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THE SCOPE OF EIA IN UKRAINE – SCIENTIFIC PRIORITIES OF THE PROFESSOR YAROSLAV ADAMENKO

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Abstract. The article describes the stages of professional formation and scientific priorities of Professor Yaroslav Adamenko. The main results of joint research with students on the procedure for assessing the environmental impact of technogenic-dangerous objects, as well as ecological assessment of urbosystems and hydro ecosystems are given. The following is a description of the main scientific research results and possibilities for their practical application.

Key words: scientific research, EIA, environmental safety, generalization of alternatives, environmental assessment procedure

Yaroslav Adamenko, Professor, Doctor of Technical Sciences, Head of the Department of Ecology of the Ivano-Frankivsk National Technical University of Oil and Gas (IFNTUOG). Since 2010, he has been the editor-in-chief of the scientific and technical journal "Ecological safety and balanced resource use", founded by IFIOG, from 2016 he is invited to the editorial board of the scientific journal "Environmental Problems".

He was born on May 25, 1964 in the village. Yelan, Novokuznetsk region, Kemerovo region (Russia) in the family of geologists. In 1986, he graduated from the Ivano-Frankivsk Institute of Oil and Gas in the specialty "Geology and exploration of oil and gas fields", having received a diploma with honors and qualification – a mining geologist.

After graduating from the institute, he began his professional activity as an engineer at the State Institute "UkrDiproNDINafta" in Kyiv, and then he returned to Ivano-Frankivsk as a research and development engineer at the Institute of Oil and Gas (IFING), and then a research associate at the Research Institute of Oil and Gas Technologies, IFING. In 1986 he entered the post-graduate course of the Department of Geology of Oil and Gas of the aforementioned university, and in 1993 he defended his Ph.D. thesis on the topic "Geological and Industrial Criteria for Increasing Gas Productivity and Gas-Adsorption of Productive Reservoirs with Low Pressure Pressures in the Underground Gas Storage Facilities of the Precarpathian Region" in the specialty 04.00.17 – Geology, exploration and exploration of oil and gas deposits.

Scientific and pedagogical activity began in 1993 as an assistant of the Department of Engineering Ecology and General Geology of IFNTUOG, after the defense of the candidate's dissertation. Along with this, he is actively engaged in scientific research on applied ecology. Together with his colleagues, he performs a large number of orders from industrial and scientific organizations for the development of environmental passports, analytical studies, projects for calculating the maximum allowable emissions of pollutants from

stationary sources. In 2001 he received the Doctor's degree in the Department of Engineering Ecology and General Geology.

Along with teaching work, he takes an active part in numerous international, state budget and municipal projects. I want to mention the professional experience of a scientist from 1998–2000, as the responsible executor of the International American-Ukrainian Demonstration for Ukraine, Project "Assessment of the environmental impacts of the development of the Pasichna's oil and gas condensate field", which was carried out within the framework of the Kuchma-Gor's program with the assistance of the United States Agency for International Development and the United Nations Office in Ukraine together with experts from the US Agency for Guarding. The experience of the responsible executive assisted in the work of the teacher of the training on "Principles of Environmental Impact Assessment", which was successfully carried out together with Volodymyr Tikhym (Leading Project Manager of REC-Kyiv "Promoting the Development of Methodology and Practices for EIA in Ukraine") in Ivano-Frankivsk and Kyiv.

This training was the first in the framework of the implementation of the International project "Improvement of the Border Guard System in Verkhovyna, Ukraine", with the support of the EU and TACIS program in Ukraine. He was one of a series of training courses developed by AOS USA at the request of the environmental authorities of countries with economies of transition type. Subsequently, the course "Principles of Environmental Impact Assessment" was conducted in the period from 1997–2001 for representatives of the Ministry of Natural Resources of Ukraine, Ministry of Fuel and Energy of Ukraine, OJSC Ukrnafta, non-governmental organizations, mass media, and others. The conducted training showed the high efficiency of mastering the basic principles of OIE in applying the chosen methodological approach (group work on case-study, that is, over a concrete project close to reality – the laying of a coal mine with the necessary infrastructure). Subsequently, the materials of the training were published manual "Principles of Environmental Impact Assessment (EIA)", which was supplemented by additional materials relevant to Ukrainian realities.

