LOOK ACADEMIC PUBLISHERS
OPEN ACCESS

IEJME — MATHEMATICS EDUCATION
2016, VOL. 5, 1419-1432

Integrated Ecological and Educational Activities: One of the Ways to Improve the Regions' Environmental Security

Natalia P. Nesgovorova[a], Vasiliy G. Savelyev[a], Elena P. Bogdanova[a], and Galina V. Ivantsova[a]

[a]Federal State Public Educational Institution of Higher Professional Education "Kurgan State university", Kurgan, RUSSIA

ABSTRACT

This research is devoted to the regional aspect of the ecological hazard and socio-demographic problems of population in the Kurgan region. It deals with the ecological safety as an aggregate of processes and actions, which provide the ecological balance in the environment and do not lead to vitally important damages (or threats of such damages) related to man and the environment. The results of soil cover sample analysis and plant resources are presented. It is established that due to the cycle of matter in biosphere natural resources become the additional sources of environmental pollution, which affect not only natural complexes, but also human health. The authors observe this problem could be solved through the development of the public culture of ecological safety. The practical value is that the measures relating to the creation of ecologically safe life conditions are described in the paper.

KEYWORDS
Ecological hazard; techno-sphere; Kurgan region; radioactive waste; ecological safety culture improvement

ARTICLE HISTORY
Received 7 April 2016
Revised 11 July 2016
Accepted 19 July 2016

Introduction

In the modern world, the threats and emergencies having natural, man-made and social character became the objective reality in the human life activity (Aliabysheva et al., 2010). They threaten human life and health, and cause huge damage to the environment and society (Shmal', 2010). Thus, the issues related to safety provision became one of the essential demands of each person, society and the state.

Ecologists believe that the growing pressure of the man-made factors on the biosphere can lead to the full break of national cycles of biological resource production, self-purification of water, soil and the atmosphere (Gitelson &

CORRESPONDENCE Natalia P. Nesgovorova ✉ natali_348@mail.ru

Lisovsky, 2003). This generates the sharp and rapid environmental degradation, which can result in the extinction of every living thing on the planet (Khoruzhaya, 2002).

The growing man-made impact on the environment induced the socio-political institutions of different countries to the development of international legal norms with a view to regulate the ecological situation. In this regard, various programs providing radio-ecological evaluation were elaborated within the framework of international organizations, in particular, the Radio-ecological assessments of the Lodine working group of the IAEA EMRAS program: Presentation of input data and analysis of results of the Prague scenario (Bartuskova et al., 2009). The progress analysis of the implemented programs is carried out (A Summary Report of the Results of the EMRAS Programme (2003-2007), 2012).

These issues refer to Russia as well. In 2009, Russia adopted its “National Security Strategy up to 2020” in 2012 the President of Russia approved “The State Policy Fundamentals in the Field of Ecological Development of Russia up to 2030”. However, the creation of the regulatory framework is only the first step, which does not provide the ecological safety per se and does not prevent man-made catastrophes and accidents, leading to the intensive environmental degradation.

It is also necessary to determine how one should understand the term “ecological hazard”. E. Aliabysheva (2010) believes, if one considers the ecological hazard as the possibility of destruction (full or partial) of the human habitat, plants and animals, as a result of uncontrolled economic development, technological delay, natural catastrophes and anthropogenic accidents, it is possible to distinguish two types of ecological hazards – the environmental (natural) and the man-made one.

The man-made threats are connected primarily with the active human activity. The damage caused by these threats directly depends on the density and energetic level of the used industry-related means (Khoruzhaya, 2002). In the Kurgan region, radioactive contamination became one of the most essential man-made ecological problems, which caused damage to the forest fund of four forest areas in Dalmatovsk, Shadrinsk, Kargapolsk and Shatrov regions, water and bottom deposits of Techa, Iset’ and Miass rivers, and flood-land territories (Pozolotina et al., 2007).

The quarterly radiation monitoring of the above territories, carried out on the area of 135,000 hectares allowed detecting 132,000 hectares of forests, polluted by strontium-90; 0.894 thousand hectares – by caesium-137. In the area, which soil pollution density with strontium-90 made 0.15 - 1.0 Ci/km2, the biggest total content of radionuclides was detected in the birch leaves of birch and in pine-tree branches and the smallest content – in the woody tissue of these kinds of trees.

It is pertinent to point out that the Kurgan region has other ecological problems. There are 79 potentially dangerous objects on its territory (according to Governor Kokorin A.V.). One of the most dangerous objects is the Shchuchansk arsenal of chemical weapons and the regions, polluted by radioactive substances because of accidents, which occurred in 1947 and 1957 in Mayak (Passport of Kurgan region: Volume of Research Papers, 2013).

