

International Journal of Agriculture Extension and Social Development

Volume 9; Issue 3; March 2026; Page No. 463-466

Received: 19-12-2025
Accepted: 22-01-2026

Indexed Journal
Peer Reviewed Journal

Assessment of post-flood changes in soil physico-chemical properties following the 2018 Kerala flood in Pariyaram panchayat, Thrissur district

¹M Saravanan, ²A Prasad and ³P Prameela

¹Subject Matter Specialist (Animal Science), ICAR, KVK, Karur, Tamil Nadu, India

²Professor (Associate), Livestock Production Management, CVAS, Mannuthy, Kerala, India

³ Professor and Head, Department of Agronomy, College of Horticulture, Vellanikkara, Kerala, India

DOI: <https://www.doi.org/10.33545/26180723.2026.v9.i3g.3423>

Corresponding Author: M Saravanan

Abstract

Flooding is a major climatic event that significantly alters soil properties and nutrient dynamics, thereby affecting agricultural productivity and livestock health. This study evaluated the impact of flooding on the physical and chemical properties of soil by comparing flood-affected and unaffected areas. Soil samples were collected systematically and analysed for pH, electrical conductivity (EC), calcium (Ca), phosphorus (P), potassium (K), and zinc (Zn) using standard analytical procedures. The results indicated no significant differences in pH and EC between affected and control soils. Among chemical parameters, calcium showed a significant increase ($p < 0.05$) in flood-affected soils, whereas phosphorus, potassium, and zinc exhibited no statistically significant differences, although numerical variations were observed. These findings indicate that flooding causes site-specific alterations in soil nutrient status. Therefore, post-flood soil assessment and area-specific nutrient management strategies are essential for restoring soil fertility and ensuring sustainable agricultural productivity.

Keywords: Flooding, soil quality, nutrient dynamics, electrical conductivity, calcium, phosphorus, potassium, zinc, soil fertility

1. Introduction

Soil quality is a critical factor influencing agricultural productivity and livestock health, as it determines the nutritional value of fodder (Abdel *et al.*, 1989) ^[1]. In extensive livestock production systems, animals rely on locally available feed and fodder resources, whose mineral composition depends largely on soil characteristics (Singare *et al.*, 2018) ^[16]. Climatic disasters such as floods and droughts can significantly alter soil structure and nutrient availability, thereby impacting crop production and animal nutrition.

Flooding leads to erosion, sediment deposition, nutrient leaching, and physico-chemical changes in soil (Kalshetty *et al.*, 2012; Akpoveta *et al.*, 2014) ^[11, 4]. These changes may result in either enrichment or depletion of essential nutrients depending on local environmental conditions. Variations in soil pH following flooding have been widely reported, ranging from acidic to alkaline conditions, affecting nutrient availability (Osakwe, 2014; Sreepriya and Balasubramanian, 2020) ^[14, 17]. Similarly, changes in electrical conductivity (EC) reflect alterations in soil salinity due to dissolved ions transported by floodwaters (Ezekiel *et al.*, 2013) ^[9].

Essential nutrients such as phosphorus, potassium, calcium, and zinc are often influenced by flooding through processes like leaching, sedimentation, and changes in microbial activity (Santhi *et al.*, 2017; Bednarek *et al.*, 2014) ^[15, 5]. Therefore, assessing soil quality after flooding is crucial for developing effective soil and nutrient management strategies. The present study aims to evaluate the impact of

flooding on selected physical and chemical properties of soil in affected and unaffected areas.

2. Materials and Methods

2.1 Study Area and Sampling

Location of Study

Pariyaram Panchayat was located at 10.3200°N, 76.3705°E in Thrissur district near Chalakkudy taluk with 16.8 km² area and population covering of 31195 (2011 census). Due to its topographic peculiarity the Panchayat was affected by landslides as well as floods during 2018. Out of 15 wards, Peelarmuzhi was not affected by flood and landslides during 2018, remaining 14 wards were affected at varying severity. So the unaffected ward was considered as control for the study. The Panchayat has hilly, plain and riverine zones.

Collection of Sample

A map demarcating the different wards of the Panchayat with its geography was prepared. From the selected areas a slice of the plough layer was cut at intervals of 15 to 20 steps or according to the area to be covered. Collected at least 10 to 15 samples from each sampling unit and placed it in a bucket. Scraped away surface litter; obtained a uniform thick slice of soil from the surface to the plough depth from each place. A “V” shape was cut to a depth of 15 cm in the sampling spot used spade to remove 1 to 2 cm slice of soil. The sample was collected on the blade of the spade and put in a clean bucket. In this way samples were collected from all the spots marked for one sampling unit. In case the

of hard soil especially in the hilly area so Pariyaram Panchayat, samples are taken with the help of augur from the plough depth and collected in the bucket (Acharya, 2018) [2]. Transferred the soil from the bucket on a piece of clean paper or cloth and mix thoroughly. Spread the soil evenly and divide it into 4 quarters. Reject two opposite quarters and mix the rest of the soil again. Repeated the process till left with about half kilogram of soil, collect it and put in a clean cloth bag. Each bag should be properly marked to identify the sample.