International experience in the field of "Environmental Impact Assessment (EIA)" is manifested in the management (1998–2001) by the project team on the development of EIA for the construction of a new ash deposit of Burshtyn TPP. This project was carried out with the assistance of the Ivano-Frankivsk Regional State Administration and the UN Office in Ukraine.

Since 1999, Ya. Adamenko has worked in parallel on the sections of the project documentation on "Assessment of the environmental impacts of ski tourism and recreational complexes "Bukovel", "Bystrica", "Zaroslyak", "Zhenets", "Khomyak", "Guta", "Dzembronya" and others.

In 2002–2003 Ya. Adamenko continues his professional activity as the key expert of the TACIS Project "Improvement of the Transboundary Verkhovyna Nature Conservation System", manages the development of a section on "Assessing the environmental impacts of tourist and recreational use of Mount Hoverla".

The accumulated experience of implementation of EIA projects was realized in the preparation of the manual for SBP (State Budget Program) A.2.2.1-2003 on the development of the section "Environmental Impact Assessment" as part of the project documentation. Ya. Adamenko became a member of the Commission for the development of this Guide.

Since 2003 Ya. Adamenko is offered to serve as the head of the Department of Natural Resources and Tourism. Until 2007, the scientist leads the graduate department and licenses a new for the university specialty "Tourism", which has no economic orientation, namely natural science.

In 2006, under the guidance of Ya. Adamenko, the study of the current state of environmental factors within the framework of the influence of oil and gas fields Kubash-Lukva and Majdan (administrative territory of Bogorodchany district) is carried out; this project was a joint work of the Ivano-Frankivsk National Technical University of Oil and Gas with Swedish.

The results of scientific research in the field of "Environmental Impact Assessment" are reflected in the preparation of a doctoral dissertation. In 2006, Ya. Adamenko successfully defended his doctoral dissertation on the topic "Assessment of the effects of technogenically hazardous objects on the environment: scientific and theoretical foundations, practical implementation", specialty 21.06.01 – Environmental safety.

During the time of working in a higher educational institution, the doctor of technical sciences, professor Ya. Adamenko has proved to be an experienced teacher, who is actively working to train highly skilled scientific staff. To the professional characteristics of a scientist we can also add organizational work as the head of the Department of Ecology IFNTUOG, which he heads in 2007, after protecting his doctoral dissertation. This post involves not only scientific or pedagogical activities, but also the ability to work with the team, to avoid conflict situations, to clearly, purposefully make decisions, to organize professional activity among the teachers of the department, with maximum efficiency and dedication. Such features of the manager allowed gaining a significant result in the form of – 1

protected doctoral dissertation, 2 dissertations for obtaining a candidate's degree.

The scientific direction of Ya. Adamenko's research is closely connected with the topics of state budget research works of the IFNTUOG, in particular, such topics as: "Scientific-fundamentals of the development of technogenic and ecological safety in the oil and gas industry and non-traditional energy", "Scientific-methodical bases for estimating the impact of objects of the fuel and energy complex on ecological systems and human health in the Carpathian region", "Research of new technologies for increasing the efficiency of hydrocarbon extraction, including low-level wells", "Thedevelopment of the models of balanced resource using and environmental security in the region Geosystems of Ukrainian's Carpathians", as well as industry research and design works JSC Ukrnafta – oil and gas departments on the job "Nadvirnanaftogaz" and "Boryslavnaftogaz". Professor Ya. Adamenko performed sections on EIA materials for Boryslavsky, Novoshodnytsky, Oryv-Ulychnyansky, Striblitsky, Skhidnytsky, Starosambirsky, Ivanikovsky and other oil and gas fields' development projects.

