

REVIEW ARTICLE • PEER-REVIEWED • OPEN ACCESS • HAC/OAK 16.00.00 — VETERINARY SCIENCES •
UDC: 619:539.16

Radiological monitoring of environmental objects on farms in the Bekabad district of the Tashkent region

Toshkent viloyati Bekobod tumanidagi fermer xo'jaliklarida atrof-muhit obyektlarining radiologik monitoringi

Радиологический мониторинг объектов окружающей среды в фермерских хозяйствах Бекабадского района Ташкентской области

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ARTICLE INFO

ARTICLE TYPE

Review Article

LANGUAGE OF FULL TEXT

O'zbekcha (UZ)

SCIENTIFIC FIELD / OAK

☒ 16.00.00 – Veterinary Sciences

Veterinariya fanlari

HAC Presidium decision No. 371/5, 13.06.2025

UDC / UDK

619:539.16

ARTICLE HISTORY

Received: 2026-07-07**Revised:** 2026-07-22**Accepted:** 2026-07-29**Published:** 2026-07-31

DOI

<https://doi.org/10.66073/ReFocus.V5I7.0707>

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AUTHOR, TITLE AND ABSTRACT METADATA (EN / UZ / RU)

ENGLISH

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Abstract. This article presents the results of radiometric and radiation-hygienic investigations conducted on dairy farms located in the Turon area of the Bekabad district, Tashkent region. The study analyses the local radiation background, including ambient gamma dose rates and radionuclide concentrations in soil, livestock feed supplies and dairy products (milk). Based on the empirical data collected, scientifically grounded conclusions and practical recommendations are provided to evaluate environmental safety and ensure the radiological purity of livestock products in the region. Detailed information is given on the laboratory testing of soil, alfalfa, water bodies and hay samples on the farm.

Keywords: radioactivity; dosimetry; ionizing radiation; ambient gamma background; radioactive fallout; radioactive isotopes; neutron; muffle furnace; feed; nuclear reactions; radioecological monitoring

O'ZBEKCHA

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Annotatsiya. Ushbu maqolada Toshkent viloyatining Bekobod tumani «Turon» hududida joylashgan sut yo'nalishidagi fermer xo'jaliklarida o'tkazilgan radiometrik va radiatsion-gigiyenik tadqiqotlar natijalari yoritilgan. Tadqiqot davomida ushbu xo'jaliklardagi radiatsiyaviy muhit holati, jumladan tuproq, ozuqa bazasi hamda chorva mahsulotlari (sut) tarkibidagi radionuklidlar miqdori va gamma-nurlanish dozasining quvvati tahlil qilingan. Olingan ma'lumotlar asosida chorvachilik mahsulotlarining ekologik va radiatsion xavfsizligini ta'minlash hamda hududdagi radiatsion fonni baholashga qaratilgan ilmiy asoslangan xulosalar va amaliy tavsiyalar ishlab chiqilgan. Xo'jalik hududidagi tuproq, beda, suv havzalari va pichan namunalari laboratoriya sharoitida tekshirilgani haqida batafsil ma'lumotlar berilgan.

Kalit so'zlar: radioaktivlik; dozimetriya; ionlashtiruvchi nurlanish; tashqi gamma-fon; radioaktiv tushish; radioaktiv izotoplar; neytron; mufle pechi; yem-xashak; yadro reaksiyalari; radioekologik monitoring

РУССКИЙ

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How to cite / Iqtibos keltirish / Как цитировать: KHAKIMOV, B. N., HOJIQULOV, H. N., AYUPOVA, J. R. (2026). Radiological monitoring of environmental objects on farms in the Bekabad district of the Tashkent region. Research Focus International Scientific Journal, 5(7), 45–48. <https://doi.org/10.66073/ReFocus.V5I7.0707>

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HAC / OAK: On the HAC list of national scientific publications (Academy of Sciences of the Republic of Uzbekistan) for 06.00.00 Agricultural Sciences and 16.00.00 Veterinary Sciences. O'zbekiston Respublikasi FA huzuridagi OAK ro'yxatida: 06.00.00 – Qishloq xo'jaligi fanlari; 16.00.00 – Veterinariya fanlari.