Therefore, the ecological hazard, as the problem of regional ecological safety is highly relevant.

The territory of the Kurgan region contaminated with radioactive isotopes, is part of the territory of the East Ural radioactive trace (EURT) of 1957. In autumn 1957, the radioactive overheating of the storage tanks with highly active liquid wastes stored at the plant "Mayak" in Kyshtym town led to the explosion of the nitrate-acetate mixture. The blast caused radioactive waste release; its total activity made 7.4x1017 Bq. Around 90% of waste fell in the immediate area of the plant, the remaining waste (its total activity made 7.4x1016 Bq) formed a radioactive cloud one-kilometer-high (Ratanova & Sirotin, 1998), which was dispersed by the wind for a considerable distance, and led to the radioactive contamination of the northern part of the Chelyabinsk region and the southern part of the Sverdlovsk region. The contaminated area was called the East Ural radioactive trace (EURT). It covers the area of about 20,000 km2 within the minimum measured level of contamination with 90Sr (0.1 Ci/km2) and 1,000 square kms in area, within the level of 90Sr 2 Ci/km2. The population size of the contaminated area was 272,000 people (Petrov, 1995).

In September 1957, another explosion occurred at the "Mayak" storages; it was an explosion of container with dried radioactive waste. This resulted in the fact that the EURT area was expanded to the territories of the Sverdlovsk, Chelyabinsk and Kurgan regions (23,000 km2, with more than 200 settlements and a population size about 300,000 people. More than 100,000 people were evacuated. The accident in Kyshtym according to some reports is estimated at 1 billion 200 million curie, which exceeds the "results" of the Chernobyl disaster by more than 20 times (Krivolutskii, 1993).

The 90Sr contamination density was used to determine the limits of contamination. The trace length with contamination density of 0.1 Ci/km2 (2 times higher than the global fallout level of strontium-90) made 300 km, its width - 30-50 km. The estimated contaminated area made 15,000-20,000 km2 (Martyushov et al., 1999).

In 1958, the state stopped using the territories, which total area made approximately 1,000 km2 with 90Sr contamination density exceeding 2 Ci/km2. Settlements were evacuated from this territory.

Until April 26, 1986, this radiation accident was the largest in the world. The Chernobyl blowout in April 1986 amounted to 380 million curie. Because of this disaster, 272,000 people in 217 villages were exposed to radiation (Vlasova et al., 2014).

In 1979, the biologist Zh. Medvedev published a book "The nuclear disaster in the Urals," in the U.S. This book disclosed some real facts related to the 1957 accident.

In 1980, in an article published by the American scientists from the atomic center in Oak Ridge ("Analysis of the nuclear accident in the Soviet Union in 1957-1958 and its reasons"), J. Trabalka, L. Eismann and S. Auerbach (1958), specialists in the nuclear energy field, recognized that the Soviet Union had a major radiation accident caused by the explosion of radioactive waste.

Almost 50 years after that accident in the Urals, V. Pozolotina et al. (2007) during the period 2006-2010 studied the EURT main ground and found that the content of Sr-90 in the soil made 6700-15000 kBq/m2, and the content of Cs-137 made 200-400 kBq/m2. In this area, accumulation rates in different kinds of herbaceous plants are lower than in other areas. Perhaps the reduction in the cumulative capacity of the plants was caused by natural selection as an adaptation to the radiation effect.

D. Vlasov (2013) in the article "The radio-ecological model of transport of radionuclides, iodine and cesium through trophic chains after radiation accidents causing emission to the atmosphere, aimed at studying the regularities of internal irradiation doses of the population" showed the agro-ecological unit of this model and noted the impact of weather conditions on the internal irradiation of the population, primarily this related to the thyroid gland.

Regarding the population, suffered from the "Mayak" disaster, a number of relevant publications showed that affective disorders are related to the patients who survived radiation accidents in South Urals, many years later. These emotional pathological disorders were found most often in patients with combined internal and external irradiation in the form of organic non-psychic depressive disorders (Burtovaya, 2006). Organic changes in human bodies exposed to similar radiation are also considered in the paper by T. Muldagaliev, R. Gaynulina & A. Adylkanova (2013).

Can note, in recent decades, environmental education has progressed significantly. This refers to the studies, which provided the analysis of lessons learned regarding the formation of ecological culture (Sihynbayeva, Zholdasbekova & Omarova, 2012; Pozolotina et al., 2007). The authors of these studies consider that the state of the environment depends on the ecological and professional training of students. Other studies indicate that environmental education has significant problems (Zholdasbekov, 2012; Dogru, 2008).

Methods

This article is based on the materials provided by the Research Institute of Agriculture of the Kurgan region, the Department of natural resources and environment of the Kurgan region, the Federal State Statistics Service data related to the Kurgan region.