From 2008 to 2010, scientific work continues as the head of domestic themes "Development and introduction of the state system of environmental monitoring (creation and maintenance of the functioning of the Center for Environmental Monitoring) in Ivano-Frankivsk Oblast", "Development of the Regional Environmental Protection Program till 2015", which was executed on request of the State Department of Environmental Protection in Ivano-Frankivsk region.

In 2012, Professor Ya. Adamenko becomes the responsible executor of the All-Ukrainian project of development of local self-government "Creation of the Dniester engineering and ecological landfill for the development of flood control measures and increase of ecological safety of the territory of Ivano-Frankivsk region".

From 2008 to 2014, the research work continues as an expert and manager of a number of international projects, in particular: the Romanian-Ukrainian RUTEM project: "Regional Center for Environmental Education, Management and Monitoring" (2008-2009), project European Bank for Reconstruction and Development: "Integrated (consolidated) program for increasing the safety of NPPs in Ukraine" (2011), Romanian-Ukrainian project RoUaSoil: "Romania-Ukraine trans-border network – Oil Pollution Management Project (2012–2014)".

Ya. Adamenko is a member of 2 specialized Academic Councils for the defense of candidate and doctoral dissertations in the specialty 21.06.01 "Ecological safety", operating in Lviv and Ivano-Frankivsk. He was a member of the Scientific and Methodological Commission of the Ministry of Education and Science, on the direction of preparation "Ecology, environmental protection and sustainable use of nature", which developed competencies related to such disciplines as environmental expertise, environmental monitoring, and geology with the basics of geomorphology. He was the one of the developers of the branch standard of higher education of Ukraine, the educational-professional program on the specialty 6.0400106 "Ecology, environmental protection and sustainable use of natural resources". He worked as a specialist at the State Inspectorate of Educational Institutions of the Ministry of Education and Science of Ukraine.

Currently Professor Ya. Adamenko is a member of the working group of the Ivano-Frankivsk Oblast State Administration for Non-traditional Energy and a member of the Scientific and Technical Council of the Carpathian National Nature Park

As noted above, Professor Ya. Adamenko is the editor-in-chief of the scientific and technical journal "Ecological safety and sustainable resource use" (founder of the Ivano-Frankivsk National Technical University of Oil and Gas), as well as a member of the editorial board of a number of domestic and international scientific journals of environmental issues "Environmental Problems" (founder of Lviv National University), "Ecological security2 (founder Kremenchuk National University named after M. Ostrogradsky), "Scientific Bulletin of the North university of Baia Mare" (founder of the Northern University of Baia Mare, Romania).

The result of the scientific work is: over 210 scientific works, presentations at more than 100 international scientific conferences, the publication of 2 textbooks, 6 manuals and 8 monographs on the "Environmental Protection", registration of 1 patent for the invention.

Yaroslav Adamenko, together with his students, graduate students Lilia Savchuk (now candidate of technical sciences), Mikhail Krychivsky (now Ph.D.), Tamara Kundelskaya, Taras Kachala, Natalia Moskalchuk, Khrystyna Karavanovich, Oleg Lukinchuk. and doctoral student Lyudmyla Arkhipova (currently a doctor of technical sciences, professor) have a number of scientific developments regarding the procedure for assessing the environmental impact of technogenically hazardous objects, as well as the ecological assessment of urbosystems and hydro ecosystems.