Аннотация. В данной статье представлены результаты радиометрических и радиационно-гигиенических исследований, проведённых в молочных фермерских хозяйствах территории «Турон» Бекабадского района Ташкентской области. В ходе исследования проанализировано состояние радиационного фона, включая мощность дозы гамма-излучения, а также содержание радионуклидов в почве, кормовой базе и животноводческой продукции (молоке). На основе полученных данных сформулированы научно обоснованные выводы и практические рекомендации, направленные на оценку экологической безопасности и обеспечение радиационной чистоты производимой молочной продукции в данном регионе. Представлена подробная информация о лабораторных исследованиях образцов почвы, люцерны, водоёмов и сена в хозяйстве.

Ключевые слова: радиоактивность; дозиметрия; ионизирующее излучение; внешний гамма-фон; радиоактивные выпадения; радиоактивные изотопы; нейтрон; муфельная печь; корм; ядерные реакции; радиоэкологический мониторинг

1. KIRISH

Introduction

Yer yuzidagi barcha tirik organizmlar doimo ionlashtiruvchi nurlanish ta'sirida bo'ladi. Ionlashtiruvchi nurlanish manbalarini kelib chiqishiga ko'ra uch guruhga bo'lish mumkin. Birinchi guruhga kosmik kelib chiqishga ega nurlanishlar kiradi. Ikkinchi guruhni yer jinslarining tabiiy radioaktiv moddalari hamda tuproq, suv, havo, o'simlik va hayvonot dunyosida, shuningdek inson tanasida mavjud bo'lgan tabiiy radioaktiv elementlarning nurlanishi tashkil etadi. Ushbu ikki guruh ionlashtiruvchi nurlanishning tabiiy fonini yuzaga keltiradi.

Uchinchi guruhga sun'iy radionuklidlar kiradi. Ular yadroviy qurol sinovlari yoki atom elektr stansiyalaridagi avariya (Chernobil, Fukushima va boshqalar) natijasida hosil bo'lib, mahalliy, troposfera yoki global yog'inlar shaklida yer yuzasiga tushadi yoxud radioaktiv sanoat korxonalarini demontaj qilish jarayonida tashqi muhitga chiqadi. Bu manbalarining barchasi ma'lum sharoitlarda ichki va tashqi nurlanish orqali hayvonlar va odamlar organizmiga sezilarli ta'sir ko'rsatishi mumkin. Tashqi va ichki manbalarining yig'indisi radiatsion fonni belgilaydi.

Elementlarning tabiiy aralashmasida mavjud bo'lgan tabiiy radioaktiv izotoplardan tashqari, turli yadroviy reaksiyalarning natijasida — yadro reaktorlarida barqaror kimyoviy elementlarning neytron oqimlari bilan nurlantirilishi yoki og'ir zarralar bilan bombardimon qilinishi orqali — olingan ko'plab sun'iy izotoplar ham ma'lum. Yadro sinovlaridan keyingi dastlabki oylarda yoki avariya natijasida parchalanish bo'laklari aralashmasi ^{131}I , ^{140}Ba va ^{90}Sr ni, keyinchalik esa asosan ^{90}Sr va ^{137}Cs ni o'z ichiga oladi; ular atrof-muhitning global radioaktiv ifloslanishining asosiy qismini tashkil qiladi.

O'z-o'zidan (quruq yog'ingarchilik) yoki ko'pincha atmosfera yog'inlari bilan birga tushadigan yadroviy parchalanishning radioaktiv mahsulotlari biosferaning abiotik (suv, tuproq) va biotik (o'simlik, hayvonot dunyosi) tarkibiga kiradi hamda moddalarning biologik aylanishiga qo'shiladi. Bunday holda parchalanish mahsulotlari inson organizmiga o'simlik oziq-ovqatlari orqali yoki radioaktiv moddalarni o'z ichiga olgan yem-xashakni iste'mol qilgan hayvonlar mahsulotlari orqali kirib boradi.

