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POLLUTION OF AGRICULTURAL SOILS WITH MOBILE METALS

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Abstract
Contamination of soil with heavy metals is one of the types of contamination of farm field soil with toxic elements as a result of mineral feeding of plants used in agriculture and the use of many pesticides similar to hexachlorocyclohexane used in the former Soviet era has been found to be similar. The highest amount was found in the soil taken from the area of the old agricultural airfield depot, the amount of copper was 1580 mg/kg, which is 526 times the permissible amount, and molybdenum was 639 mg/kg, which was 63.9 times the permissible amount.

Keywords: soil, heavy metal (Cr, Ni, Cd, Pb, Mo, Zn, Cu), pollution series.

Introduction

The increasing use of mineral fertilizers in agriculture significantly contributes to soil pollution, leading to extensive ecosystem and environmental degradation. [2; 139-152]. During the mining process, heavy metals are released, and throughout this process, some parts are exposed by floods and wind and move to different places, causing serious environmental hazards. Despite the fact that heavy metals are part of the soil, they cause serious damage to plants and are considered dangerous [3; 414-419.].
Heavy metals (HM) are responsible not only for changing the composition of the soil, in the plant world, but also for forming the basis of stress in plants, which leads to crop loss. Biological molecules such as lipids, nucleic acids, proteins, and enzymes are damaged by HM due to the production of mobile radicals, thereby increasing the level of reactive oxygen species within the cell, leading to oxidative stress. A malfunction in all these biological substances causes a number of physiological problems, including possible cell damage [6; 427-451.].
HM pollution in modern agriculture has become a serious problem in most developing and underdeveloped countries due to various socio-economic, scientific and developmental challenges. Finding environmentally safe, long-term solutions to the problem of HM pollution is a serious task. Currently, the remediation of soil contaminated with HM requires the use of microorganisms or functional biocatalysts [1; 1281–1291.].
These strategies offer a new perspective in biotechnology, allowing the creation of a complex biological system to produce a better microbial system that can combat HM contamination [4;

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To reduce the mobile forms of heavy metals in the soil, it is first necessary to determine their concentrations. This can be followed by using biopreparations to alter the chemical forms of the metals. Through microbial sorption processes and the incorporation of metal ions into solid chitin, these metals are transformed from one type to another, effectively reducing their mobility and overall quantity in the soil.

Heavy metalls affect soil microbiology and alter rhizosphere interactions between plants and microorganisms, affecting soil properties, plant growth, plant type, and agricultural land productivity, etc. Soil is home to diverse microbial communities with unique metabolic capabilities. Some microorganisms can interact with toxic metals to form organic matter, while others contribute to the formation of natural nanoparticles, thereby reducing heavy metals (HM) in the soil [6; 427-451.]. Due to their high surface area to volume ratio, which is directly related to their high reactivity, nanotechnology-based materials have also been studied for HM micro-remediation [5; 3619–3632.].

75% of the known elements are metals and they are distributed in all parts of the biosphere. With the development of industry, heavy metals are increasing in the environment, accumulating in land and water bodies, as a result of which they have a negative impact on biota and human health. Thirteen metals and metalloids (Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn) are main pollutants. Such metals accumulate in natural rocks, particularly metal-bearing minerals, and in agriculture through anthropogenic impacts such as metallurgy and wastewater.

Today, the soil is acting as a toxic object, as the accumulated toxic elements affect not only the environment, but also the properties of the soil.

Therefore, it is necessary to reduce the accumulation of toxic chemical elements in the soil or to transform them into less harmful forms. For example, microorganisms can reduce Cr (VI) to Cr (III) and Fe (III) to Fe (II). The large accumulation of such toxic elements deteriorates the soil ecosystem.

Due to the toxic gases released into the atmosphere by the Samarkand chemical complex and the presence of toxic elements that accumulate during the agrotechnical activities of the anthropogenic factor in agriculture, the soil of the farm "Karimkulov Arslonqul" in Pastdargom district, Samarkand region, and due to the Shurtan gas processing plant and anthropogenic impacts, “Burkhan” farm’s soil in Boston block, Guzor district, Kashkadarya region and garden’s soils allocated for Potassium plant in Dehkhanabad district, old agricultural airfield of Okkorgan district, Tashkent region (78th contour) was selected for pesticide contamination.