The ecological activity in the form of monitoring of radiation situation in the forests of the Kurgan region was carried out in accordance with the standard methods (Sokolov, 2012). During the period 2004-2010, 6 stationary grounds were selected for studying the soil pollution with strontium-90 and partially with caesium-137; these grounds are located in high-water beds of Techa-Iset' river and also on the territory of Eastern-Ural radioactive trace (EURT). During the summer period both teachers and students of higher educational establishments selected soil samples, beddings and forest vegetation for further measurement of the exposition doze of gamma radiation and determination of coordinates in the places of sample selection.

Soil and plant sampling

Preliminary radiation monitoring was carried out during the soil and plant sampling. Field dosimeters were used to measure the dose rate of gamma radiation. The time required for sampling was determined in such a way, that the researcher's total dose did not exceed the maximum permissible dose (17 mrem/day), pursuant to the Radiation Safety Standards (1999).

In order to carry out the radiochemical analysis, the specialists collected mixed samples of arable and subsurface layers of soil as well as vegetation samples in the period of their technical maturity. The number of samples and the total acres of grounds depended on the category of the area; topographic features, soil diversity and vegetation were also taken into account. Samples were selected based on the required amount for further analysis (2 kg for herbs and 6 kg for berries and mushrooms).

Moreover, the soil carbonate content was also defined in the field. Given homogeneous soil cover, 5 individual soil samples were collected using the "envelope" method from a total area of 1 ha; after that one mixed sample was made. Soil samples weighing not less than 2 kg were packed into clean plastic bags; after that the bags were labeled.

Radiochemical analysis

The main objective of the radiochemical analysis is the most comprehensive selection of the desired radionuclide in the isotopically pure form from a soil or plant sample taken for analysis.

The main stages of radiochemical analysis:

- Separation of the radionuclide from the mass of sample elements;
- Separation of elements, similar in chemical behavior;
- Isolation and identification of radionuclide to be determined;
- Verification of radiochemical purity of the isotope (all recorded activity should belong only to the determined isotope);
- Chemical determination of the carrying agent.

Observance of the exact values of acidity and temperature is an important condition for isotope isolation in the pure radiochemical form. Concentration and isolation of the radionuclide in vitro was carried out by using organic solvents (Radiochemical Analysis, 1963).

Then the spectrometric analysis on the universal spectrometric complex (USC) “Gamma plus” was conducted.

The USC "Gamma Plus" is designed to measure specific (volumetric) activity of beta- and gamma-emitting nuclides in the selected samples through spectrometric analysis.

The complex is used in vitro as a specific installation. It is intended for measuring the activity of radionuclides in food, biological samples and other objects that could be found in the environment. The complex consists of two independent spectrometric sections (gamma and beta section), and connected to a personal computer (PC). The beta-section is the analog part of the scintillation beta-spectrometer.

The principle of operation is based on the transformation of gamma rays and beta particles into flashes of light (scintillation) within the detector’s working volume. The intensity of flashes is proportional to the energy lost by the gamma-quantum or beta particle in the detector.

The PC program allows managing the analyzer in various modes, and the included software gives the possibility to automate the measurement process (Artemenkova et al., 1988).

Based upon the obtained data, the specialists charted the results of radiation monitoring in the forest fund of the selected areas.

Data, Analysis, and Results

The Results of Soil Cover Sample Analysis and Plant Resources

The regular monitoring of lands gave the possibility to detect the following tendency – during the recent five-year period (2010-2015) the content of pollutants in the soil and forest bedding reduced. However, the forest bedding turned out to be more polluted than the soil. This problem is highly relevant and relates to the use of forest resources not only by the local population, but also by people, who visit the forest with a view to have a rest. The visitors collect forest resources, which have medicinal, food and aesthetic meaning.

In 2015, specialists of the department studied 140 samples of forest berry resources, selected in Dalmatovsk forest area. Based upon the obtained results, they determined the level of food pollution in the forest areas and its correlation with the radiation safety standards (Figure 1).

