Scottish International Conference on

Multidisciplinary research and Innovation (SICMRI 2026)

HUMUS CONTENT AND SOIL pH IN DIFFERENT FUNCTIONAL ZONES OF KOKAND CITY AND ADJACENT AREAS

Ergasheva N.A
Kokand State University, Kokand, Uzbekistan
nazokatochilova1@gmail.com

Abstract

This study assessed variations in humus content and soil reaction (pH) across functional zones and two sampling depths (0–10 and 10–30 cm) in Kokand city and adjacent areas. According to the author, the wider field survey covered 60 soil sampling locations; the analytical dataset used in this article comprised 116 samples from 58 paired, two-depth sites and seven samples from one reference soil profile, giving a total of 123 samples. Soil pH was measured potentiometrically in an aqueous soil extract, while humus content was determined photometrically using the Tyurin method. Across all 123 samples, humus content ranged from 0.30% to 4.40% (mean ± SD: 2.03 ± 0.86%), and pH ranged from 6.16 to 8.45 (7.84 ± 0.36); 119 samples had pH values above 7. Differences between the paired depths were not statistically significant for either pH or humus content according to the Wilcoxon signed-rank test ($p = 0.377$ and $p = 0.446$, respectively). The site-level Spearman association between pH and humus was also not statistically significant ($\rho = -0.060$; $n = 58$; $p = 0.653$). The descriptive mean humus content was 1.78% in the transport zone and 2.17% in the peripheral zone; the statistical significance of between-zone differences was not evaluated. These findings provide an initial agrochemical basis for differentiated monitoring of soil organic matter.

Keywords: Kokand; urban soils; humus; soil pH; functional zones; paired-depth sampling.

Introduction

Soil organic matter and soil reaction are important agrochemical indicators of urban ecosystems. Humus reflects the quantitative status of soil organic matter, while pH influences sorption, nutrient availability, and various biogeochemical processes [1]. Construction, soil sealing, transport, and other human activities may produce spatially heterogeneous properties in urban soils [2].

Previous morphological and ecological studies of soils in Kokand and other cities of the Fergana region have described anthropogenically modified soil profiles and differences in soil ecological functions [3]. Accordingly, joint assessment of humus and pH in industrial, transport, centrally located green, and peripheral areas may help establish a scientific basis for local soil monitoring.

The objective of this study was to characterize descriptive differences in humus content and soil pH across sampling depths and functional zones in Kokand city and adjacent areas, test paired differences between soil layers, and identify priorities for subsequent monitoring.

© 2026Scottish International Conference on Multidisciplinary Research and Innovation. All Rights Reserved.

Study Sites and Methods

According to the author, the wider field survey covered 60 soil sampling locations. The agrochemical laboratory dataset used in this article comprised 123 soil samples: 116 samples collected at depths of 0–10 and 10–30 cm from 58 sites with matching sample identifiers, and seven samples from one reference soil profile. The reference profile was excluded from the paired-depth statistical analysis. The 60 locations in the wider field survey and the sites represented in this analytical dataset do not constitute identical statistical populations; the laboratory identifiers of additional field locations could not be verified from the available records. Consequently, the dataset was not treated as containing 120 paired laboratory measurements from 60 locations.

Soil samples were air-dried under cool conditions and initially passed through a 1 mm sieve. Subsamples intended for humus analysis were subsequently passed through a 0.25 mm sieve in the laboratory. Soil pH was measured potentiometrically in an aqueous soil extract using a pH electrode; KCl was the internal electrode electrolyte and was not added to the soil extract. Humus content was determined photometrically by the Tyurin method in accordance with GOST 26213-2021 [4, 7]. The soil-to-water ratio and the instrument model were not reported because they could not be independently verified from the original laboratory report.

