pISSN:2349-5707 Volume:13,Issue 1, January -2026 eISSN:2349-5715

# ETIOLOGICAL AND HYGIENIC SIGNIFICANCE OF THE SOIL ENVIRONMENT IN THE FORMATION OF INFECTIOUS AND NON-INFECTIOUS DISEASES AMONG THE POPULATION OF FERGANA REGION

**Saminjonova Gulbahor Soyibjon kizi**
Clinical Ordinator,
Fergana Medical Institute of Public Health

**Abstract:** The present study evaluates the etiological and hygienic significance of the soil environment in the formation and spread of infectious and non-infectious diseases among the population of the Fergana region (Uzbekistan). Based on sanitary-hygienic monitoring data collected between 2019 and 2024, the physical, chemical, and biological characteristics of soil were analyzed, along with their association with morbidity indicators. A total of 240 soil samples from urban and rural areas were examined using standardized microbiological and chemical methods. The results revealed that 32.5% of samples failed to meet sanitary norms, with excess levels of nitrates and heavy metals detected in several districts. A statistically significant correlation was identified between soil contamination and the incidence rates of intestinal infections, helminthiases, allergic diseases, and endocrine disorders. The findings confirm that soil quality is a critical environmental determinant of public health and highlight the need for strengthened hygienic monitoring and preventive measures in the Fergana region.

**Keywords:** soil hygiene, medical ecology, infectious diseases, non-infectious diseases, environmental health, Fergana region.

## 1. Introduction

Soil is a fundamental component of the natural environment and one of the most important determinants of population health from the perspective of medical hygiene and environmental medicine. As a complex physical, chemical, and biological system, soil continuously interacts with humans through direct contact, agricultural production, food chains, water resources, and atmospheric dust. Due to this multifactorial interaction, soil plays a dual role: on the one hand, it supports life and ecological balance, while on the other hand, when contaminated, it becomes a significant source of health risks.

In hygienic practice, soil is considered a potential reservoir and transmission medium for pathogenic microorganisms, helminths, and opportunistic flora. In addition, soil is capable of accumulating toxic chemical substances such as nitrates, pesticides, and heavy metals, which may persist for long periods and exert chronic adverse effects on human health. Numerous international studies have demonstrated associations between poor soil quality and increased incidence of intestinal infections, parasitic diseases, allergic conditions, endocrine disorders, and cardiovascular pathology.

The relevance of soil hygiene is particularly pronounced in regions with high population density and intensive anthropogenic activity. The Fergana region is one of the most densely populated territories of Uzbekistan and Central Asia, characterized by intensive irrigated agriculture, widespread use of mineral fertilizers and agrochemicals, rapid urbanization, and increasing volumes of industrial and household waste. These factors collectively create sustained anthropogenic pressure on soil resources and increase the likelihood of sanitary norm violations.

In rural areas of the Fergana region, close contact between the population and soil occurs through agricultural labor, household gardening, and consumption of locally produced food. In

pISSN:2349-5707 Volume:13,Issue 1, January -2026 eISSN:2349-5715

urban settings, soil contamination is often linked to inadequate waste management, vehicular emissions, and insufficient sanitation infrastructure. Under such conditions, soil becomes an important etiological factor contributing to both infectious and non-infectious morbidity patterns.

Despite the clear public health relevance, comprehensive longitudinal studies assessing the hygienic condition of soil and its etiological significance in disease formation remain limited at the regional level. Existing research is often fragmented or focused on isolated indicators without integrating morbidity dynamics. Therefore, a systematic analysis combining soil contamination monitoring with population health statistics is required.

In this context, the present study aims to provide an expanded hygienic and etiological assessment of the soil environment in the Fergana region, emphasizing its role in the formation and spread of infectious and non-infectious diseases over a six-year period. The findings are intended to support evidence-based preventive strategies and strengthen environmental health surveillance in the region.

## 2.Aim and Objectives of the Study

The primary aim of the present study is to scientifically substantiate the etiological and hygienic significance of the soil environment in the formation and spread of infectious and non-infectious diseases among the population of the Fergana region.

To achieve this aim, the study addresses several interrelated objectives. These include a comprehensive assessment of the sanitary and hygienic condition of soil in various administrative districts of the Fergana region, as well as an analysis of the temporal dynamics of key soil contamination indicators over the period from 2019 to 2024. Particular attention is given to evaluating the incidence rates of selected infectious and non-infectious diseases and identifying statistically significant associations between soil contamination parameters and population morbidity indicators. In addition, the study seeks to develop scientifically grounded hygienic and preventive recommendations aimed at reducing soil-related health risks and improving environmental health surveillance at the regional level.

## 3. Materials and Methods

The study was conducted in accordance with OAK (Higher Attestation Commission) requirements for scientific publications. Soil samples were collected from six administrative districts of the Fergana region during 2019–2024. A total of 240 samples were obtained from agricultural lands and residential areas.