Deterioration of the ecological condition of the soil is a condition caused by the change of all complex substances involved in the processes of soil formation.

The soil contains all the elements of Mendeleev's periodic system, and for all products grown in agriculture, their presence in the normal state and exceeding the norm has a negative effect on all environmental factors.

A pesticide warehouse is located in the old agricultural airfield (78th contour) in the Okkorgan district of the Tashkent region, and now this circuit is neglected and not used for agriculture. According to the chemical analyzes of the soil composition, it was found that alpha, beta, gamma hexachlorocyclohexane and dichlorodiphenyltrichloroethane and its metabolites are up to 3000

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times higher than the maximum permissible concentration (MPC) of the residual pesticides. In addition, in the first year of the project, a research was carried out to determine the heavy metals present in the soil, mainly mobile forms of 23 types of elements were found out.

Cadmium is one of the most toxic heavy metals, and therefore classified as dangerous class 2 - "extremely dangerous substances" by the SanPiN of Russia. As a result of the operation of its smelters, about 1 million kg of cadmium are released into the atmosphere every year, which is about 45% of the total pollution with this element. 52% of pollution comes from incineration or processing of products containing cadmium. Cadmium has a relatively high volatility, so it easily enters the atmosphere [8; https://shn.tatarstan.ru/index.].

MPC for the mobile form of cadmium in soil is 0.5 mg/kg [9; 62.]. Soil samples were taken by the envelope method from a total of 5 points from the selected area of 78th contour. The highest values of cadmium were found to be 13.3 mg/kg in plowed layer soils and 9.02 mg/kg in 0-50 cm soils. It was found that the substratum is at the average MPC level and above (Figure 1).

The mobile form of cadmium is 5.06-8.15 mg/kg in plowed soils of 0-30 cm taken from Potassium plant's garden, Dekhkanabad district, Kashkadarya region, up to 1.63 times from MPC, under plowed soil 30-50 cm. It was found that it was less than MPC in the layers, and the beginning of pollution was found in the upper layer of the soil.

In the 2nd and 5th section soils obtained from the "Burkhan" farm soils of Guzor district, Kashkadarya region, it was around 9.02-9.85 mg/kg in the 0-30 cm layer, and 10,9-29,3 mg/kg in the 30-50 cm layers and was calculated to be 5.86 times higher than MPC values. It was found that the amount of cadmium ions in the soil taken from the "Karimkulov Arslonqul" farm area of Pastdargom district of Samarkand region is around 6.4-14.8 mg/kg, and it is 1.28-2.96 times higher than MPC.