Scientific direction of Professor Ya. Adamenko is "Assessment of environmental impacts of technogenically hazardous objects". The main scientific priority of Yaroslav Adamenko is the study of EIA in Ukraine. The research scientist first performed the scientific substantiation of the successive procedures and procedural stages of environmental assessment during EIAs in Ukraine – it has been proved that the

procedure for assessing the impact of technogenically hazardous objects on the environment should begin before the land is allocated for construction, that is, during the investment plan. For the first time, for the investment process of the construction of technogenically hazardous objects, scientifically substantiated content and further development of the stages of the EA: "screening", "scoping" and "estimation and comparison of alternatives", developed the models of their use for the assessment of environmental impacts.

Also Professor Ya. Adamenko for the first time, theoretically grounded and proposed methodology for involving the public in the environmental assessment of the project activity as an instrument of transparency and openness at all stages of the investment construction process.

The scientist proposed a methodology for the generalization of alternatives [1] for the environmental assessment of an investment project, which transforms the set of all possible alternatives into a number of feasible alternatives using the Delfi technology and the method of pair comparisons. The process of generalization of alternatives consists in the initial formation of the whole set of alternatives, based on the experience of the stakeholders of the EIA, as well as on the latest technical and technological decisions that can lead to the achievement of the objective of the project. As soon as the factors limiting the solution to the possibility of implementing one or another alternative, the next step is to work on the generalization of identified alternatives or possible directions of action to solve the problem. Many alternative solutions are usually known from previous experience, standard and easily fit into the criterion boundaries of a better solution. The procedure for generalization of alternatives, as a rule, can take place in three stages: the formation, evaluation and choice of alternatives (Fig. 1). Such a methodology is based on fuzzy expert assessments, which in the future make the transformation of a set of all possible alternatives into a clear set of feasible alternatives. The author developed a technology that contains step-by-step steps: brain attack, Delphi technology, the method of pair comparisons and decision-making.

The essence of the proposed methodology [1] is as follows: using a method of brainstorming, a group of experts finds a radically new solution to achieve the goal of the proposed activity, which has not been tested, has no analogues and therefore does not cause any risks. According to the results of the brain attack, experts formulate a number of alternatives that can help achieve the goals of the proposed activity (the first step, see Fig. 1). However, during brainstorming experts will have their own judgments about one or another alternative, therefore, to level their thoughts it is suggested to use technology Delphi.