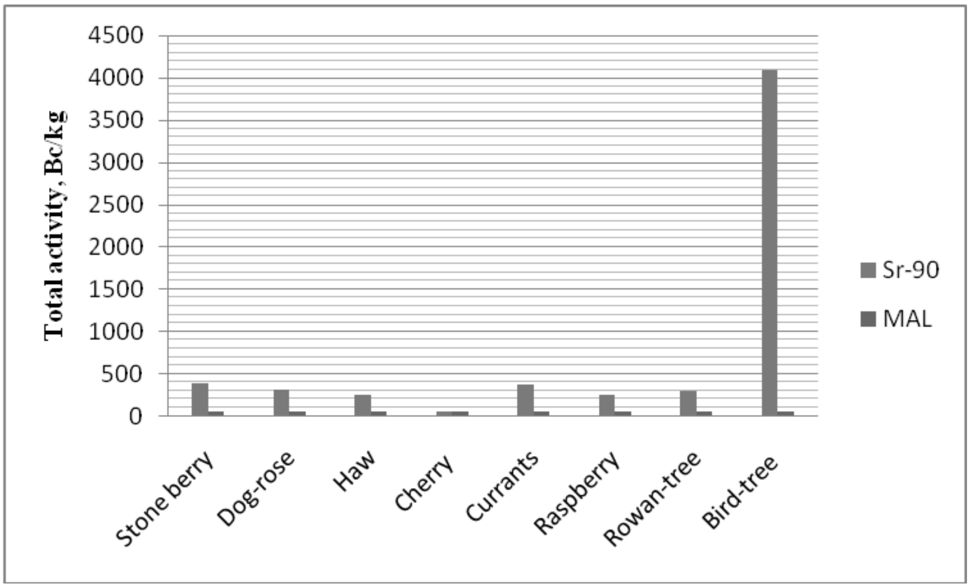

Figure 1. The levels of maximal content of strontium-90 in the most distributed types of berries on Dalmatovsk forest land of Kurgan area in 2015 (according to the Department on Environmental Protection and Natural Resources).

The obtained results demonstrate that the content of strontium-90 in the forest berries exceeds MAND almost on all types of berry plants, especially in bird cherry. Only the cherries turned out to be safe for consumption.

As regards the content of strontium – 90 in mushrooms, it was detected that this element is well absorbed and accumulated in the tissues of mushrooms, this feature is especially typical for milk mushrooms and shaggy boletus (Figure 2).

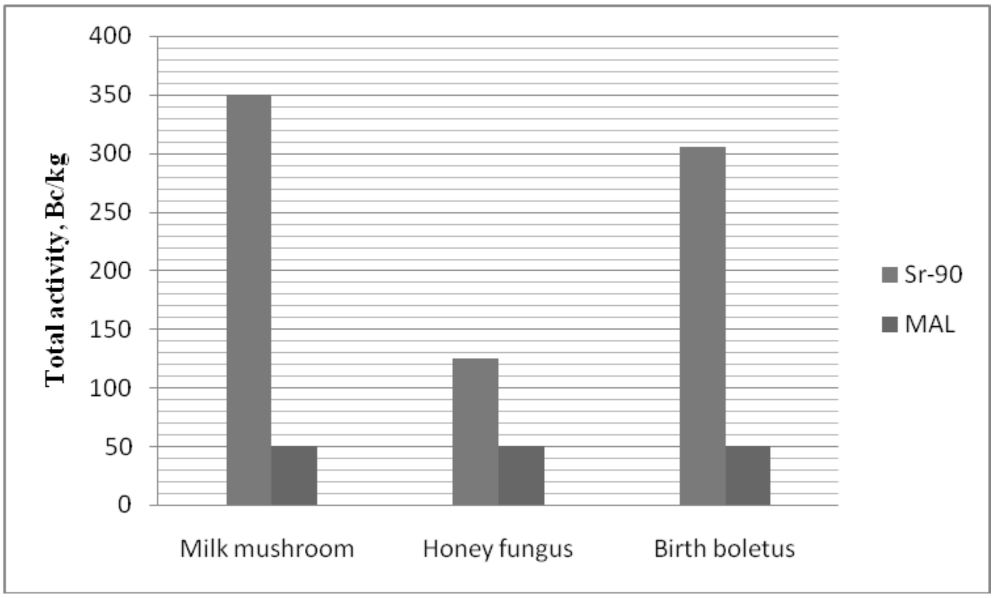

Figure 2. The levels of maximal content of strontium-90 in the most distributed species of mushrooms on Dolmatovsk forest area of Kurgan region in 2015.

Generally, in the radiation-dangerous territories of the Kurgan region in 2015, analysis of the obtained results showed that the content of pollutants in the plant species, gathered by the forest visitors, exceeded safe concentrations. 52% of the selected samples of crude drugs are characterized by the increased content of strontium-90 (by 1.01 to 20.31 times), 100% mushroom samples showed the increased content of strontium-90 (by 2.76 to 7.02 times). 95% of berry samples showed the increased content of strontium-90 (by 1.38 to 13.05 times). 89% of the checked samples of hay have excessive content of strontium-90 from (by 1.05 to 4.68 times).

Keeping in mind the results obtained during examination of crude drugs in 2014 and 2015 in the Kurgan region, one should mark growth in polluted samples (from 44% in 2014 to 52% in 2015). As regards berries, the growth of polluted samples was detected as well (from 76% in 2011 to 95% in 2015).