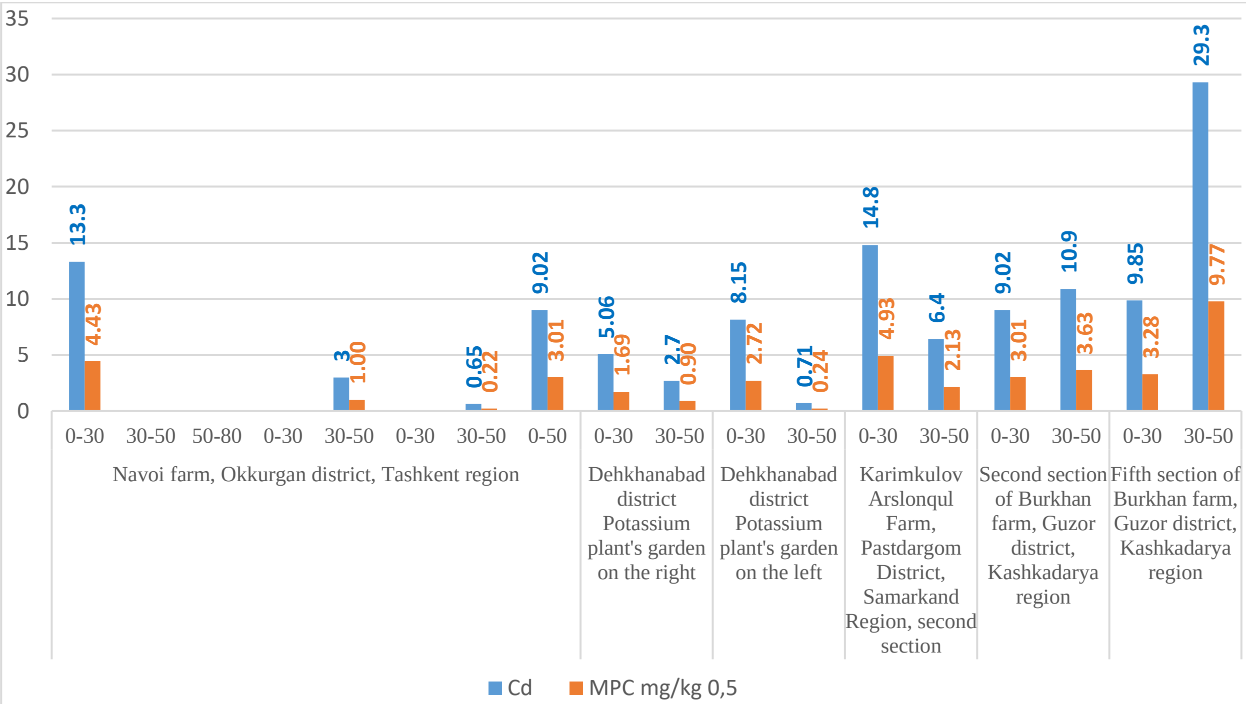

Figure 1. Mobile form of cadmium element in soil

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MPC for the mobile form of copper is 3 mg/kg [9; 62.]. In the 0-30 cm layer of the soil brought from the 78th contour's field allocated for the old agricultural airfield in Okkurgan district, Tashkent region, mobile form of copper was around 812-966 mg/kg, from the MPC indicator 271-322 times, and 1580 mg/kg in the 0-50 cm layer, which is 527 times higher than MPC. The fact that not only the amount of pesticides is high in the soil of the storage area, but also the copper element is higher than MPC can be explained by the large amount of copper sulfate used and stored in agriculture (Fig. 2).
The amount of copper in the 0-30 cm layer and the 30-50 cm layer of Potassium plant's garden was 36.7-37.9 mg/kg and 13.9-41.2 mg/kg respectively, 12.2-12.6 and 4,6-13,7 times higher than MPC indicator. It was 45.4-58.5 mg/kg in the 0-30 cm layer of "Burkhan" farm's soils (15.1-19.5, 13.5-26.8 times more than the MPC indicator), and 40,5-80,3 mg/kg in the 30-50 cm layer, an increase of 13.5-26.7 times from MPC was observed (Fig. 2).