2.2 Sample Preparation

The collected soil samples were air-dried, sieved through a 2 mm mesh, and stored in labelled containers for further analysis.

2.3 Analytical Methods

2.3.1 Physical Parameters

- **Soil pH:** Determined in a 1:2.5 soil-water suspension using a calibrated pH meter (Jackson, 2005) [10].
- **Electrical Conductivity (EC):** Measured in the same suspension using an EC meter to assess soil salinity (Jackson, 2005) [10].

2.3.2 Chemical Parameters

- **Available Phosphorus (P):** Estimated using Bray No. 1 extraction method followed by colorimetric determination (Watanabe and Olsen, 1965; Murphy and Riley, 1962) [19, 13].
- **Available Potassium (K):** Determined using a flame photometer after extraction with neutral ammonium acetate (Jackson, 2005) [10].
- **Calcium (Ca):** Measured using atomic absorption spectrophotometry (Clayton and Tiller, 1979) [6].
- **Zinc (Zn):** Estimated using acid extraction followed by atomic absorption spectrophotometry (Clayton and Tiller, 1979) [6].

Statistical analysis

- Statistical analysis of the data was carried out using the analysis of variance and Wilcoxon signed rank test. Software used was SPSS V 24.0

3. Results

3.1 Physical Properties of Soil

The pH of soil in the control area (5.50 ± 0.18) was not significantly different from that of the flood-affected area (5.84 ± 0.09), indicating minimal alteration in soil acidity due to flooding. These findings are consistent with Ubuoh *et al.* (2016) [18], who reported similar pH ranges in flood-affected soils. Electrical conductivity (EC) values also showed no significant difference between control ($51.00 \pm 5.83 \mu\text{S/cm}$) and affected soils ($52.12 \pm 2.15 \mu\text{S/cm}$). The absence of significant variation in soil pH suggests that the buffering capacity of the soil might have mitigated drastic changes despite flood exposure. Soils rich in organic matter and clay minerals often resist sudden pH fluctuations due to their high cation exchange capacity. This stability is beneficial for maintaining nutrient availability, as extreme pH changes can lead to nutrient fixation or toxicity. Similarly, the non-significant difference in electrical conductivity indicates that the floodwaters did not introduce

excessive soluble salts into the soil system. This could be attributed to the dilution effect of rainwater or rapid drainage in the study area. However, it is important to note that EC values alone may not fully capture transient salinity changes immediately after flooding, as salts may leach deeper into the soil profile over time.

This suggests that flooding did not significantly alter soil salinity levels, although previous studies have reported increased EC following flooding due to higher ionic concentrations (Ezekiel *et al.*, 2013; Cox *et al.*, 2018) [9, 7].

Table 1: Physical quality of soil in affected and unaffected area

Parameters	Control	Affected area
pH	5.50 ± 0.18^a	5.84 ± 0.09^a
Electrical Conductivity/ Salinity ($\mu\text{S/cm}$)	51.00 ± 5.83^a	52.12 ± 2.15^a

For each parameter, means with different superscript (a-b in rows) differ significantly ($p < 0.05$)

Table 2: Chemical quality of soil in flood affected and unaffected area

Parameters	Control	Affected Area
Calcium (mg/kg)	6.58 ± 0.85^a	9.89 ± 0.36^b
Potassium (kg/ha)	334.66 ± 61.65^a	236.35 ± 8.3^a
Phosphorous (kg/ha)	24.60 ± 9.88^a	37.72 ± 3.53^a
Zinc (mg/kg)	3.24 ± 0.59^a	4.37 ± 0.4^a

For each parameter, means with different superscript (a-b in rows) differ significantly ($p < 0.05$)

3.2 Chemical Properties of Soil

3.2.1 Calcium

Calcium content was significantly higher ($p < 0.05$) in flood-affected soils ($9.89 \pm 0.36 \text{ mg/kg}$) compared to control soils ($6.58 \pm 0.85 \text{ mg/kg}$). The significant increase in calcium content in flood-affected soils highlights the role of sediment deposition as a major factor influencing soil nutrient status. Floodwaters often transport calcareous materials from upstream regions, which can accumulate in low-lying agricultural lands. This enrichment can be beneficial in acidic soils by improving soil structure and enhancing nutrient availability. This increase may be attributed to the deposition of calcium-rich sediments during flooding (Emeka and Osondu, 2016) [8]. Calcium plays a vital role in neutralizing soil acidity and influencing the mobility of heavy metals (Katutis and Rudzianskaite, 2015) [12].