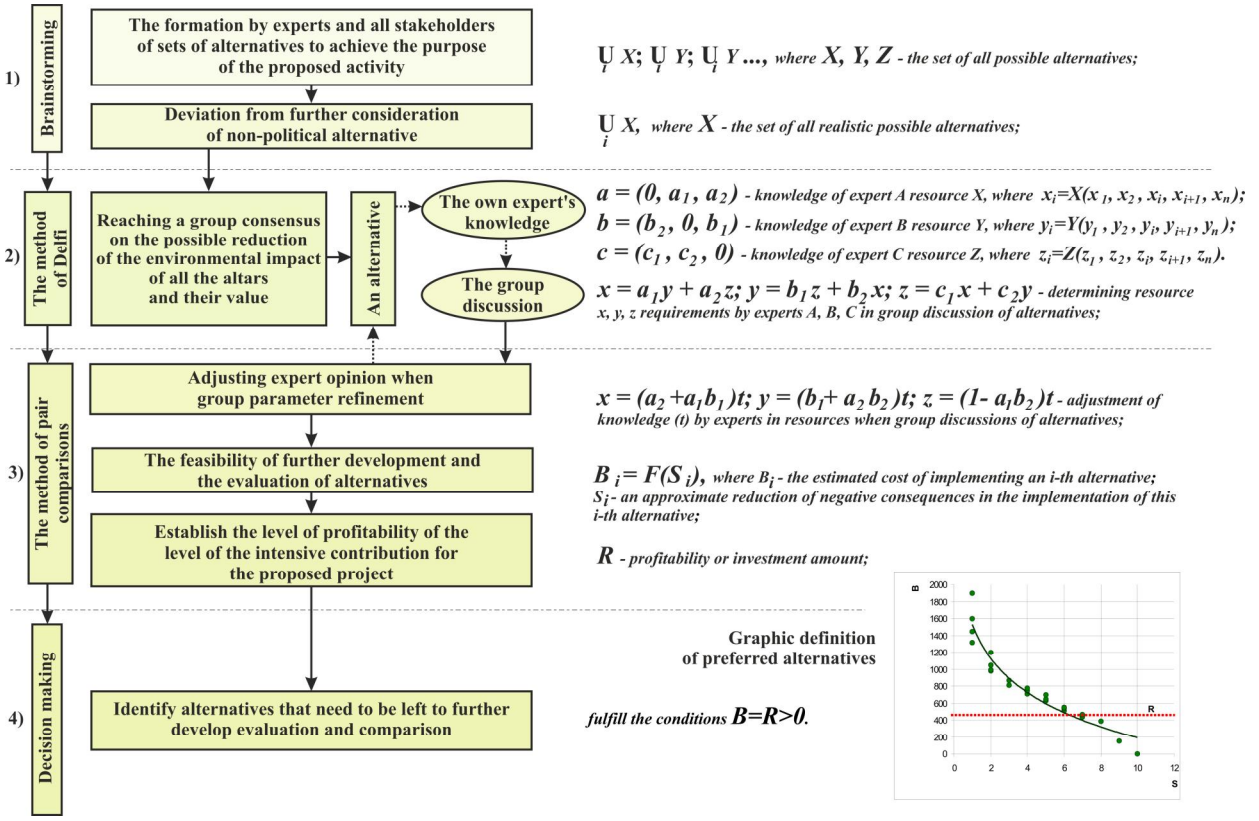

Fig. 1. The methodology of alternative's generalization

According to the Delphi method (second step, see Fig. 1), it is assumed that the estimation xi of an alternative to an expert depends on its characteristics in aspects in which it is not a specialist:

$$x_i = X(x_1, x_2, x_i, x_{i+1}, x_n),$$

where X is an estimate of x_i of the alternative of the same expert for uncertain x_n aspects.

In the expert opinion, these additional characteristics were "within the standard". But with the open discussion of alternatives and the exchange of information by a group of experts, his further judgment of the planned activities within the proposed alternative gives him the opportunity to correct his opinion. This is the scheme of consensus on the Delphi method. It is proposed to establish the expediency of further consideration and evaluation of alternatives by using the paired comparison of expert opinions (third step, see Fig. 1). At the same time, for all alternatives, their possible value and a ballistic assessment of the reduction of the negative impact on the environment are established and the function is calculated:

$$B_i = F(S_i),$$

where B_i is the estimated cost of implementing the *i*-th alternative;

S_i is an indicative reduction of negative impacts when implementing the *i*-th alternative.

Knowing the level of profitability or the amount of investment for the proposed project (R), decisions are made on the alternatives that need to be left for further consideration, evaluation and comparison, while the condition must be met (step 4, see Fig. 1):

$$B = R \to 0,$$

where R is the level of profitability or investment amount for the proposed project.

Thus, according to the proposed methodology, a certain number of feasible alternatives are formed that satisfy the purpose of the investment plan and all interested parties. Considering the proposed stage of the EIA procedure, the next step is to compare and evaluate alternatives that satisfy the purpose of the investment plan. This stage is based on the following criteria: compliance with local conditions – natural, social, economic, etc. types of potential environmental impact; needs for additional infrastructure; capital and operating costs of the project. The procedure for comparing alternatives makes it possible to make environmentally sound solutions.