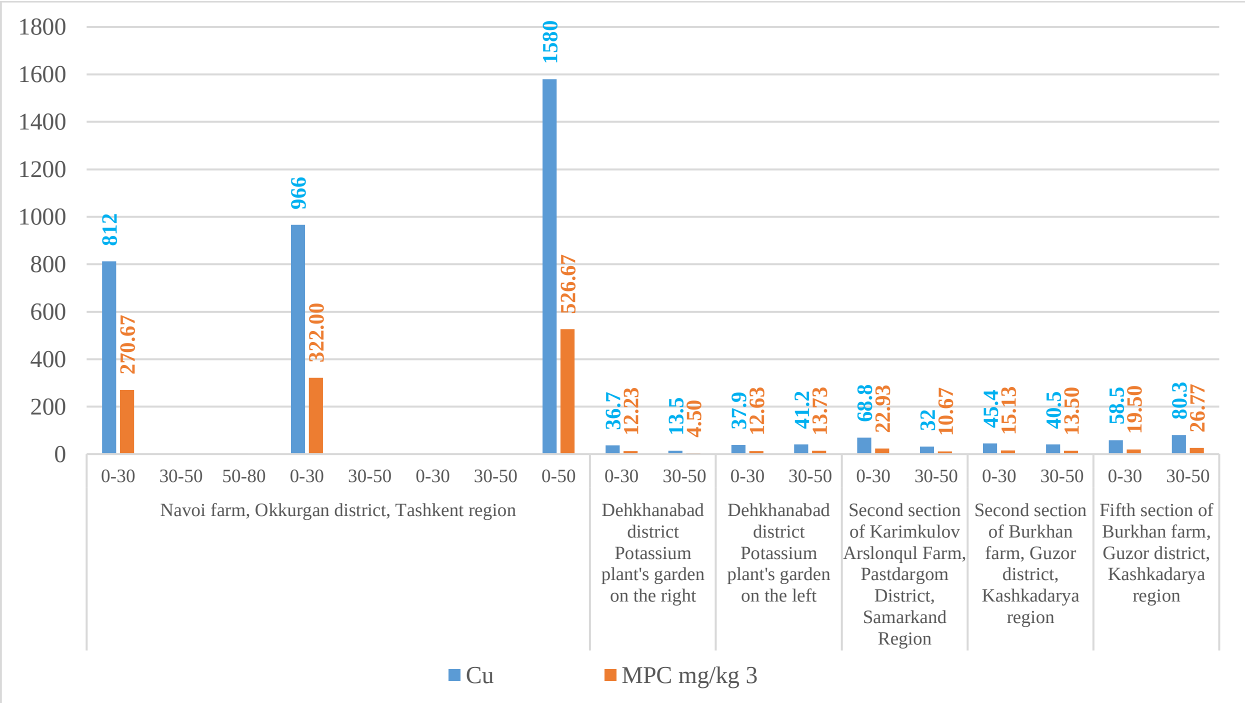

Figure 2. A mobile form of copper in the soil

Accumulation of zinc element was observed to increase from MPC in all selected area soils. mobile form of zinc was 78.1-23.5 mg/kg in the 0-30 cm layer of soil of the 78th contour's selected area from Okkurgan district, 52 mg/kg in the 30-50 cm layer, and 23.8 mg/kg was accumulated in the 0-50 cm layer. The highest zinc content in these soil samples was 78.1 mg/kg, which was 3.40 times higher than MPC (Fig. 3).
Accumulation of zinc ions in the garden soils allocated for the Potassium plant was around 43.6-58.2 mg/kg, and it was observed that this pollution is consistent with the amounts of the element scattered in the soils of the selected area from Okkurgan district (Fig. 3).
It was observed that contamination of soil with the above-mentioned element in the farm "Karimkulov Arslanqul" was accumulated in plowed and under-plowed soil in the amount of 86.3-

44.5 mg/kg, 3.75-1.93 times more than MPC. It is the proximity of the Samarkand chemical complex to the soils of this region and the large amount of waste gases emitted from the plant that lead to an increase in the mobile element of zinc (Fig. 3).