Among the reasons, causing growth in polluted grassy and brushwood plants, one should note the initial accumulation of radionuclides in the leaf litter (left from the previous years). Further accumulation of pollutants is detected in the food chain: after the initial accumulation in the leaf litter, the pollutants are transferred into the soil in the process of its decay, and due to intensive activity of soil microflora and root nutrition they could be found in the plants again. Therefore, due to the cycle of matter in biosphere natural resources become the additional sources of environmental pollution, which affect not only natural complexes, but also human health.

Making a comparison between indicators related to socio-demographic state of the Kurgan region population and the medical-social scale, which takes into account different groups of population (native, migrants and etc.) and negative ecological changes (Krivoshein, Muravei & Roeva, 2000), it is possible to conclude the following.

The analysis of birth rate, mortality rate and infantile mortality rate in the Kurgan region during recent decade (Passport of the Kurgan region, 2013) allowed detecting two evident tendencies: first – the general birth rate growth; second – reduction in the total and infantile mortality rates (Figure 3).

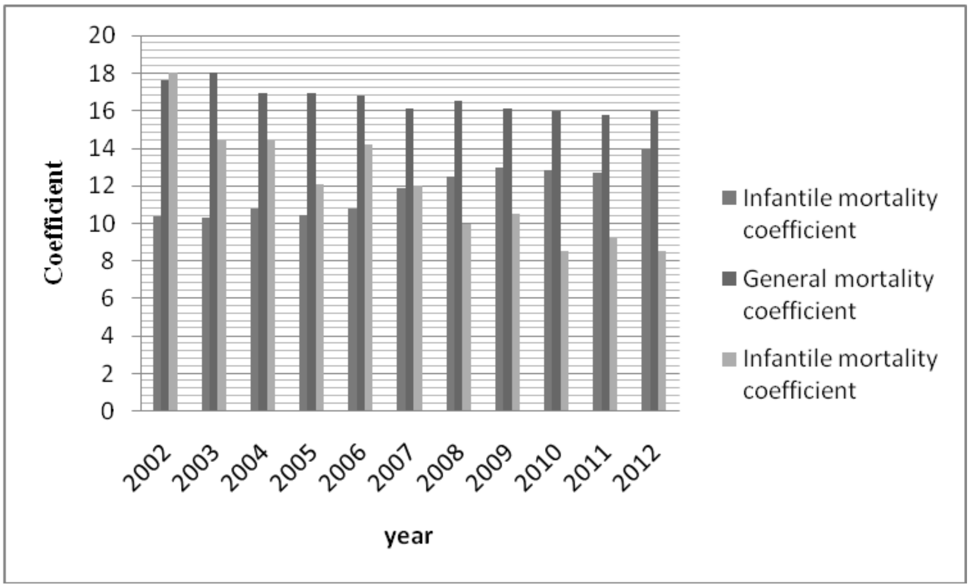

Figure 3. Tendency of the indicators of basic coefficients of region population dynamics.

Regarding the specific indicators of the population size dynamics in the Kurgan region, it is possible to mark population growth both in the cities and in the villages due to the newly born citizens of the region. However, according to the average indicators, the mortality rate dynamics generally exceeds the birth rate both in the cities and in the villages, and the infantile mortality rate remains rather high. Therefore, population development in the region is generally negative. The population of the region continues to decline, although the pace is slower as compared with 2006-2008 (Figure 4).

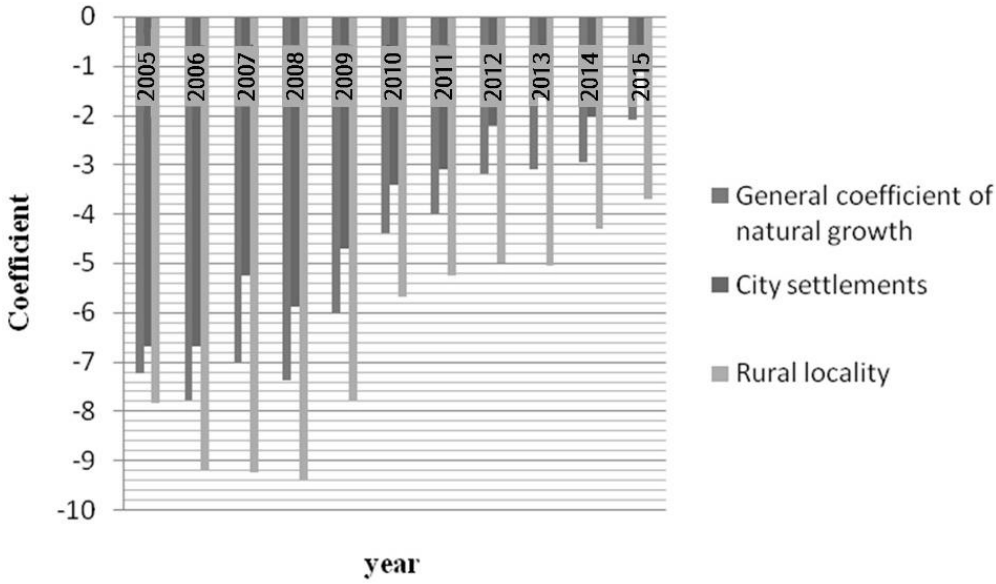

Figure 4. The dynamics of growth coefficient of Kurgan region population.