For each paired site, the first sample represented 0-10 cm and the second represented 10-30 cm. Differences between depths were evaluated using the paired Wilcoxon signed-rank test [5]. The monotonic association between pH and humus was assessed using Spearman's rank correlation coefficient [6]. To avoid treating the two layers from a single site as statistically independent observations, the primary correlation analysis was based on equally weighted means of the two depth measurements at each site ($n = 58$). The correlation based on all 123 individual samples was retained as a descriptive comparison. Only descriptive statistics were available for functional-zone groups; no inferential test of between-zone differences was documented. A significance threshold of $p < 0.05$ was applied to the depth comparisons and correlation analyses.

The 116 two-depth samples were distributed across functional zones as follows: industrial, 32 samples (16 sites); transport, 14 samples (7 sites); central green spaces, 36 samples (18 sites); and peripheral areas, 34 samples (17 sites). These figures refer to individual layer samples, not independent sampling sites; the corresponding numbers of paired sites are given in parentheses.

Results and Discussion

Across the 123 laboratory samples, humus content ranged from 0.30% to 4.40%, with a mean ± SD of 2.03 ± 0.86% and a median of 2.00%. Humus content exceeded 2.00% in 58 samples, was between 1.00% and 2.00% (inclusive) in 55 samples, and was below 1.00% in 10 samples. These findings indicate quantitative variation in soil organic matter among samples but do not, by themselves, support conclusions about all aspects of soil fertility.

Soil pH ranged from 6.16 to 8.45, with a mean ± SD of 7.84 ± 0.36 and a median of 7.89. A total of 119 samples had $pH > 7$, three had $pH < 7$, and one had $pH = 7$. More specifically, 77 samples fell within the pH interval 7.00–7.99 (including one sample with pH exactly 7.00), 43 had $pH \geq 8.00$, and three had $pH < 7.00$. Thus, alkaline soil reaction predominated in the sampled material.

Table 1. Descriptive pH and humus characteristics across functional zones

Functional zone	Samples, n (sites)	Humus, % (mean ± SD)	pH (mean)	pH range

© 2026Scottish International Conference on Multidisciplinary Research and Innovation. All Rights Reserved.

Functional zone	Samples, n (sites)	Humus, % (mean ± SD)	pH (mean)	pH range
Industrial	32 (16)	2.12 ± 0.87	7.70	6.16–8.37
Transport	14 (7)	1.78 ± 0.94	7.90	7.05–8.31
Central green spaces	36 (18)	2.10 ± 0.75	7.96	7.16–8.45
Peripheral	34 (17)	2.17 ± 0.88	7.81	6.98–8.28

Note: n denotes individual depth samples; the numbers in parentheses indicate paired sampling sites. The seven samples from the reference soil profile were not included in these zone totals. This table alone does not establish statistical significance of between-zone differences.

Table 2. Depth-specific pH and humus values at 58 paired sampling sites

Parameter	0–10 cm, mean	10–30 cm, mean	Wilcoxon W	p-value
pH	7.87	7.81	741.5	0.377
Humus, %	2.15	2.03	654.0	0.446

Note: n = 58 for each depth. The p-values are from two-sided paired Wilcoxon signed-rank tests. The difference in mean pH was 0.06 pH units, and the difference in mean humus content was 0.12 percentage points. Neither comparison met the $p < 0.05$ significance threshold.

For the seven samples from the reference soil profile, mean pH was 7.90 ± 0.27 and mean humus content was 1.10 ± 0.42%. The reference-profile results were not pooled with the paired analysis of the 0-10 and 10-30 cm layers.

Across functional zones, descriptive mean humus content was 1.78% in the transport zone and 2.17% in the peripheral zone, a difference of 0.39 percentage points. This is a descriptive difference only: because no inferential analysis based on independent sampling sites was available and potential confounding factors were not controlled, it cannot be considered statistical proof of a between-zone difference or evidence of a causal effect of transport activity. The lowest individual humus value (0.30%) was observed in the transport zone, whereas the highest (4.40%) occurred in the peripheral zone. Humus content ranged from 0.4% to 3.9% in the industrial zone.