The decision to introduce technogenically safe investment activity is taken taking into account the engineering capabilities, economic feasibility and environmental safety taking into account the proposed alternatives. To solve this problem, it is proposed to use calculation of individual utility functions for each alternative and criteria by the formula:

$$P = U_{eng.}^{A_n}(C_i^{eng.}) + U_{econ.}^{A_n}(C_j^{econ.}) + U_{env.}^{A_n}(C_k^{env.}),$$

where P – decision making; $U_{eng.}^{A_n}(C_i^{eng.})$ – the function of the utility of *n*-th alternatives in terms of engineering capabilities and requirements for the proposed activity; $U_{econ.}^{A_n}(C_j^{econ.})$ – the function of the utility of *n*-th alternatives for *j*-th criteria of economic opportunities and expediency of the proposed activity; $U_{env.}^{A_n}(C_k^{env.})$ – function of the utility of *n*-th alternatives for *k*-th environmental safety criteria regarding the proposed activity.

The final stage of the proposed methodology of the procedure for assessing the impacts of technogenically hazardous objects on the environment is the development of EA documentation – the section "EIA Materials" and "Environmental Impact Statement" (EIS) of investment activity. After reviewing these documents by all interested parties of investment activity and their discussion at public hearings, ZEN is announced through the mass media, and the project documentation along with the EIA materials is submitted to the state investment expertise, according to which the investor makes a decision on the implementation of the proposed activity.

Professor Ya. Adamenko has practically proved that the procedures of the EIA of the Western type do not contradict the current legislation in Ukraine for EIA conditions in the investment process for the construction of technogenically hazardous objects, and their application in the early stages of designing – is a preventive tool for environmental protection. Such conclusions were highlighted during the preparation of the doctoral dissertation in 2006, and only now, in 2017, Ukraine passed a new law "On Environmental Impact Assessment", which sets out the main requirements for the stages of design and mandatory participation of the public in the environmental process assessments.

Together with his doctoral student Lyudmyla Arkhipova [2] Professor Ya. Adamenko proposed a methodology for assessing the natural and technogenic safety of hydro ecosystems that takes into account various hazards and is based on the principles of sustainable balanced use of water using a quantitative and qualitative component of the buffer capacity of hydro ecosystems and includes assessment of qualitative potential, quantitative potential, balance of water use, natural and man-made risks of water use and their based assessment of the acceptability unacceptability of the level of natural and man-made safety of hydro ecosystems, unlike the Their earlier studies, based on levels of pollution and depletion of hydro ecosystems.

The proposed concept of ecological safety of naturally-technogenic surface hydroelectric systems contains a model of control with a system of permanent hydro-ecological support at the stage of development and operation of PTSG.

For the first time scientific methods for assessing the qualitative and quantitative component of the natural and technogenic safety of hydroelectric systems were developed, including the study of a comprehensive index of quality potential (CIQP), the evaluation of quantitative safety parameters on the basis of analysis of data of long-term observations, their spatial time patterns, determination of norms, water use balance, justification natural and man-made risks of water use, which allow to assess the existing level of safety, compare it with the normative regional values, in to show the temporal tendency of development for the purpose of management of ecological safety.

On the basis of the conducted research the further development of the theoretical basis of the natural and technogenic safety of hydro ecosystems on the basis of sustainable balanced water use with the use of quantitative and qualitative component of the buffering capacity of hydro ecosystems as a subject of research, the selected component of the theory of constructive ecology – constructive hydroecology by improving the classification of anthropogenic influences, hierarchical classification , mathematical formalisation of natural technogenic hydro ecosystems, the law of balanced nature management, which allows to develop, implement effective methods and means of controlling environmental safety at the stage of development and functioning.

On the basis of technical solutions, the method of controlling the state of hydro ecosystems was improved by taking into account self-purification, the spatial distribution of a qualitative component of natural and technogenic safety separately for the Dniester, Prut-Siretska and Tysyansk hydroelectric systems, and, in general, for the territory of the Carpathian region, the spatial distribution of the self-healing qualitative a component of natural and technogenic safety, the allocation of groups of hydro ecosystems on the basis of similarity of time changes in the quantitative potential of natural and technological safety, a typical model of its distribution under different conditions for justification of permissible levels of influence of technogenic activity, measures of stabilization and improvement of the environment.