These characteristics of the basic medical-social indicators in the Kurgan region give reason to believe that the ecological situation in the region is quite far from being successful, but still cannot be regarded as the situation of ecological disaster.

Measures Relating to the Creation of Ecologically Safe Life Conditions

Proceeding from the fact that ecological safety is the complex of measures, directed at the reduction of harmful impact of modern industrial production, life activity and behaviour of people in the natural and social-natural environment, the effectiveness of its system is determined by the aggregate of indicators, which characterize the state of environment in each concrete moment. The criteria of ecological safety imply limitations related to concentration of substances and energy flows in the living space. Their basic sense lies in preservation of human health and life through preventing the effect of the harmful and dangerous factors of technosphere.

With a view to provide ecologically safe sustainable development the state regulation of nature management and stimulation of nature protection activity is executed by means of relevant social-economic, financial and taxation policy. Economic activity is oriented on the achievement of economic prosperity in combination with ecological safety of Russia. The management of ecological safety should be realized at the global, regional and local levels.

At the regional level, the main safety criteria for separate ecological systems imply their integrity, safety of their species composition, biodiversity and the internal interrelation structure. Similar criteria relate to technical-economical systems.

At the local level (for individuals), the main safety criterion is preservation of their health and normal life activity.

Ecological safety provision should be considered in the context of Article 42 of the Constitution of the Russian Federation, which stipulates the right of each citizen to the favorable environment, reliable information on its state and indemnification of loss, inflicted to the health and property inflicted by the ecological lawbreakers, and also the obligation to protect the environment, and to cherish the country's nature heritage.

In 2009, "The National Security Strategy up to 2020" was adopted in Russia and in 2012 "The Fundamentals of the State Policy in the Field of Ecological Development of Russia up to 2030" was approved by the president.

These documents set basic tasks in the field of national security provision. Among them, one should note the prevention of man-made crises, which can create possibilities to improve the country's ecological situation. However, in practice the tension in technosphere grows rapidly, consequently, the ecological risk grows and the security level drops.

The current situation in the country and in its separate regions, such as the Kurgan region, is characterized by the contradiction between the social demand for individuals having high level of culture related to ecological safety and inability to satisfy this demand only by legislative means. Such problems are metavariable by their content and require complex solution.

The culture of safety implies the psychological and qualification preparedness of all persons, which perceive the security provision as a foreground task, and internal demand that leads to self-understanding of the responsibility and to self-control during fulfilment of all works, which have an impact on safety (Vorobiov, 2006).

From the authors' viewpoint, the ecological safety culture should be understood as the means of interrelation between people and the environment, which is directed at the elimination and minimization of ecological risks, hazards and threats that appear in different social-ecological situations. It characterizes the qualitative state of society that possesses the aggregate of material and spiritual values, norms, rules of behavior, along with their traditions, customs, as a certain level of education. This results in creating the conditions, that promote both social and nature protection, preventing threats, which would put at risk their present and future existence (Nesgovorova, 2014).

The main components of the ecological safety culture are presented at several levels. The individual level includes the demand-motivation-value area of personality; the public level implies traditions of safe behaviour, public values, preparedness of all population in the ecological security area; the public-state level involves ethics and morality, values, norms and rules of ecologically safe behaviour in accordance with social traditions and the state requirements.

Axiological component of the ecological safety culture includes the demands, motives, and values, which are the basis of harmonious interaction between the society and nature. These demands and motives also include the values of "golden ecological ethics" and the values of sustainable development that are based on the formed beliefs regarding interrelations between the society and nature.

Development of the axiological component in the field of education, as practice shows, promotes active interaction between the students and nature, relevant activities and the socio-natural environment, developed and directed at the formation of responsibility for their actions and deeds related to nature. Direct contact with nature in the process of transdisciplinary practice is the key condition on the way toward success.

The cognitive component of the ecological safety culture implies knowledge of laws and codes in the field of ecological law and, more specifically, – ecological security as well as knowledge of the mechanisms of ecological regulation and methods of ecosystem stability estimation.

