

GEOGRAPHY

Radionuclides and heavy metals in soils and waters on the territory of radioactive contamination in Volyn region

O. Hromyk¹, O. Ilyina²

¹Department of Tourism and Hospitality Management Eastern European National University of Lesia Ukrainka

²Tourism and Hospitality Management Eastern European National University of Lesia Ukrainka, Lutsk, Ukraine

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Abstract. An important environmental issue is the need to develop cost-effective measures to reduce contamination of soil and water with heavy metals and radioactive substances. Soil and water are intensively used in agricultural production and require analysis of their condition due to the risk of food contaminants. The estimation of radionuclides and heavy metals in the soil and surface waters on the territory of radioactive contamination in the Volyn region was conducted. It shows that the proportion of ¹³⁷Cs, ⁹⁰Sr exceeds the maximum permissible concentration of heavy metals. The study area requires a long process of social and economic rehabilitation, which involves restoration of natural resources and safe living conditions, the introduction of advanced technologies for the production of environmentally friendly agricultural products.

Keywords: radionuclides, heavy metals, water, soil, maximum permissible concentration, radiological analysis, radioactive contamination.

Raising of scientific problem and its value. Intensification and different forms of anthropogenic influence on a natural environment puts before geographical science various and difficult problems which need study and decision. It touches tasks from the guard of environment optimizations of measures about the use of natural resources. In this aspect considerable attention is deserved by soils and reservoirs as accumulations of contaminants in a landscape.

After the Chernobyl disaster the Volyn region suffered radioactive contamination (cesium, strontium, etc.) including Manevychi, Kamin-Kashirsk, and Liubeshiv Districts. The negative impact of the Chernobyl disaster reflected in all spheres of life in the region. The biggest loss sustained agriculture. Also, agricultural products received in the zone of radioactive contamination is a source of public exposure. Equally important are ponds and soil contamination by heavy metals. The problem of security of the population living in such areas not fully resolved. The large areas of pollution and high levels of pollution of agricultural land of radionuclides and heavy metals and high transfer of pollutants from soil and water to food stuffs. There is a requirement in finding out of features of their distribution and concentration in the soils and waters.

An analysis of researches of this problem. The problem of contamination by toxic substances devoted a significant amount of work. Particular attention is deserved by work V. Samoilenko, who proposed comprehensive zoning contaminated areas and possible radiological consequences [11–12], Y. Tavrov, which identified the most environmentally dangerous types of local systems and types of using the water, biological and landed recourses of geosystems of Polissia and north Lisostep [13] L. Ilyin, who studied natural water bodies as environments of piling up and accumulation of the ground deposits and established state of lake ecosystems examined technological processes of transformation and sources of income and types of toxic substances in them [4–10, 14] and others. However, the spatio-temporal aspects of distribution and accumulation of pollutants, especially near settlements require detailed research.

A purpose of the article is an estimation of content of radionuclides and heavy metals in water bodies, soils of radioactive zone in the Volyn region. Were put such tasks to achieve this: to analyze the spatial differentiation of ra-

dionuclide ¹³⁷Cs, ⁹⁰Sr; set the level of heavy metals (lead, zinc, copper, cadmium).

The accumulation of information necessary for decision-making regarding the control and regulation of radioactive contamination of the environment and the development of measures to reduce the absorption of doses applied population is an important challenge for the study area. The distribution of radionuclides in soils and waters, their ability to migration on ecological chain and concentrate in certain levels of food chains necessitate the analysis of radioactive contamination of agricultural land, soil, crop production, which leads to the need for targeted monitoring of agriculture.

During organization of radiation control it should pay attention to objects and parts of ecological relationships that are critical to the absorbed dose by population. Therefore, one of the most important objects of radiation analysis is a branch of agricultural production, especially production of plant-grower and stock-raising. In this case the main source of radionuclides in the food chain is soil. Radionuclides accumulated in the soil, are involved in the biogeochemical cycles of migration and become the new components of soil. Depending on the stability of the sorption of radionuclides in the soil and speed of migration is determined by their distribution in the food chain. When absorbed by plants, the radionuclides arrive in the crop production and in its consumption in the human body.

During the execution of the studies are processed stock materials of Volyn regional state production engineering center of Protection of Soil Fertility and product quality “Oblderzhrodiuchist”. Field and laboratory studies were carried out with different applicable standard measurement methods and selection of samples in accordance with applicable radiochemical techniques, radiospectrometry, hydrochemical, statistical analysis [1–3].

As a result of analysis of the soil contamination ¹³⁷Cs, ⁹⁰Sr in settlements established that the maximum concentration of ¹³⁷Cs and ⁹⁰Sr are available in Liubeshiv Administrative Region (¹³⁷Cs v. Berezna Wolia (2,83 Ci/km²) and ⁹⁰Sr v. Lahvychi (0,04 Ci/km²). Manevychi, Kamin-Kashirsk and Liubeshiv Districts

As a result of studies are found excess of maximum permissible concentration (MPC) contents of heavy metals

(Hg, Cd, Pb, Cu, Zn) in soils and waters. Specifically excess found for cadmium in soil v. Mala Glusha (0,54 mg/kg) to 1.1 times, v. Mukoshyn (0,64 mg/kg) is 1,3 times in Liubeshiv district and v. Haluziia, or (1,25 mg/kg) is 2,5 times in Manevychi area. The lead content in the water exceeds the maximum permissible concentration by 1,7 times (v. Nuine Kamin-Kashyrsk District 0,05 mg/l). The greatest accumulation of zinc, according to our assessments, the soil in the v. Berezna Volia (110 mg/kg) Liubeshiv area (exceeding 2 times). These information certifies about contamination of soil and water heavy metals near-by settlements. According to the radio-ecological studies of soil in the settlements Kamin-Kashyrsk, Liubeshiv, Manevychi administrative districts it is set that contamination of soil of ^{137}Cs hesitates from 0,24 (v. Olshany) to 1,41 Ci/km^2 (v. Kachyn), maximal content of ^{90}Sr is fixed in v. Karasyn (0,048 Ci/km^2) of Kamin-Kashyrsk administrative district.