The result of the work of Ya. Adamenko and L. Arhipova was the proposed method (which was later protected in the doctoral dissertation), which allows to quantify the critical loads, trace the long-term dynamics of changes in the anthropogenic load on water objects, compare the indicator of balanced water use in different hydroecosystems, which is intended for the substantiation and adoption of technical solutions aimed at increasing the level of natural and technological safety of hydro ecosystems. Protested in the hydraulic system of the Prut River, by means of mathematical processing of the results of measurements and analysis of surface waters, the parameters of sustainable balanced water use in four sections were obtained and the level of shifts in the natural balance of the hydroelectric system by the technogenic load was estimated. The following states of hydro ecosystems of the Prut region are established: optimal (Zaroslyak I_{bwr} = 0.05); Pesimal (Vorokhta I_{bwr} = 0.39); the tension of adaptation (Tatariv I_{bwr} = 0.11, Yaremche I_{bwr} = 0.23). The analysis of the results showed that the situation in the village of Vorokhta needs to be optimized, the corresponding technical decision on the construction of new sewage treatment plants and the reconstruction of sewage networks in the village of Vorokhta is included in the "Program of environmental protection in Ivano-Frankivsk region until 2015".

The cooperation of Professor Ya. Adamenko with the applicant Lilia Savchuk [3] turned out to be a study of the organization of environmental monitoring in the areas of development of potassium deposits in the Carpathian region, in particular in the Kalush industrialized region.

For the first time, by means of mathematical modeling, correlation has been established between a certain type of disease of the population of the region and dominant ecological factors in the territory subject to intense pollution. In particular, the process of scattering of harmful substances in the atmospheric air, depending on the mass of particles, taking into account the Reynolds number, was theoretically substantiated, which allows us to determine the critical parameters of their motion and the conditions for the transition from the laminar and turbulent flow regime.

The method of hydraulic modeling of the water flows of the region has been further developed, which allows determining the extent of chemical pollution in groundwater while simultaneously influencing the processes of filtration, dispersion, gravity segregation and sorption.

In cooperation, the method of joint processing of liquid and solid wastes accumulated on the surface of the region of the region of the mining and chemical industries by cleaning them from heavy metals, changing the temperature regime of evaporation, and obtaining marketable products, which will minimize their impact on the environment, in particular on the social component, has been improved. Realization of this method will allow to receive annually 110 thousand

tons of mineral fertilizers containing 28–30 % K_2O, 210 thousand tons of technical salt and about 74 thousand tons of crystalline bischofite.

The research of the Ivano-Frankivsk Urbsystem started in cooperation with the applicant Mikhail Krychivsky [4]. The main objective of the research was to investigate the relationship between the concentrations of individual chemical elements in soils and indicators of health of the population, justification of the methodology and development of indicators of the level of environmental safety, creation of information analytical system.

Since the urbosystem is characterized by anthropogenic influences, caused by pollution by industrial enterprises, dense buildings and intensive traffic, the city's territory was divided into ecological areas. The next step was to calculate the E_{bec} environmentally safe concentration index.

Taking into account the influence of heavy metals within the framework of the urbosystem, the excess and asymmetry of their distribution were calculated, respectively, the excess and asymmetry of the morbidity and mortality among the city population were calculated, statistically significant relationships between the indicators were established and the approximation of the revealed dependencies was made (in particular, the primary morbidity, depending on concentration of selenium in the soil on the territory of residence).

In the work, further methods of generalization of alternatives have been found, utility norms and norms of risk alternatives have been calculated for the areas of environmental safety.

The result of the study was the creation of a computer program for the calculation of ecological medical indexes of ecological safety of the city "EcoSafetyCity" and the development of a comprehensive sectoral methodology "Forecasting indicators of environmental safety of cities according to the results of soil monitoring".