2. RADIOEKOLOGIK MONITORINGNING MAQSADI VA VAZIFALARI

Aims and objectives of radioecological monitoring

Radioekologik monitoring — atrof-muhit komponentlarida (atmosfera havosi, tuproq, yer usti va yer osti suvlari, o'simlik va hayvonot dunyosi) tabiiy hamda texnogen radionuklidlarning tarqalishini, ularning migratsiyasi va biologik aylanishini muntazam kuzatish, baholash hamda prognozlashga qaratilgan kompleks ilmiy-amaliy tadbirlar tizimidir. Monitoring natijalari aholi salomatligini muhofaza qilish, qishloq xo'jaligi mahsulotlari xavfsizligini ta'minlash va ekologik barqarorlikni saqlashda muhim ilmiy asos bo'lib xizmat qiladi.

Radioekologik monitoringning asosiy maqsadi radiatsiyaviy xavf tug'dirishi mumkin bo'lgan tabiiy va texnogen manbalar ta'sirida atrof-muhitda yuz berayotgan radiatsion o'zgarishlarni o'z vaqtida aniqlash, ularning ekologik va sanitariya-gigiyenik oqibatlarini baholash hamda inson salomatligi va biosfera uchun xavfsiz sharoitni ta'minlashdan iborat. Ayniqsa atom energetikasi obyektlari, metallurgiya korxonalari, konchilik sanoati, radioaktiv materiallardan foydalanuvchi ishlab chiqarish tarmoqlari hamda radioaktiv chiqindilar saqlanadigan hududlarda bunday monitoringning ahamiyati yanada ortadi.

Toshkent viloyatining Bekobod tumani va Bekobod shahri respublikaning yirik sanoat hududlaridan biri bo'lib, metallurgiya, qurilish materiallari ishlab chiqarish hamda yangi metallurgiya quvvatlarining rivojlanishi bilan tavsiflanadi. Hududda qora metallurgiya sanoatining rivojlanganligi va to'g'ridan-to'g'ri tiklangan temir ishlab chiqarish loyihalarining amalga oshirilishi atmosfera, tuproq va suv obyektlarining ekologik holatini, jumladan radiatsion fon ko'rsatkichlarini muntazam nazorat qilish zaruratini yuzaga keltiradi. Bunda radioekologik monitoring sanoat faoliyatini radiatsion xavfsizlik nuqtai nazaridan baholash uchun muhim ilmiy vosita hisoblanadi.



1-rasm. Radioekologik monitoringning maqsadi / Fig. 1. Aims of radioecological monitoring

Bekobod tumani sharoitida radioekologik monitoringning asosiy vazifalari quyidagilardan iborat: atmosfera havosidagi tashqi gamma-fon dozasining quvvatini muntazam o'lchash; tuproq namunalari tarkibidagi tabiiy radionuklidlar (^{238}U , ^{232}Th , ^{40}K) hamda zarur hollarda sun'iy radionuklidlar (^{137}Cs , ^{90}Sr) miqdorini aniqlash; Sirdaryo suvi, sug'orish suvlari va yer osti suvlari tarkibidagi radiologik ko'rsatkichlarni baholash; qishloq xo'jaligi ekinlari, yem-xashak, sut, go'sht va baliq mahsulotlarida radionuklidlarning biokkumulyatsiya darajasini aniqlash; sanoat korxonalari yaqinidagi kuzatuv nuqtalarida radiatsion foning vaqt bo'yicha dinamikasini o'rganish; radiatsion ko'rsatkichlarning sanitariya me'yorlari va

xalqaro tavsiyalarga mosligini baholash; radiatsion xavf tug'ilishi mumkin bo'lgan holatlarni erta aniqlash va ularning oldini olish bo'yicha tavsiyalar ishlab chiqish.