The contents of Cu, Zn, Ng in the waters and soils generally does not exceed the MPC. However, the Pb content in the water with. Karasyn (0,0468 mg/l) and v. Kachyn (0,0435 mg/l) of Kamin-Kashyrsk administrative region exceeds the standards 1,6 and 1,4 times, respectively. Cadmium was found in the maximum amount in the v. Vetly (0,0076 mg/l) of Liubeshiv administrative region (0,0013 mg/dm^3 in excess of 5,8 times).

Taking into account, that a most danger for life of man is made in soil of, ^{90}Sr and ^{137}Cs , a task consists in creation of pre-conditions for the maximal decline of migration of radionuclides in plant products and the optimization of soil. One of the important tasks of radiological protection is to minimize doses to the population. Solving this problem is possible by reducing the intake of radionuclides with food. Taking into account, that the share of private sector output increased and the local population diet consists mainly of food grown in private households, it is necessary to take measures that would prevent the production and consumption of contaminated food. In order to preserve the natural resources of the zone of radioactive contamination should

be performed complex agronomic and agrochemical measures to reduce radioactive contamination. The main activities are cultivation and liming acid soils. Fertilizing and liming sorbents with mandatory - one of the main ways that most effectively can affect locking radionuclide by soil absorbing complex. The organic fertilizers increases the absorption capacity of the soil, normalizes acidity reduces the availability of radionuclides by plants through the formation of complex organic-mineral compounds.

For agricultural products with permissible content of radionuclides and radiation safety of people in contaminated areas is necessary protective measures (organizational, agro technical, agrochemical, veterinary, technology, sanitary-hygienic, informative).

The control system of agricultural land in the radiation-contaminated areas should include the following elements: analysis and quantification of the effects of radioactive contamination of the environment; formation of information-analytical database of environmental and economic indicators for sustainable development of the territory, the development of national and regional programs to attract investment and others.

Conclusions and recommendations for further research. The analysis shows that in the zone of radioactive contamination of Volyn region in soils and waters are concentrated significant content of radioactive elements.

Finding out features of spatial differentiation of radionuclides, establishing levels of contamination with radioactive elements ^{137}Cs , ^{90}Sr , heavy metals, water, soils investigated area and determination of maximum permissible concentration in ecosystems requires further study their migration and accumulation.

The problem of contamination by the radionuclides and heavy metals has serious social and economic consequences. The area requires a long process of social and economic rehabilitation, which provides for renewal lost naturally resource potential and safe terms of life of people. The introduction of advanced technologies for the production of environmentally clean products.

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Abstract. An important environmental issue is the need to develop cost-effective measures to reduce contamination of soil and water with heavy metals and radioactive substances. Soil and water are intensively used in agricultural production and require analysis of their condition due to the risk of flow of food contaminants. The estimation of radionuclides and heavy metals in the soil and surface waters on the territory of radioactive contamination in the Volyn region was conducted. It shows that the proportion of ^{137}Cs , ^{90}Sr exceeds the maximum permissible concentration of heavy metals. The study area requires a long process of social and economic rehabilitation, which involves restoration of natural resources and safe living conditions, the introduction of advanced technologies for the production of environmentally friendly agricultural products.

Keywords: radionuclides, heavy metals, water, soil, maximum permissible concentration, radiological analysis, radioactive contamination.

Радионуклиды и тяжелые металлы в почвах и водах территории радиоактивного загрязнения Волынской области

О. Громик, О. Ильина

Аннотация. Важной проблемой охраны окружающей среды является необходимость разработки эффективных и экономически целесообразных мероприятий снижения загрязнения почв и вод тяжелыми металлами и радиоактивными веществами. Почвы и воды интенсивно используются в сельскохозяйственном производстве и требуют анализа их состояния в связи с опасностью поступления загрязнителей в пищевые продукты. Осуществлена оценка содержания радиоактивных элементов и тяжелых металлов в почвенном покрове и водах территории радиоактивного загрязнения в пределах Волынской области свидетельствует, что здесь аккумуляровано значительное содержание ^{137}Cs , ^{90}Sr , обнаружено превышение предельно-допустимых концентраций тяжелых металлов. Территория исследования нуждается в длительном процессе социально-экономической реабилитации, которая предусматривает восстановление природно-ресурсного потенциала и безопасных условий жизни людей, внедрение прогрессивных технологий производства экологически чистой сельскохозяйственной продукции.

Ключевые слова: радионуклиды, тяжелые металлы, вода, почва, предельно-допустимая концентрация, радиоэкологический анализ, радиоактивное загрязнение.