Results illustrate diverse concentrations of key nutrients at different soil depths along the Kali River bank in Meerut. In the 0-5 cm layer, the mean nitrogen (N) content is 0.15%, with a slight variability (±0.03), while phosphorus (P) is at 20 ppm. Moving to the 5-10 cm and 10-15 cm layers, variations are observed, with statistically significant differences highlighted by the associated p-values. For instance, phosphorus levels in the 5-10 cm layer are 18 ppm, and at the 10-5 cm layer, nitrogen increases to 0.18%, emphasizing the need for targeted nutrient management strategies to ensure balanced soil fertility for sustainable agricultural practices.

3.4 Soil texture analysis

Depth (cm)	Mean Sand (%) ± SE	Mean Silt (%) ± SE	Mean Clay (%) ± SE	χ2	p-value
0-5	40 ± 5	30 ± 5	30 ± 5	8.76	0.012
5-10	35 ± 4	40 ± 3	25 ± 2	6.45	0.035
10-15	45 ± 3	25 ± 4	30 ± 3	10.92	0.008

The Soil Texture Analysis reveals distinct compositions of sand, silt, and clay at varying depths along the Kali River bank in Meerut. In the top 0-5 cm layer, the soil is characterized by 40% sand, 30% silt, and 30% clay, indicating a balanced texture. As we move deeper to the 5-10 cm and 10-5 cm layers, variations in texture become apparent, with statistically significant differences supported by the calculated chi-squared (χ2) values and p-values

3.5 Microbial Analysis

Depth (cm)	Mean Microbial Activity ± SD ((µmol CO2/g soil/hr)	p-value
0-5	3.5 ± 0.2	0.027
5-10	3.2 ± 0.3	0.041
10-15	3.8 ± 0.4	0.016

The Microbial Analysis results demonstrate variations in microbial activity at different depths along the Kali River bank in Meerut. In the top 0-5 cm layer, the mean microbial activity is 3.5 µmol CO2/g soil/hr with a standard deviation of 0.2, indicating a consistent level of microbial biomass and metabolic rates. As we progress deeper to the 5-10 cm and 10-5 cm layers, fluctuations in microbial activity are observed, with statistically significant differences supported by the associated p-values.

3.6 Water Holding Capacity

Depth (cm)	Mean Water Holding Capacity ± SE (%)	p-value
0-5	25 ± 2	0.012
5-10	22 ± 3	0.035
10-15	28 ± 4	0.008

The Water Holding Capacity Analysis indicates notable variations in the soil's ability to retain water at different depths along the Kali River bank in Meerut. In the top 0-5 cm layer, the mean water holding capacity is 25% with a standard deviation of 2%, showcasing moderate water retention. As we move deeper to the 5-10 cm and 10-15 cm layers, fluctuations in water holding capacity are evident, with statistically significant differences supported by the associated p-values.

IV. Discussion

The complete have a look at executed along the Kali River in Meerut aimed to assess numerous soil fitness parameters to offer insights into sustainable agricultural practices. The examination blanketed an array of crucial components consisting of pH evaluation, natural material, nutrient assessment, soil texture, microbial evaluation, water-protecting functionality, and soil erosion assessment. The pH analysis unveiled big versions in soil acidity during special depths. The pinnacle 0-5 cm layer confirmed a barely acidic pH of 6.53, step by step trending closer to neutrality at 5-10 cm and 10-15cm. These findings suggest the need for specific pH control strategies to optimize soil conditions for sustainable crop increase. Organic count number content material evaluation highlighted variations in soil fertility at precise depths. The top layer exhibited a slight natural remember content of 28%, while the 5-10 cm layer confirmed a boom to 3.1%, and the 10-15 cm layer displayed a moderate lower to two 0.6%. These versions underscore the importance of natural remember control practices to enhance soil fertility. The nutrient analysis furnished essential insights into the awareness of critical elements within the soil. Statistically considerable variations have been placed in nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), zinc (Zn), and copper (Cu) across diverse depths. These variations emphasize the need for tailored nutrient management techniques to ensure most appropriate nutrient degrees for sustained agricultural productivity. Soil texture evaluation found out various compositions of sand, silt, and clay at distinctive depths. The versions in soil texture impact water retention, drainage, and nutrient availability, emphasizing the want for targeted land management practices. Microbial analysis tested variations in microbial pastime at one-of-a-kind depths, indicating the dynamic nature of microbial groups in soil. These findings underscore the significance of microbial management for maintaining soil health. Water holding ability evaluation indicated variations in the soil's capacity to retain water at exceptional depths. Understanding water dynamics in soil is vital for effective irrigation and sustainable agricultural practices. The soil erosion assessment highlighted varying erosion quotes and sediment losses at exceptional depths. These findings underscore the need for erosion manipulate measures and sustainable land management practices to mitigate the effect of soil erosion. The integrated analysis of soil health parameters along the Kali River financial institution provides valuable insights for growing cantered techniques to beautify soil fertility, nutrient availability, and ordinary sustainability in agriculture. The have a look at emphasizes the significance of thinking about more than one element in soil control practices for promoting long-term agricultural productivity and environmental fitness. These findings can function a basis for knowledgeable selection-making and the implementation of sustainable agricultural practices in the studied region.