The activity-behavioral component includes the knowledge and skills of using the methods of man-made impact estimation, along with the establishment of ecological balance in the community at the level, which the mankind is ready to reach physically, socially and economically, technologically and politically. This component is developed in the context of long-term activity aiming at the development and implementation of ecological projects, accomplished by the students independently and in cooperation with teachers.

The reflexive-purposeful component of the ecological security culture is displayed in the expression of feelings, caused by communication, understanding the attitude toward nature, estimation of one's own relation to understanding the nature, signs of moral relation to nature, satisfaction with the results of nature protection activities. The display of sympathy to the environment, aspiration regarding active participation in the creative work aimed at the environmental preservation and restoration, estimation of one's own relation to environmental activities, the level of satisfaction with the developed ecological projects, aspiration to organization and participation in ecological actions, aesthetic nature perception – these are indicators of the above component of this culture.

In order to survive, a person should have a high level of ecological safety culture, being able not only to care of himself/herself, but also to provide the safe social and nature development. As practice shows, success of activity in any area depends on human qualities and capabilities, motives of behavior, and his/her confidence in the necessity and effectiveness of the measures taken in the field of environmental protection. Complex development of all these qualities and properties is possible only through the development of ecological safety culture, which is an indispensable component of the general culture.

Discussions

It is pertinent to say that different researchers tried to find answers to the main question related to the future state of the environment, affected by radiation pollution, including its possible impact. Various models for assessing the radiological consequences of nuclear accidents were developed. For example, H. Muller & G. Prohl (1993) described a dynamic ECOSYS-87 model.

These researchers also suggested a model of food contamination assessment. Their studied resulted in the study, written by J. Till & H. Meyer «Radioecological assessment: A textbook on environmental dose analysis» (1983).

E. Cardis, A. Kosminiene & V. Ivanov (2005) in their study “Risk of thyroid cancer after exposure to 131 I in childhood” returned to the issue of radioactive contamination of the environment. They raised one of the most important aspects of this problem related to the internal irradiation of the human body at different age.

N. Vlasova, Y. Visenberg & G. Evtushkova (2014) have demonstrated the similar approach. In their article "Assessment of radiation doses of the population in the long-term period after the Chernobyl disaster" scholars had developed a method of estimating the average annual doses of people living in areas exposed to radioactive contamination (settlements in the Republic of Belarus). The method is based on the analysis of VHF measurements with regard to the indirect factors.

The role of environmental education and environmental awareness of the population is proved by the fact that in 1958, all settlements in Kurgan region were evacuated from the territory with the Sr-90 contamination density exceeding 2 Ci/km2 (its total area makes approximately 1,000 km2) but on the border area with the contamination density of 2 Ci / km2 several settlements remained, including Tatar Karabolka (about 500 inhabitants) and Musakaevo (about 100 inhabitants).

At the same time, the authorities claim that living on the bordering territory is safe. However, the practice shows the opposite.

Conclusion

To sum up, the man-made hazards are associated primarily with active human activities. The level of damage caused by man-made hazards directly depends on the density and the energy level of technical means used by man.

In the Kurgan region, radioactive contamination became one of the most significant man-made environmental problems, which caused damage to the forest fund of the northwestern part of the region, as well as water and bottom sediments of the main sources of surface water supply – the rivers Techa, Iset', Miass, and their floodplain areas.

The man-made disasters, which occurred in the Chelyabinsk region fifty years ago, not only led to the contamination of the territory, but also had long-term environmental consequences related to the accumulation of radionuclides in today's vegetation, which is still dangerous for its users - animals and people.

Among the reasons, causing growth in polluted grassy and brushwood plants, one should note the initial accumulation of radionuclides in the leaf litter. Therefore, due to the cycle of matter in biosphere natural resources become the additional sources of environmental pollution, which affect not only natural complexes, but also human health.

Making a comparison between indicators related to socio-demographic state of the Kurgan region population and the medical-social scale, which takes into account different groups of population (native, migrants and etc.) and negative ecological changes, it is possible to conclude that the ecological situation in the region is quite far from being successful, but still cannot be regarded as the situation of ecological disaster. Decisive measures should be taken as regards the creation of ecologically safe life conditions.

This problem could be addressed as well through the development of ecological safety culture, which will give the possibility to make a conscious choice of behavior toward nature and the environment, including the unfavorable environment.

Can summarize that the current situation is characterized by the contradiction between the social demand for individuals having high level of culture related to ecological safety and inability to satisfy this demand only by legislative means. Such problems are metavariable by their content and require complex solution.

