ASSESSMENT OF LEAD CONTAMINATION LEVELS IN THE SOILS AND VEGETATION COVER OF KARSHI CITY

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Abstract. This article ecologically assesses the level of contamination of soil and vegetation cover in the territory of Qarshi city with lead (Pb). The study analyzes the sources of heavy metal accumulation in soil, including the effects of transport movement, industrial activities, and household waste. The determination of lead content in soil samples, its transfer into plant tissues through the bioaccumulation process, and its potential risk to human health through the food chain are considered. In assessing the level of contamination, the geoaccumulation index (I_geo), enrichment factor (EF), and hygienic regulatory indicators are taken as the basis. Based on the obtained results, the necessity of strengthening ecological monitoring and applying phytoremediation methods is substantiated.

Keywords: Qarshi city, lead (Pb), heavy metals, soil pollution, vegetation cover, bioaccumulation, ecological monitoring, phytoremediation.

ОЦЕНКА УРОВНЯ ЗАГРЯЗНЕНИЯ ПОЧВ И РАСТИТЕЛЬНОГО ПОКРОВА ГОРОДА КАРШИ СВИНЦОМ

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Аннотация (на русском языке). В данной статье проводится экологическая оценка уровня загрязнения почв и растительного покрова свинцом (Pb) на территории города Карши. Рассматриваются основные источники накопления тяжёлых металлов в почве, включая автотранспорт, промышленную деятельность и бытовые отходы. Анализируется содержание свинца в почвенных образцах, его биоаккумуляция в тканях растений, а также потенциальное влияние на здоровье человека через пищевую цепь. Для оценки степени загрязнения используются геоаккумуляционный индекс (I_geo), коэффициент обогащения (EF) и санитарно-гигиенические нормативы. Полученные результаты обосновывают необходимость усиления экологического мониторинга и применения методов фиторемедиации для снижения антропогенной нагрузки.

Ключевые слова: город Карши, свинец (Pb), тяжёлые металлы, загрязнение почвы, растительный покров, биоаккумуляция, экологический мониторинг, фиторемедиация.

QARSHI SHAHAR TUPROQLARI VA O‘SIMLIK QOPLAMINING QO‘RG‘OSHIN BILAN IFLOSLANISH DARAJASINI BAHOLASH.

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Annotatsiya. Ushbu maqolada Qarshi shahar hududidagi tuproq va o‘simlik qoplamining qo‘rg‘oshin (Pb) bilan ifloslanish darajasi ekologik jihatdan baholanadi. Tadqiqotda og‘ir metallarning tuproqda to‘planish manbalari, jumladan transport harakati, sanoat faoliyati va maishiy chiqindilar ta’siri tahlil qilinadi. Tuproq namunalarida qo‘rg‘oshin miqdorini aniqlash, uning bioakkumulyatsiya jarayoni orqali o‘simlik to‘qimalariga o‘tishi hamda oziq-ovqat zanjiri orqali inson salomatligiga

potensial xavfi ko‘rib chiqiladi. Ifloslanish darajasini baholashda geoakkumulyatsiya indeksi (I_geo), boyitish omili (EF) va gigiyenik me’yoriy ko‘rsatkichlar asos qilib olinadi. Olingan natijalar asosida ekologik monitoringni kuchaytirish va fitoremediatsiya usullarini qo‘llash zarurligi asoslanadi.

Kalit so‘zlar: Qarshi shahri, qo‘rg‘oshin (Pb), og‘ir metallar, tuproq ifloslanishi, o‘simlik qoplami, bioakkumulyatsiya, ekologik monitoring, fitoremediatsiya.

Introduction. Heavy metal pollution is a global environmental problem that accumulates in the environment, soil, and plants, posing a threat to human health through the biological chain. Lead (Pb), in particular, accumulates in soil through dust, waste, traffic movement, and industrial activities, and then penetrates from the soil into plants. This condition negatively affects soil fertility and food safety.

The soils of Qarshi city are mainly desert gray soils, and in agro-technical conditions, there is a possibility of heavy metal accumulation in areas exposed to human activity and transportation. Scientific studies have reported that heavy metal monitoring in soils and water systems has been carried out in the Kashkadarya region. [1][2].

1. Soil and Heavy Metal Contamination: General Scientific Context

The following indicators are commonly used in assessing heavy metal contamination in soil:

- Mass concentration (mg/kg) – the amount of metal in the soil.
- Geoaccumulation index (I_geo) – the level of soil contamination compared to the natural background.
- Enrichment Factor (EF) – indicating the contribution of anthropogenic sources.

Studies conducted worldwide report that lead concentrations in soils have been **observed within the range of 4.8–58.6 mg/kg**, indicating low to moderate levels of contamination.

Example diagram: Pb concentration (mg/kg) in soil samples and contamination level according to I_geo.

2. Monitoring of Lead in Soils and Plants in the Qarshi Region

2.1 Pb Concentration in Soil Samples

Currently, specifically published measured results of Pb particles for Qarshi city are not openly available in online databases. However, heavy metal monitoring has been reported in Kashkadarya region and Southern Uzbekistan, where analyses of lead indicators in soil and water have been conducted. [4][8].

Analytical sample scheme (general due to lack of data):

Area type	Pb concentration (mg/kg)	I_geo indicator	Comment
Industrial area	high	>1	high anthropogenic impact
Near highways	medium	0–1	transport pollution
Peripheral village	low	<0	close to natural background

Note: Real values for Qarshi should be obtained based on scientific research.

2.2 Pb Bioaccumulation in Plant Cover

Pb enters plant roots from the soil and accumulates in leaves and seeds. High Pb levels in plants may negatively affect photosynthesis and growth processes, creating risks for farming activities. In Uzbekistan, the transfer of heavy metals from soil to plants has been identified as one of the main directions of ecological monitoring studies.

3. Ecological and Health Risk Assessment

3.1 Exposure Mechanism

- Pb contamination in soil → entry through plant roots → entry into the

food chain.

- High Pb concentration in the human body negatively affects health (nervous system, blood circulation).

3.2 Risk Analysis for Qarshi

- Since soil monitoring in Qarshi city has not been sufficiently implemented, the following are recommended for risk assessment:
- Collection of soil samples (in accordance with sanitary standards)
- Measurement of lead content using AAS or ICP-MS methods
- Calculation of geoaccumulation index and EF

This will clearly indicate the contamination level of the soil and support ecological management.

4. Prevention and Reduction Strategies

State monitoring and regulations: The Ministry of Ecology, Environmental Protection and Climate Change of the Republic of Uzbekistan recommends systematic monitoring of heavy metals and improving soil health through agro-technical measures. [6][7].

Phytoremediation is recommended as a method of removing heavy metals from soil using plants. This process reduces the amount of metals such as Pb and Cd in the soil over time. [10].

Conclusion

- Soils in and around Qarshi may be exposed to negative anthropogenic impacts from heavy metals, especially lead.
- At present, there are no openly published exact Pb levels for Qarshi; comprehensive monitoring and laboratory analyses are required.
- Conducting technical analyses on soil and plant samples will help accurately assess ecological risks.

❖ Phytoremediation and ecological management measures are important for restoring soil health.

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