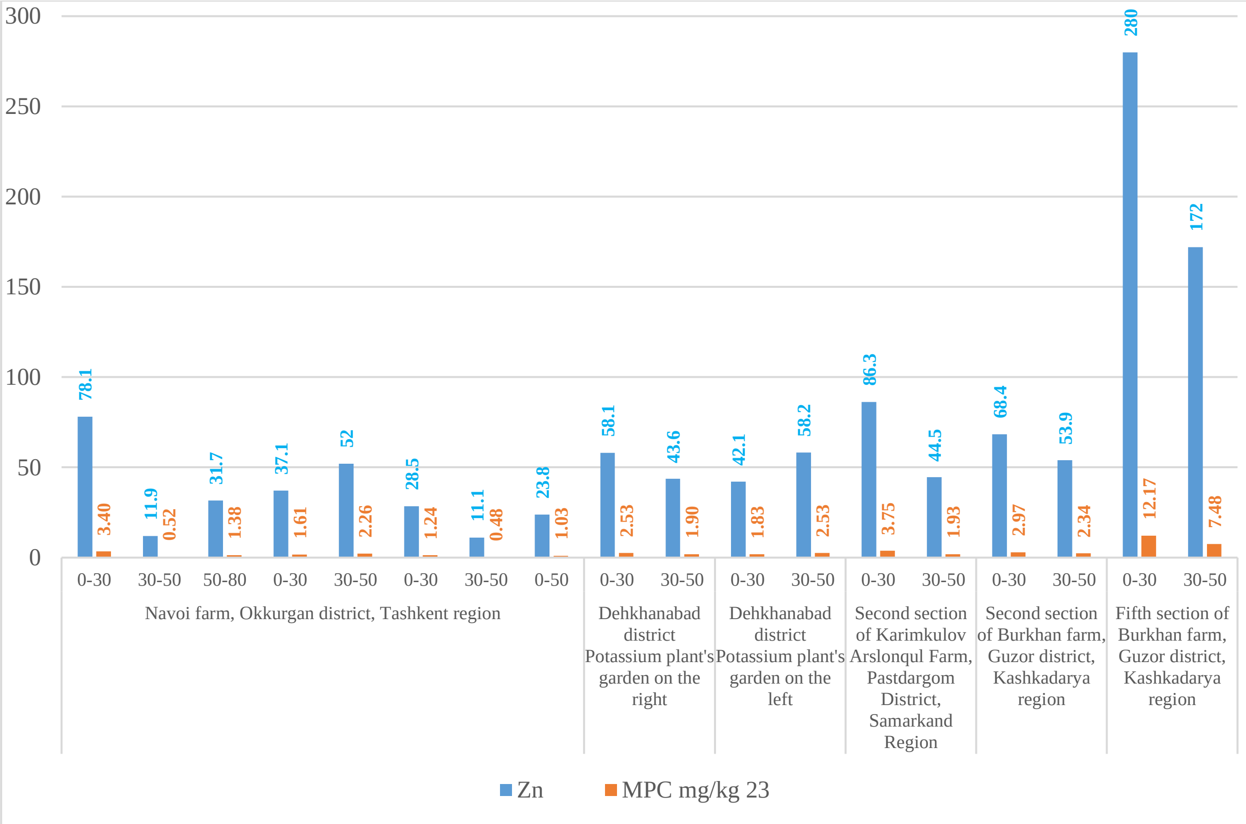

Figure 3. A mobile form of zinc in the soil

High pollution was detected in the light gray soils spread on the "Burkhan" farm, located in Boston block, Guzor district, and it was 280 mg/kg in the 0-30 cm layer, and 172 mg/kg in the 30-50 cm layer which is 7.48 times more than MPC (Fig. 3).

The permissible amount for the mobile form of chromium in the soil is 6 mg/kg, and only in the 0-30 cm layer of the 78th contour soil samples selected from the Okkurgan district, it is about 34.8 mg/kg and it was observed that the element was not encountered at all towards the lower layers. A soil sample taken from the 0-50 cm layer showed 20.4 mg/kg contamination, which is 3.4 times higher than the MPC (Fig. 4).

Accumulated element was 1.53 mg/kg in the 0-30 cm layer of the first section of Potassium plant's garden in Dehqonabad district, 3.55 mg/kg towards the lower 30-50 cm layers, and 62-9.14 mg/kg in the second section respectively. The amount of chromium accumulated in the first and second sections compared to MPC was observed to be less than 0-30 MPC of the first and second sections, while it was 1.52 times higher than MPC in the 30-50 cm layer of second section.

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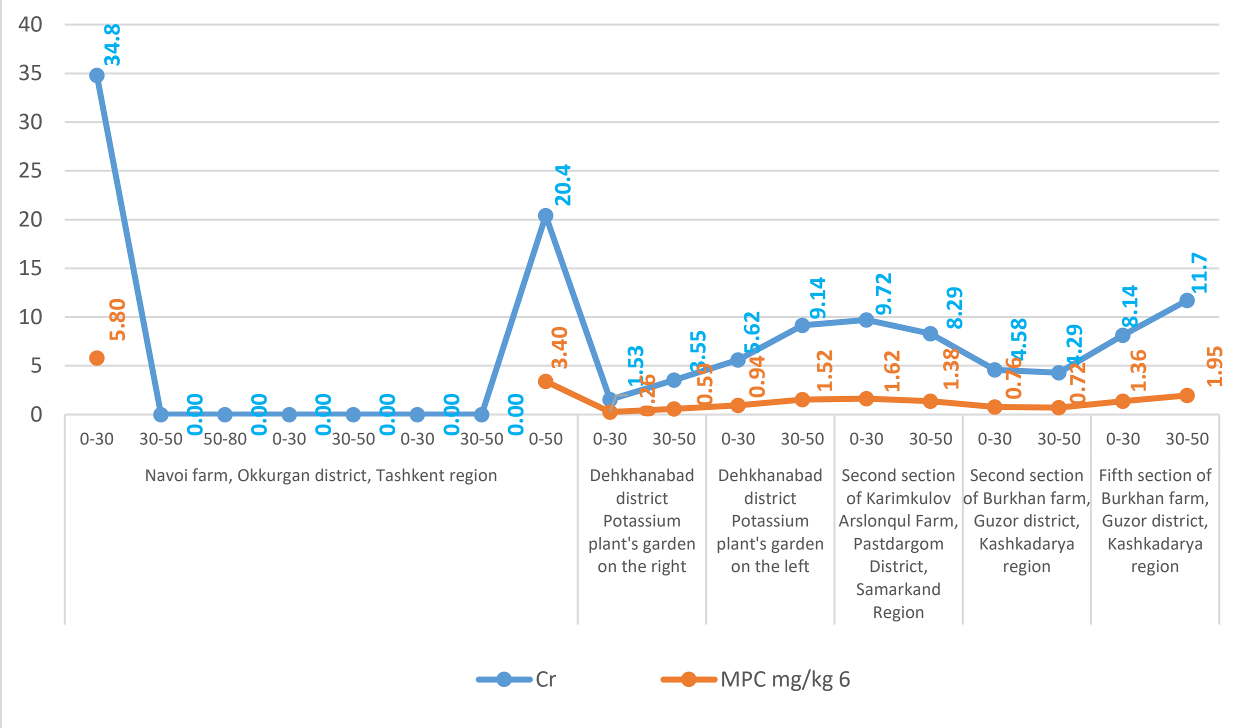