3.2.2 Phosphorus

Phosphorus levels were higher in flood-affected soils ($37.72 \pm 3.53 \text{ kg/ha}$) compared to control soils ($24.60 \pm 9.88 \text{ kg/ha}$), although the difference was not statistically significant. Phosphorus dynamics in flooded soils are complex, as anaerobic conditions can lead to the reduction of iron and aluminium compounds, thereby releasing bound phosphorus into the soil solution. However, this increased availability may be temporary, as phosphorus can quickly become immobilized upon re-oxidation of soil after drainage. Additionally, phosphorus losses through runoff during flooding can counterbalance any gains from sediment deposition.

The variability observed in phosphorus levels indicates that its behaviour is highly site-specific and influenced by

multiple factors including soil type, flood duration, and organic matter content. Therefore, blanket fertilizer recommendations may not be suitable for post-flood management, and soil testing becomes essential. Similar findings were reported by Akpoveta *et al.* (2014) ^[4], who observed variations in phosphorus levels between flooded and non-flooded areas. Flood-induced sedimentation and microbial activity may influence phosphorus availability.

3.2.3 Potassium

Potassium levels were lower in flood-affected soils (236.35 ± 8.3 kg/ha) compared to control soils (334.66 ± 61.65 kg/ha), though the difference was not significant. The reduction in potassium levels in flood-affected soils, although not significant, indicates the possibility of leaching losses during flooding. Potassium is highly soluble and can be easily washed away, especially in sandy or well-drained soils. This loss can have serious implications for crop productivity, as potassium is essential for enzyme activation, water regulation, and stress tolerance in plants. This reduction may be due to leaching losses during flooding (Akpoveta *et al.*, 2014) ^[4]. Potassium is essential for plant growth and microbial functioning, and its depletion can negatively impact soil fertility.

3.2.4 Zinc

Zinc content showed a slight increase in flood-affected soils (4.37 ± 0.4 mg/kg) compared to control soils (3.24 ± 0.59 mg/kg), but the difference was not statistically significant. The slight increase in zinc concentration in flood-affected soils may be attributed to sediment deposition or changes in soil redox conditions. Under flooded conditions, the solubility of micronutrients like zinc can increase due to reduction reactions, making them more available in the soil solution. Similar observations were reported by Akhter *et al.* (2011) ^[3], indicating variability in micronutrient availability following flooding.

4. Discussion

Flooding is a multifaceted environmental phenomenon that influences soil quality through interconnected physical, chemical, and biological processes. The present study demonstrates that the impact of flooding on soil properties is highly variable and dependent on local conditions such as topography, soil type, and flood intensity. The stability of soil pH observed in this study indicates that the buffering capacity of the soil was sufficient to resist major changes. This is an important finding, as soil pH governs nutrient availability and microbial activity. In contrast, studies conducted in other regions have reported significant pH fluctuations following flooding, highlighting the role of site-specific factors.

Electrical conductivity, an indicator of soil salinity, also remained unchanged, suggesting minimal salt accumulation. This could be due to the flushing effect of rainfall or low salinity of floodwaters. However, it is important to consider that salinity changes may occur at deeper soil layers, which were not assessed in this study.

The significant increase in calcium content is indicative of sediment deposition, which is a common consequence of flooding. This process can enhance soil fertility by adding essential nutrients, but excessive accumulation may disrupt

nutrient balance. The enrichment of calcium also suggests potential improvement in soil structure, which could benefit crop growth in subsequent seasons.

The observed variations in phosphorus, potassium, and zinc highlight the complex nature of nutrient dynamics in flooded soils. While phosphorus and zinc showed increasing trends, potassium exhibited a decreasing pattern, suggesting differential responses to flooding processes such as leaching and sedimentation.

These findings underscore the importance of adopting a holistic approach to soil management in flood-affected areas. Post-flood soil testing should be prioritized to assess nutrient status and guide fertilizer application. Additionally, incorporating organic matter, practicing crop rotation, and adopting conservation agriculture techniques can help restore soil health. From a broader perspective, the study highlights the need for developing climate-resilient agricultural systems that can withstand extreme weather events. This includes improving drainage infrastructure, promoting soil conservation practices, and enhancing farmer awareness regarding post-flood management strategies.

Furthermore, future research should focus on long-term monitoring of soil properties and include biological parameters such as microbial activity and organic carbon content. Understanding these aspects will provide a more comprehensive picture of soil health and its recovery after flooding.