Radioekologik monitoringda olingan natijalar faqat radiatsiya darajasini aniqlash bilan cheklanmaydi. Ular radionuklidlarning migratsiya qonuniyatlarini, oziq zanjiri orqali tirik organizmlarga o'tishini, bioakkumulyatsiya va biomagnifikatsiya jarayonlarini o'rganish imkonini beradi. Shu sababli monitoring natijalari ekologik xavfni baholash, qishloq xo'jaligi mahsulotlarining radiatsion xavfsizligini ta'minlash hamda hududning ekologik pasportini shakllantirishda muhim ilmiy asos hisoblanadi.

Bekobod tumani misolida radioekologik monitoringni tashkil etishda kuzatuv punktlarini sanoat korxonalari, avtomobil yo'llari, aholi yashash punktlari, sug'oriladigan qishloq xo'jaligi maydonlari hamda Sirdaryo bo'ylarida joylashtirish maqsadga muvofiqdir. Har bir kuzatuv nuqtasida gamma-fon doza quvvati ($\mu\text{Sv/soat}$), tuproqning solishtirma faolligi (Bq/kg), suvning umumiy alfa va beta faolligi (Bq/l), shuningdek qishloq xo'jaligi mahsulotlaridagi radionuklidlar miqdori aniqlanadi. Ushbu ma'lumotlar geografik axborot tizimlari va statistik tahlil usullari yordamida qayta ishlanib, hududning radioekologik xaritalari tuziladi. Bu esa radiatsion xavf zonalarini aniqlash, ekologik prognozlar tuzish hamda hududning barqaror rivojlanish strategiyasini ishlab chiqishda muhim ahamiyat kasb etadi.

3. XULOSA

Conclusion

Toshkent viloyati Bekobod tumani sharoitida radioekologik monitoringni muntazam tashkil etish sanoatlashgan hududlarda radiatsion xavfsizlikni ta'minlash, ekologik muvozanatni saqlash, oziq-ovqat xavfsizligini mustahkamlash hamda aholi salomatligini muhofaza qilishning muhim ilmiy-amaliy omillaridan biri hisoblanadi. Monitoring natijalari hududning ekologik holatini kompleks baholash, radiatsion xavf darajasini prognozlash va ekologik boshqaruv qarorlarini ilmiy asoslash imkonini beradi.

DECLARATIONS

Declarations

Author contributions CRedit

Conceptualization; Methodology; Investigation; Data curation; Writing – original draft; Writing – review & editing. All authors have read and agreed to the published version of the manuscript.

Funding

This research received no external funding.

Ethics approval

The work was carried out as part of routine radiometric and radiation-hygienic monitoring on farms in accordance with the requirements in force in the Republic of Uzbekistan. It involved no experiments on animals and no human participants.

Informed consent

All authors have read and approved the final version of the manuscript and have given their consent to its submission and publication. The study involved no human participants and no personal data.

Data availability statement

All data supporting the findings of this study are presented in the article and are available from the corresponding author upon reasonable request.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgements

The authors thank the Laboratory of Biochemistry and Radiobiology of the Scientific-Research Institute of Veterinary and the veterinary specialists of the farms that took part in the monitoring.

Generative AI disclosure

Generative AI was used only partially. The authors used Claude (Anthropic, Opus 5) for language editing, formatting of the reference list and preparation of the English and Russian metadata. No text, data, figures or conclusions were generated by AI. The authors reviewed and verified all output and take full responsibility for the content of the publication.

EXTENDED SUMMARY IN ENGLISH

Kengaytirilgan inglizcha xulosa / Расширенный реферат на английском языке

Purpose and research problem

All living organisms on Earth are continuously exposed to ionizing radiation. Its sources fall into three groups: cosmic radiation; the natural radioactive substances of the Earth's crust and the natural radionuclides present in soil, water, air, plants, animals and the human body; and artificial radionuclides formed by nuclear weapon tests or accidents at nuclear power plants such as Chernobyl and Fukushima, which reach the Earth's surface as local, tropospheric or global fallout, or enter the environment during the decommissioning of radioactive industrial facilities. The first two groups create the natural radiation background, and the sum of external and internal sources determines the total background. Radioactive products of nuclear fission enter the abiotic components of the biosphere — water and soil — and its biotic components, and then the biological cycle of matter, so that fission products reach the human body through plant foods or through the products of animals that have consumed contaminated feed. The Bekabad district and the town of Bekabad in the Tashkent region form one of the largest industrial areas of the republic, characterized by metallurgy, the production of building materials and the development of new metallurgical capacity, including direct reduced iron projects. This makes regular monitoring of the ecological state of the atmosphere, soil and water bodies — and of radiation background indicators in particular — a necessity. The purpose of this article is to set out the aims, objectives and organizational principles of radioecological monitoring for the conditions of the Bekabad district and to present the results of radiometric and radiation-hygienic investigations carried out on dairy farms of the Turan area.