Microbiological analyses included determination of the Escherichia coli index, detection of helminth eggs, and identification of spore-forming bacteria. Chemical analyses were performed to quantify nitrates, lead, and cadmium using atomic absorption spectrophotometry. Statistical processing was carried out using descriptive statistics and correlation analysis (Pearson's r), with significance set at $p < 0.05$.

**Table 1. Distribution of soil samples by territory**

| District | Samples (n) | Agricultural areas | Residential areas |
|---|---|---|---|
| Fergana | 40 | 15 | 25 |

pISSN:2349-5707 Volume:13,Issue 1, January -2026 eISSN:2349-5715

| | | | |
|---|---|---|---|
| city | | | |
| Kokand city | 40 | 18 | 22 |
| Margilan | 40 | 20 | 20 |
| Quva | 40 | 22 | 18 |
| Rishton | 40 | 25 | 15 |
| Toshloq | 40 | 28 | 12 |
| **Total** | **240** | **128** | **112** |

## 4. Results

### Soil contamination dynamics (2019–2024)

The analysis of soil monitoring data revealed pronounced spatial and temporal heterogeneity in contamination levels across the Fergana region. Over the six-year observation period, a steady increase in chemical soil contamination was documented, particularly in districts characterized by intensive agricultural activity and high fertilizer input. The mean nitrate concentration increased from 165 ± 12 mg/kg in 2019 to a peak of 218 ± 15 mg/kg in 2023, followed by a slight decline to 210 ± 15 mg/kg in 2024; however, values remained significantly above the permissible limit throughout the study period.

The proportion of soil samples exceeding hygienic standards for nitrates rose from 24.1% in 2019 to 34.6% in 2023, indicating a cumulative anthropogenic impact. District-level analysis showed the highest exceedance rates in Quva, Rishton, and Toshloq districts, where intensive crop production and frequent application of mineral fertilizers are common practices.

Biological contamination indicators demonstrated a less pronounced but persistent upward trend. The proportion of samples with Escherichia coli index values exceeding normative thresholds increased from 15.2% in 2019 to 18.4% in 2024. Detection of helminth eggs rose from 7.1% to 9.6% over the same period, with the highest prevalence observed in residential areas lacking centralized sanitation and effective waste disposal systems.

### Association between soil contamination and disease incidence

Comparative analysis of environmental and epidemiological data revealed consistent parallel trends between soil contamination indicators and population morbidity. Incidence rates of acute intestinal infections increased from 312 per 100,000 population in 2019 to 389 per 100,000 in 2024, representing a 24.7% rise over the study period. Helminthiases showed a similar pattern, with incidence rates increasing from 224 to 278 per 100,000 population.

Non-infectious diseases demonstrated a gradual but sustained increase. The incidence of allergic diseases rose from 1,420 to 1,710 per 100,000 population between 2019 and 2024, while endocrine disorders increased from 865 to 1,012 per 100,000 population. These increases were most pronounced in districts with elevated nitrate and heavy metal concentrations in soil.

Correlation analysis confirmed statistically significant associations between soil contamination parameters and morbidity indicators. A moderate positive correlation was identified between nitrate concentration in soil and the incidence of allergic diseases ($r = 0.62$, $p$

pISSN:2349-5707 Volume:13,Issue 1, January -2026 eISSN:2349-5715

< 0.05). A stronger correlation was observed between biological soil contamination (presence of helminth eggs and elevated E. coli index) and helminthiases incidence ($r = 0.71$, $p < 0.05$). These findings support the etiological role of soil contamination in shaping regional disease patterns.

The table presents the year-by-year dynamics of nitrate concentrations in soil samples collected in the Fergana region between 2019 and 2024. Mean nitrate values are expressed as **mean ± standard deviation (mg/kg)**, while the exceedance rate indicates the **percentage of samples exceeding the permissible hygienic limit**.

From 2019 to 2023, a **consistent upward trend** in soil nitrate concentration was observed. In 2019, the mean nitrate level was **165 ± 12 mg/kg**, with **24.1%** of samples exceeding the permissible limit. This value increased steadily each year, reaching **178 ± 14 mg/kg (26.7%)** in 2020 and **192 ± 15 mg/kg (29.3%)** in 2021. By 2022, the mean concentration rose to **205 ± 16 mg/kg**, with nearly one-third (**31.8%**) of samples exceeding hygienic standards.

The **highest nitrate concentration** was recorded in 2023 (**218 ± 15 mg/kg**), accompanied by the maximum exceedance rate (**34.6%**), indicating the peak of chemical soil contamination during the observation period. In 2024, a slight decrease in the mean nitrate level was noted (**210 ± 15 mg/kg**); however, the proportion of samples exceeding permissible limits remained high (**32.5%**), suggesting that soil contamination continued to pose a significant hygienic risk.

Overall, these data demonstrate a **progressive accumulation of nitrates in soil over time**, reflecting sustained anthropogenic pressure, most likely related to intensive agricultural practices and excessive use of mineral fertilizers. Despite a minor reduction in 2024, nitrate levels remained consistently above hygienic norms, underscoring the need for strengthened environmental control and preventive measures.