Figure 4. A mobile form of chromium in the soil

Mobile form of chromium in the scattered soils of "Karimkulov Arslanqul" farm field was around 8.29-9.72 mg/kg higher than MPC, and in the soils of "Burkhan" farm field in Guzor district , it was increased up to 1.95 times above MPC in the lower layers (Fig. 4).

MPC for mobile molybdenum element in the soil is 10 mg/kg [9; 62.]. Only in the soils around the warehouse where pesticides were stored, molybdenum was observed to increase from 21.6 to 63.9 times MPC (Fig. 5).

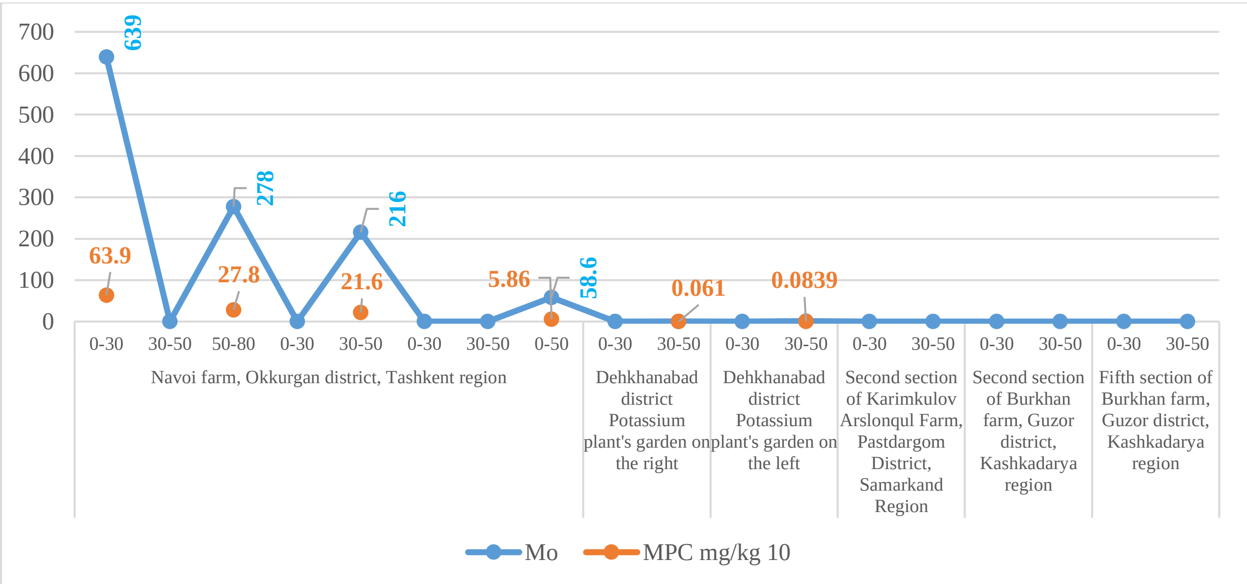

Figure 5. Mobile form of molybdenum in the soil

The MPC of mobile nickel is 4 mg/kg [9; 62.]. Just like molybdenum element, it was observed to increase from MPC 8.23-7.85 times in the 0-30 cm layers of the soil, and to 3.28 times towards the lower layers (Fig. 6). The highest concentrations of the element were also found in places where pesticides were stored.