5. Conclusion

Flooding has a variable impact on soil quality, influencing both physical and chemical properties. In this study, pH and EC were not significantly affected, while calcium content increased significantly in flood-affected soils. In addition, the study emphasizes the importance of integrating soil health assessment into disaster management planning. Sustainable recovery of agricultural systems in flood-prone areas requires coordinated efforts involving soil scientists, agronomists, and policymakers. Long-term resilience can be achieved through adaptive soil management practices and continuous monitoring. Other nutrients such as phosphorus, potassium, and zinc showed non-significant but notable variations. The findings highlight the importance of post-flood soil testing and site-specific nutrient management strategies to restore soil fertility, improve crop productivity, and support livestock nutrition.

Acknowledgements

The authors acknowledge the support provided by the laboratory staff and field assistants during sample collection and analysis. Gratitude is also extended to the institution for providing the necessary facilities to carry out this research.

References

1. Abdel Rehman MM, Kincad PI, Elzubejr EA. Mineral deficiencies in grazing cattle in Kardofan and Darfur regions in eastern Sudan. *Trop Anim Hlth Prod.* 1989;30:123-135.
2. Acharya SM. Collection and preparation of soil, water and plant samples for analysis. *Int J Chem Studies.* 2018;2:3298-3303.
3. Akhter KF, Khan ZH, Hussain MS, Mazumder AR. Physico-chemical characteristics of the seasonally

- flooded soils of Bangladesh and their management implications. Dhaka Univ J Biol Sci. 2011;2:173-182.
4. Akpoveta VO, Osakwe SA, Ize-Iyamu OK, Medjor WO, Egharevba F. Post flooding effect on soil quality in Nigeria: The Asaba, Onitsha experience. Open J Soil Sci. 2014;2:72-74.
 5. Bednarek W, Dresler S, Tkaczyk P, Hanaka A. Physicochemical properties of surface soil layer after the flood in the middle Vistula River Valley. J Environ. 2014;19.
 6. Clayton PM, Tiller KG. A chemical method for the determination of heavy metals content of soils in environmental studies. CSIRO, Australia, Melbourne, Div Soil Tech Paper. 1979;41:1-7.
 7. Cox C, Jin L, Ganjegunte G, Borrok D, Loughheed V, Ma L. Soil quality changes due to flood irrigation in agricultural fields along the Rio Grande in western Texas. Appl Geol Chem. 2018;90:87-100.
 8. Emeka UJ, Osondu NA. Post impact studies of the 2012 flooding on the environment and health of Oguta residents, Southeastern, Nigeria. J Multidisciplinary Engng Sci Technol. 2016;11:28-36.
 9. Ezekiel E, Abowei J, Charles E. Effects of flooding on Amassoma flood plain sediments Niger delta. Appl Sci Rep. 2013;4:173-180.
 10. Jackson ML. Soil chemical analysis: advanced course. UW-Madison Libraries, Parallel Press. 2005. 321 p.
 11. Kalshetty BM, Giraddi TP, Sheth RC, Kalashetti MB. River Krishna flood effects on soil properties of cultivated areas in Bagalkot District, Karnataka State. Global J Sci Frontier Res Chem. 2012;12:6.
 12. Katutis K, Rudzianskaitė A. The fluctuation of calcium and magnesium concentrations in the floodwater in the Nemunas and Minija lowlands. Zemdirbyste-Agric. 2015;102.
 13. Murphy J, Riley JP. A modified single solution method for the determination of phosphate in natural waters. Anal Chem. 1962;27:31-36.
 14. Osakwe SA. Evaluation of Physicochemical Characteristics of Soils in the Flood Disaster Affected Areas of Isoko Region of Delta State, Nigeria. J Appl Chem. 2014;5:24-31.
 15. Santhi GR, Binitha NK, Suresh PR, Ebimol NL. Assessment of Physical and Chemical Properties of Soil Samples in Kaipad Tracts of Kannur District, India. Int J Curr Microbiol App Sci. 2017;11:1464-1475.
 16. Singare PB, Patil VD, Pillewad SR. Soil-plant-animal relationship of micro minerals in cattle from Northern Tehsils of Parbhani District, India. Int J Curr Microbiol App Sci. 2018;6:1105-1110.
 17. Sreepriya P, Balasubramanian R. Soil degradation in Kerala state and a case study on socio-economic impact due to flood in its Idukki district. J Appl Nat Sci. 2020;2:159-164.
 18. Ubuoh EA, Uka A, Egbe C. Effects of flooding on soil quality in Abakaliki agro-ecological zone of south-eastern state, Nigeria. Int J Environ Chem Ecol Toxicol Res. 2016;3:20-32.
 19. Watanabe FS, Olsen SR. Test of an Ascorbic Acid Method for Determining Phosphorus in Water and NaHCO₃ Extracts from the Soil. Soil Sci Soc Am J. 1965;29:677-678.