Further studies of the urban system of the city of Ivano-Frankivsk were carried out in cooperation with graduate student Tamara Kundelska [5]. The main focus was on acoustic and electromagnetic pollution of the city and assessment of environmental risks that are likely from the effects of these factors.

To ensure a comfortable habitat within the boundary of the urbo-system, the isotropic measurements of the components of the electromagnetic field at 122 points of the test-polygon were performed on the electromagnetic load factor. At each point, in the section of maximum and average values were measured: electric field intensity (E, W/m); magnetic field strength (H, mA/m); Surface energy flux density (W, $\mu W/cm^2$). Base cell stations are counted, their contribution to the electromagnetic situation of the city is described. For the spatial analysis of changes in the levels of the electromagnetic field, within the boundary of the urbosystem, maps of technogenic electromagnetic pollution with the help of the Surfer program are constructed. Spline interpolation method was used to construct maps.

In addition, measurements were made of 5 basic test facilities of the urbosystem, which are the most vulnerable to the action of the electromagnetic field. Test objects were selected: stationary medical institutions, educational institution, and shopping center. Objects were chosen according to the principle of probable forecast influence, – near visible sources of electromagnetic pollution (base stations of cellular communication, objects of broadcasting broadcasting). According to the results of the study, schematic images of the distribution of the electromagnetic field were constructed, taking into account the fields created by sources of radiation inside the premises. The most sensitive zones are located within the test objects.

In order to provide an acoustically comfortable environment for inhabitants of the Ivano-Frankivsk Urbosystem, the following tasks were solved: daily observations were made to determine the number of green areas in the city, measurements of the equivalent level of sound in green zones; the establishment of the main sources of noise impact, the intensity of the noise load along the highways and near the nearest residential buildings along the roads, the special attention was paid to the public transport stops, where the audio-boxes of the "Street Radio" are located. In general, an equivalent level of sound was measured at 165 points on the territory of the Ivano-Frankivsk Urbosystem. According to the research results: separate zones (streets) within the city with the greatest acoustic discomfort are allocated, profiles of the acoustic load distribution along the main streets are constructed, taking into account the equivalent sound level in the green areas of the city that are located next to it. With the help of the Surfer software, for the first time a map of noise was created for Ivano-Frankivsk, which is a binding requirement for the environmental safety of European cities, in accordance with Directive 2002/49 / EC.

In cooperation with the graduate student Taras Kachala [6], the issues of oil pollution of soils in the Ivano-Frankivsk region were addressed. The main results of work in the international project HUSKROUA/1001/110 were considered, namely, an expert assessment of the possible contamination of soil cover with petroleum products. In the work, an algorithm and calculations of the assessment of the competence of experts were proposed. The presented results of expert estimation is using for determining the

rates of oil product contamination of the land plots in Ivano-Frankivsk region from various industries.

Comparison of the obtained results of expert assessments with calculations by median rank and average grades is carried out. The methodology used by expert assessments will further solve the issue of developing a system of environmental monitoring of soil cover and develop methods for the restoration of oil-contaminated land plots.

Together with the post-graduate student Natalia Moskalchuk [7] is currently conducting a study on environmental impact assessment from wind power plants. Measures to mitigate the effects of WEEE on the environment are proposed. Mitigation should be systematic and include measures to prevent, reduce, eliminate and compensate for impacts. In cooperation, the issues of assessing the magnitude and significance of residual impacts from wind power activities were solved.

Also, at the present time, the research of Yaroslav Adamenko and his post-graduate students (Kristina Karavanovich, Oleg Lukinchuk) is aimed at assessing the residual impacts on the territory of worked drilling mud, reclamation of sludge barns, evaluation of preserved mineral deposits and the territory of Ivano-Frankivsk region. The ultimate goal of the overall environmental research of Yaroslav Adamenko's scientific work is to ensure the conditions for sustainable development, improvement of the state of the environment and solving the issues of environmental security of Ukraine.

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