In the soil samples taken from Kashkadarya and Samarkand regions, it was observed that nickel was accumulated in small amounts. 12.9 mg/kg was accumulated in the 30-50 cm layer of the second section taken from the garden of the Potassium plant, which was 3.23 times higher than the MPC (Fig. 6).

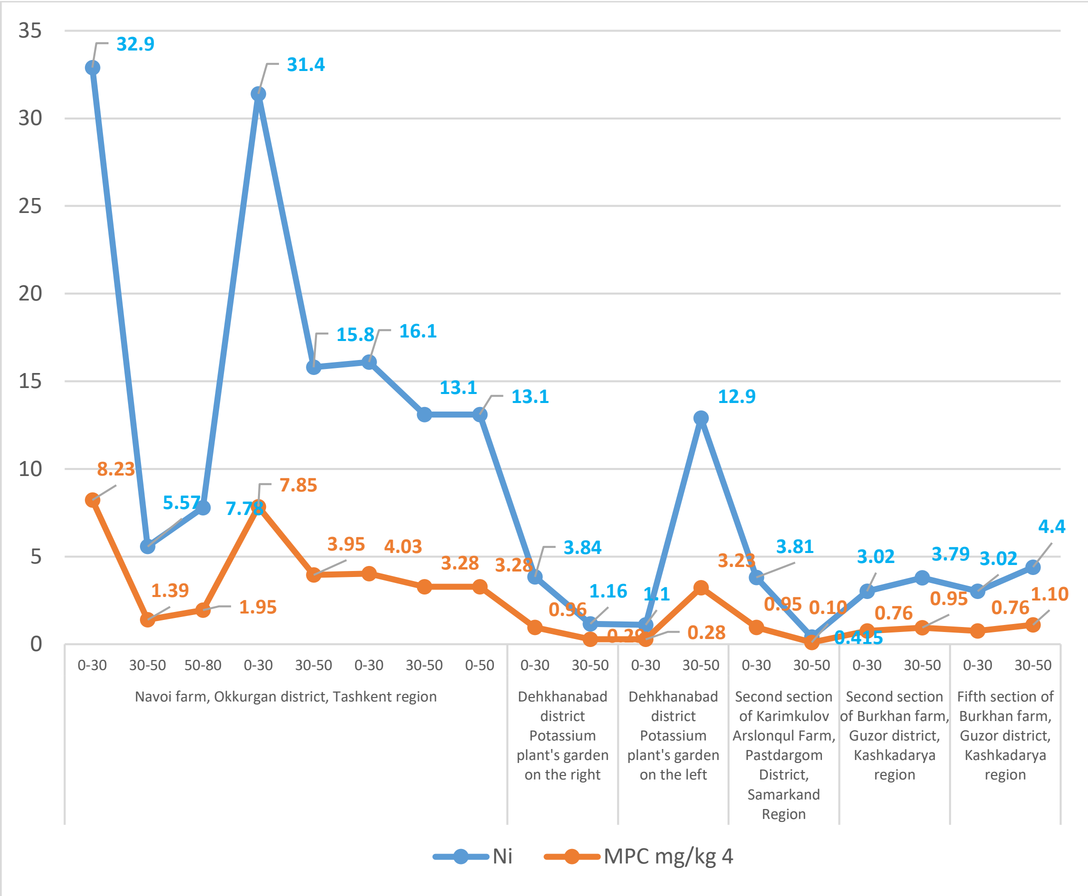

Figure 6. Mobile form of nickel in the soil

The mobile form of lead in soil is 6 mg/kg [9; 62.]. In the sections taken from the soils of all the selected objects, the lead element is 1.08-7.52 times higher than MPC, and the highest value is in the 30-50 cm soil layer of the Potassium plant in Dehqonabad district. It was found to be 45.1 mg/kg (Figure 7).