Materials and methods

The work is based on the analysis of published sources on radioecological monitoring, practical dosimetry and veterinary radiobiology, and on radiometric and radiation-hygienic investigations carried out on dairy farms in the Turan area of the Bekabad district. The monitoring programme covered the ambient gamma dose rate in the atmosphere, the content of natural radionuclides — uranium-238, thorium-232 and potassium-40 — in soil samples and, where required, of artificial radionuclides such as caesium-137 and strontium-90; the radiological indicators of the water of the Syr Darya, of irrigation water and of groundwater; the degree of bioaccumulation of radionuclides in agricultural crops, feed, milk, meat and fish products; and the dynamics of the radiation background over time at observation points near industrial enterprises. Samples of soil, alfalfa, hay and water taken on the farms were examined under laboratory conditions. At each observation point the gamma dose rate is measured in microsieverts per hour, the specific activity of the soil in becquerels per kilogram and the total alpha and beta activity of water in becquerels per litre. Observation points are placed with regard to the location of industrial enterprises, motor roads, settlements, irrigated agricultural land and the banks of the Syr Darya; the data are processed by means of geographic information systems and statistical methods so that radioecological maps of the territory can be compiled.

Results and discussion

Radioecological monitoring is a system of complex scientific and practical measures aimed at the regular observation, assessment and forecasting of the distribution, migration and biological circulation of natural and technogenic radionuclides in the components of the environment. Its results serve as an important scientific basis for protecting public health, ensuring the safety of agricultural products and maintaining ecological stability. The principal aim of such monitoring is the timely detection of radiation changes occurring in the environment under the influence of natural and technogenic sources that may present a radiation hazard, the assessment of their ecological and sanitary-hygienic consequences, and the provision of safe conditions for

human health and for the biosphere. The importance of monitoring increases further in the vicinity of nuclear power facilities, metallurgical enterprises, the mining industry, production sectors using radioactive materials and areas where radioactive waste is stored. For the conditions of the Bekabad district the main tasks were defined as regular measurement of the ambient gamma dose rate; determination of natural and, where necessary, artificial radionuclides in soil; assessment of radiological indicators in the Syr Darya, irrigation water and groundwater; determination of the bioaccumulation of radionuclides in crops, feed, milk, meat and fish; study of the temporal dynamics of the background near industrial enterprises; assessment of the compliance of radiation indicators with sanitary norms and international recommendations; and early detection of situations that may give rise to radiation hazard, together with the development of preventive recommendations. The results of monitoring are not limited to establishing radiation levels: they make it possible to study the migration patterns of radionuclides, their transfer to living organisms through the food chain, and the processes of bioaccumulation and biomagnification. They therefore constitute an important scientific basis for assessing ecological risk, ensuring the radiation safety of agricultural products and compiling an ecological passport of the territory.

Conclusion and contribution

Regular organization of radioecological monitoring in the conditions of the Bekabad district of the Tashkent region is one of the important scientific and practical factors in ensuring radiation safety in industrialized areas, maintaining ecological balance, strengthening food safety and protecting public health. The results of monitoring make it possible to assess the ecological state of the territory comprehensively, to forecast the level of radiation risk and to place ecological management decisions on a scientific footing. The contribution of this work lies in setting out, for a specific industrial district of Uzbekistan, a structured programme of radioecological monitoring covering the atmosphere, soil, water, feed and livestock products, and in linking that programme to the practical requirement of guaranteeing the radiological purity of dairy production.

ADABIYOTLAR RO‘YXATI

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