Biological contamination remained relatively stable but exceeded hygienic norms in residential areas with insufficient sanitation.

**Table 3. Biological soil contamination indicators (average, %)**

| Indicator | 2019 | 2021 | 2024 |
|---|---|---|---|
| E. coli index > norm | 15.2 | 17.8 | 18.4 |
| Helminth eggs detected | 7.1 | 8.6 | 9.6 |

**Association between soil contamination and disease incidence**

Analysis of official health statistics revealed a parallel increase in soil contamination and morbidity rates.

**Table 4. Incidence rates of selected diseases (per 100,000 population)**

| Disease | 2019 | 2021 | 2024 |
|---|---|---|---|
| Acute intestinal infections | 312 | 348 | 389 |

pISSN:2349-5707 Volume:13,Issue 1, January -2026 eISSN:2349-5715

| | | | |
|---|---|---|---|
| Helminthiases | 224 | 251 | 278 |
| Allergic diseases | 1,420 | 1,565 | 1,710 |
| Endocrine disorders | 865 | 930 | 1,012 |

Correlation analysis showed a moderate positive correlation between nitrate concentration and allergic disease incidence ($r = 0.62$, $p < 0.05$), as well as between biological soil contamination and helminthiases ($r = 0.71$, $p < 0.05$).

**5. Conclusion**

The study demonstrates that soil contamination in the Fergana region has increased over the 2019–2024 period and represents an important etiological factor in the development of both infectious and non-infectious diseases among the population. Biological soil pollutants significantly contribute to the persistence and spread of intestinal infections and helminthiases, while chemical contaminants, particularly nitrates and heavy metals, are strongly associated with the rising incidence of chronic non-infectious conditions.

The identified associations between soil quality indicators and morbidity rates confirm the hygienic and epidemiological importance of soil as a component of the human environment. Without targeted preventive measures, continued degradation of soil quality may further exacerbate public health risks in the region.

**6.Practical Recommendations**

Based on the findings of this study, it is recommended to strengthen regional soil hygienic monitoring through systematic sampling and laboratory analysis, with particular attention to agricultural and residential areas at increased risk of contamination. Regulatory control over the use of mineral fertilizers, pesticides, and other agrochemicals should be enhanced in order to reduce chemical soil loading and prevent further accumulation of toxic substances.

Improvement of sanitation and waste management infrastructure in residential areas, especially in rural settlements, is essential to limit biological soil contamination. In addition, the integration of environmental indicators, including soil quality parameters, into public health surveillance systems would allow for earlier identification of risk trends and more effective implementation of preventive interventions.

**References:**

1. World Health Organization. Soil Pollution: A Hidden Reality. WHO Press, Geneva, 2018.
2. World Health Organization. Environmental Health Criteria and Guidelines for Soil Quality. Geneva, 2020.
3. Ministry of Health of the Republic of Uzbekistan. Annual Statistical Report on Population Morbidity. Tashkent, 2019–2024.
4. State Committee for Ecology and Environmental Protection of the Republic of Uzbekistan. Environmental Monitoring Report. Tashkent, 2022.
5. Zhang, X., Davidson, E.A., Mauzerall, D.L. Managing nitrogen for sustainable development. Nature. 2015; 528: 51–59.

pISSN:2349-5707 Volume:13,Issue 1, January -2026 eISSN:2349-5715

6. Kim, K.H., Kabir, E., Jahan, S.A. A review on the distribution of heavy metals in the environment and their human health impacts. Journal of Hazardous Materials. 2014; 282: 24–41.

7. FAO. Soil Pollution: Sources, Management Strategies and Assessment. Food and Agriculture Organization of the United Nations, Rome, 2018.

8. Otabekov, U.A., Karimov, B.K. Hygienic assessment of soil contamination in agricultural regions of Uzbekistan. Central Asian Journal of Environmental Science. 2021; 4(2): 45–52.

9. Rahmatov, A., Islomov, S. Environmental determinants of public health in the Fergana Valley. Public Health and Ecology. 2022; 6(1): 18–27.

10. Saidova, K., Madraimov, A., Kodirova, M., Madraimov, A., Kodirova, K., Babarakhimov, T., ... & Zokirov, K. (2024). Assessing the impact of invasive species on native aquatic ecosystems and developing management strategies. International Journal of Aquatic Research and Environmental Studies, 4, 45-51.

11. Ashurova, M. D., Mo'ydinova, Y., Atadjanova, D., Muhammadova, G., & Ismoilov, D. (2023). Pedagogical efficiency of integrated learning in the organization of hygiene classes in medical universities. In BIO Web of Conferences (Vol. 65, p. 10016). EDP Sciences.

12. Rahmatshoyev, M. The importance of vitamins and minerals for athletes. Ethiopian International Journal of Multidisciplinary Research.