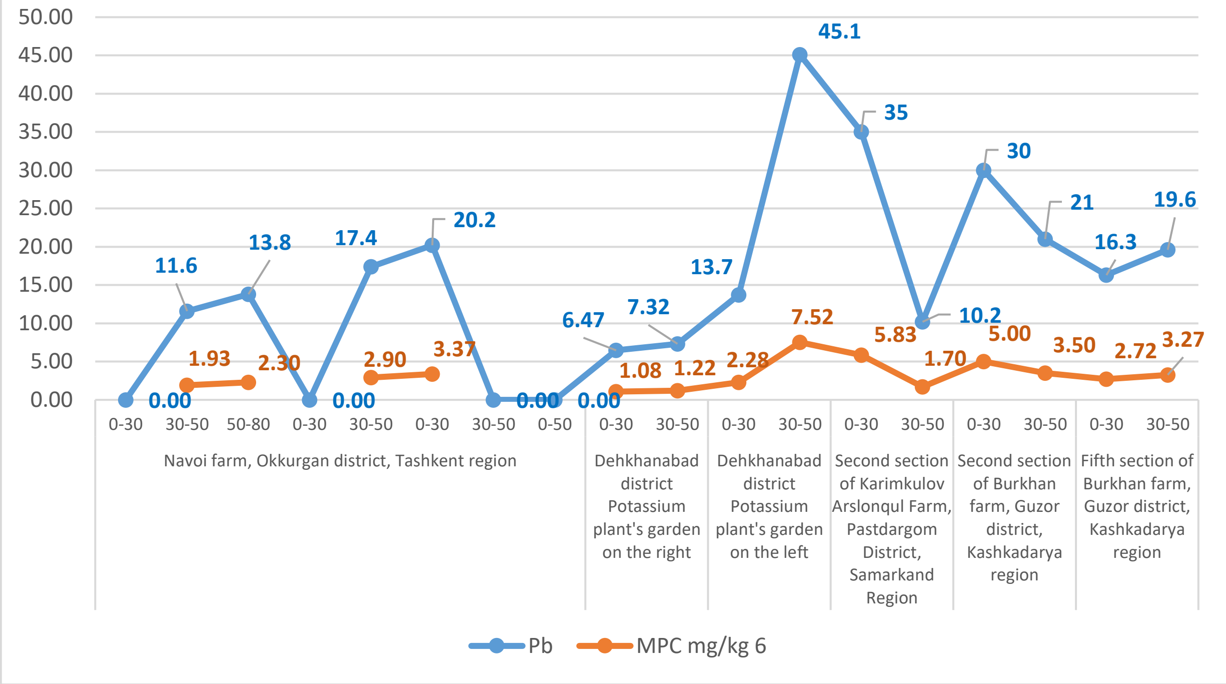

Figure 7. A mobile form of the lead in the soil

Due to the presence of nickel elements in the minerals, it can be seen that element ions are higher than MPC in the soils of all regions and soil pollution has begun (Fig. 7).

It was found that the amount of lead in the soil brought from the area of the old agricultural airfield in the Okkurgan district of Tashkent region is around 11.6-20.2 mg/kg, and it is 1.93-3.37 times higher than MPC. The soils of 78th contour, where pesticides were stored, showed high concentrations of certain metal ions.

In conclusion, heavy metal contamination of the soil, resulting from an increase in metal ions, negatively impacts all plant life in agriculture and affects consumer organisms in the food chain through plant products. It was found that the soils under study are highly contaminated with elements such as Cr, Ni, Cd, Pb, Zn, Mo, and Cu, it is evident that these soils are polluted with elemental ions:

1. Potassium Plant's garden in Dehkhanabad District - Pb→Zn→Cu→Ni→Cr→Cd→Mo;
2. Burkhan farm in Guzor district- Zn→ Cu→Pb→Cd→Cr→Ni→ Mo;
3. Karimkulov Arslankul farm - Zn→Cu→Pb→Cd→ Cr→Ni→Mo;
4. Old agricultural airfield in the Burkhan farm's 78th contour , Okkurgan district - Cu→Mo →Zn→Cr→ Ni→Pb→Cd.

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