Of the 10 samples with humus content below 1.00%, three belonged to the transport zone, two to the industrial zone, one each to the central green-space and peripheral zones, and three to the reference soil profile. These were 10 laboratory samples, not 10 independent sampling locations.

The Spearman correlation coefficient between pH and humus across all 123 individual samples was $\rho = -0.013$ ($p = 0.887$). However, measurements from two depths at the same site may be correlated. Therefore, the primary site-level analysis used the means of the two depths at each of the 58 paired sites and yielded $\rho = -0.060$ ($p = 0.653$). Neither analysis identified a statistically significant monotonic association between pH and humus. This result does not imply an absence of physicochemical relationships between soil pH and organic matter.

© 2026Scottish International Conference on Multidisciplinary Research and Innovation. All Rights Reserved.

Morphological modification of urban soils, imported materials, land-use history, and vegetation cover may contribute to spatial differences in pH and humus content [2, 3]. However, the available data do not permit quantitative estimation of the separate contribution of each factor. Because the layers were sampled only once at each site, the results do not establish seasonal or multi-year trends. Moreover, averages calculated across laboratory samples are not area-weighted estimates for the whole city.

Conclusions

1. In the 123 soil samples from Kokand city and adjacent areas, mean humus content was 2.03 ± 0.86% (range: 0.30-4.40%), and mean pH was 7.84 ± 0.36 (range: 6.16-8.45). Soil pH exceeded 7 in 119 samples. The dataset thus demonstrated predominantly alkaline soil reaction and heterogeneous humus content.

2. At the 58 paired sites, mean pH and humus content differed slightly between 0-10 and 10-30 cm, but neither difference was statistically significant in the Wilcoxon signed-rank test ($p = 0.377$ and $p = 0.446$, respectively). The site-level Spearman association between pH and humus was likewise not statistically significant ($\rho = -0.060$; $p = 0.653$). These findings do not prove the absence of differences at individual sites.

3. Descriptive mean humus content was 0.39 percentage points lower in the transport zone (1.78%) than in the peripheral zone (2.17%). Because no between-zone statistical test was conducted, this contrast cannot be interpreted as an established zonal pattern or causal evidence of transport impacts. The 10 samples with humus content below 1%, particularly observations from the transport zone and reference soil profile, merit further investigation.

4. Future monitoring should revisit the same coordinates and depth intervals, establish a verified registry of independent sites within each functional zone, account for soil texture and morphological characteristics, and statistically evaluate between-zone differences at the site level. These data provide an empirical basis for examining spatial variation in soil organic matter but do not quantify contributions from anthropogenic sources.

References

1. Neina D. The Role of Soil pH in Plant Nutrition and Soil Remediation. Applied and Environmental Soil Science. 2019;2019:5794869. https://doi.org/10.1155/2019/5794869.
2. O'Riordan R., Davies J., Stevens C., Quinton J.N. The effects of sealing on urban soil carbon and nutrients. SOIL. 2021;7:661–675. https://doi.org/10.5194/soil-7-661-2021.
3. Qo'chqarov O.A., Ergasheva N.A. Shaharlar landshaftlarining tuproqlari: ekologik funksiyalar va urbanizatsiya ta'siri [Soils of urban landscapes: ecological functions and effects of urbanization]. O'zbekiston zamini. 2025;(1):46–51. https://doi.org/10.63027/2025/1/12. [In Uzbek].
4. GOST 26213–2021. Pochvy. Metody opredeleniya organicheskogo veshchestva [Soils. Methods for the determination of organic matter]. Interstate standard. 2021. [In Russian].
5. Wilcoxon F. Individual Comparisons by Ranking Methods. Biometrics Bulletin. 1945;1(6):80–83. https://doi.org/10.2307/3001968.
6. Spearman C. The Proof and Measurement of Association between Two Things. The American Journal of Psychology. 1904;15(1):72–101. https://doi.org/10.2307/1412159.

© 2026Scottish International Conference on Multidisciplinary Research and Innovation. All Rights Reserved.