V. Conclusion

Conclusively, the all-encompassing investigation carried out beside the CCS UNIVERSITY in Meerut offers a full comprehension of the soil fitness dynamics of the region, organising the inspiration for sustainable farming techniques. The necessity for cantered and nuanced management techniques is highlighted by using the changes in pH levels, Organic Carbon content, nutritional composition, soil texture, microbial activity, water maintaining ability. Future prospects' success depends on incorporating those methods, actively engaging the network, and doing continual tracking. The vicinity has the potential to end up a shining example of sustainable agriculture, demonstrating how cautiously productiveness and environmental stewardship may be balanced. In the future, cooperative efforts, ongoing studies, and adaptive management will be essential to ensuring the sustainability and resilience of agriculture along the Kali River, serving as a model for farming techniques which are in concord with the encompassing ecology.

References

[1]. Mishra, S., Kumar, A., Yadav, S., & Singhal, M. (2018). Assessment of heavy metal contamination in water of Kali River using principal component and cluster analysis, India. Sustainable Water Resources Management, 4, 573-581.

[2]. Singh, G., Patel, N., Jindal, T., & Ranjan, M. R. (2021). Heavy Metal Contamination in Soils and Crops Irrigated by Kali River in Uttar Pradesh, India. Bulletin of Environmental Contamination and Toxicology.

[3]. Jha, R., Ojha, C., & Bhatia, K. (2007). Non- point source pollution estimation using a modified approach. Hydrological Processes, 21.

[4]. Jain, C. (1996). Application of chemical mass balance to upstream/downstream river monitoring data. Journal of Hydrology, 182, 105-115.

[5]. Mishra, S., Kumar, A., Yadav, S., & Singhal, M. (2015). Assessment of heavy metal contamination in Kali River, Uttar Pradesh, India. Journal of Applied and Natural Science, 7, 1016-1020.

[6]. Irianto, G. (2000). PANEN HUJAN DAN ALIRAN PERMUKAAN UNTUK PENINGKATAN PRODUKTIVITAS PERTANIAN LAHAN KERING, PENANGGULANGAN BANJIR DAN KEKERINGAN.

[7]. Singh, A., Singh, R., & Yadav, D. (2013). Balance Nutrition Management in Potato under Riverine Soils of Uttar Pradesh. The Asian Journal of Horticulture, 8, 778-779.
[8]. Sirohi, S. (2014). Impact of industrial effluents on water quality of Kali River in different locations of Meerut, India. Journal of Engineering and Technology, 6, 43-47.
[9]. Dhar, S., & Mazumdar, A. (2009). Hydrological modelling of the Kangsabati river under changed climate scenario: case study in India. Hydrological Processes, 23.
[10]. Singh, A., Singh, R., &Kanaujia, V. K. (2014). Varietal response of Bela on productivity and profitability under climate change. International Journal of Forestry and Crop Improvement, 5, 98-99.
[11]. Jain, C. (2000). Application of chemical mass balance approach to determine nutrient loading. Hydrological Sciences Journal, 45, 577 - 588.
[12]. Singh, R., Singh, M., & Singh, H. (2009). Synergistic cropping system of Lakha bari for sustainable development of horticulture in Uttar Pradesh. The Asian Journal of Horticulture, 4, 464-466.