The ecological safety culture is a complex and open system, which is reflected by all its components: axiological, cognitive, activity-behavioral and the reflexive-purposeful one. Public recognition and development of this type of culture is one of the effective means to solve the ecological safety problem.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Natalia P. Nesgovorova a Doctor of Pedagogical Sciences, Head of Department of Geography and Nature, Federal State Public Educational Institution of Higher Professional Education "Kurgan State university", Kurgan, Russia;

Vasiliy G. Savelyev a PhD, Associate Professor of Department of Geography and Nature, Federal State Public Educational Institution of Higher Professional Education "Kurgan State university", Kurgan, Russia;

Elena P. Bogdanova a Reserch of Department of Geography and Nature, Federal State Public Educational Institution of Higher Professional Education "Kurgan State university", Kurgan, Russia;

Galina V. Ivantsova a PhD, Associate Professor of Department of Geography and Nature, Federal State Public Educational Institution of Higher Professional Education "Kurgan State university", Kurgan, Russia.

References

Aliabysheva, E.A., Sarbaeva, E.V., Kopylova, T.I., & Voskresenskaya, O.L. (2010). Industrial Ecology. Yoshkar-Ola: Thesis submitted for the degree: Master of Philosophy in Indigenous Studies Faculty of Social Science, *University of Tromsø*, 91 p.

Artemenkova, L.V., Druziak, V.S., Ryabov N.V. et al. (1988). Recommendations on Developing a Report Card on Radiometric, Dosimetric and Spectrometric Equipment for Radiological Services. Technical Progress in the Nuclear Industry. Series «*Isotopes in the USSR*", 73, 158 - 162. Moscow: Energoatomizdat.

Burtovaya, E.Y. (2006). Features of Affective "Organic" Disorders of the Population in Remote Periods in the Area of Radiological Incidents in the Southern Urals. Scientific Journal "*Bulletin of the South Ural State University*», 3(1), 112-118.

Cardis, E., Kosminiene, A., Ivanov, V. et al. (2005). Risk of Thyroid Cancer After Exposure to 131 I in Childhood. J. Nat. (Ed.). *Cancer Institute, 97*(10), 724-732.

Dogru, M. (2008). The Application of Problem Solving Method on Science Teacher Trainees on the Solution of the Environmental Problems. *International Journal of Environmental and Science Education, 3*(1), 9-18.

Gowdy, J., & Erickson, J.D. (2005). The Approach of Ecological Economics. *Cambridge Journal of Economics*, *29*(2), 207-222.

Gitelson, J.I., & Lisovsky, G.M. (2003). *Man-made Closed Ecological Systems*, 9. Florida: *CRC Press*.

Khoruzhaya, T. A. (2002). Estimation of ecological danger. Moscow: "Kniga servis".

Krivolutskii, D.A. (1993). Environmental implications of radioactive contamination in the southern Urals. The science.

Krivoshein, D.A., Muravei, L.A., Roeva, N.N. (2000). Ecology and Life Activity Safety. Moscow: *Yuniti-Dana*.

Martyushov, V.Z., Krivolutskii, D.A., Smirnov, E.G. & Tarasov, O. (1999). Environmental effects of long-term radioactive contamination in the southern Urals. Bioindication radioactive zagryazneniy. Moscow: Science, 49-72

Medvedev, Zh. A. (1979). Nuclear Disaster in the Urals, 224. Britain: *The Book Service Ltd*.

Muller, H., Prohl, G. (1993). ECOSYS-87: a Dynamic Model for Assessing Radiological Consequences of Nuclear Accidents. *Health Physics, 64*(3), 231-252.

Passport of Kurgan region: Volume of Research Papers. (2013). Russia: Kurgan.

Petrov, N.N. (1995). Man in Emergencies. Cheliabinsk: South Ural Publishing house.

Pozolotina, V.N., Molchanova, I.V., Karavaeva, E.N., Mihkaylovskaya, L.N., & Antonova, E.V. (2007). Distribution and Transport of Radionuclides in the Terrestrial Ecosystems, Zone of Accident on the Urals. The International Conference on Biogeochemistry of Trace Elements: Environmental Protection, Remediation and Human Health. 15-19 July. *Tsinghua University Press*, 437-438. China: Bei Jing.

Radiochemical analysis. (1963). USSR Academy of Sciences. Moscow.

Ratanova, M.P., & Sirotin, V.I. (1998). Rational Nature Management and Environmental Protection. Moscow. *Mnemosina*, 166 p.

Reimers, N.F. (1994). Ecology (Theory, Laws, Rules, Principles and Hypothesis). Moscow: *Rossiya Molodaya*, 352 p.

Shmal', A.G. (2010). Factors of Ecological Security – Ecological Risks. Part of the series Strategies for Sustainability. *Spatial Planning and Sustainable Development*, 3, 305-321

Sihynbayeva, Z.S. (2012). Some Questions Regarding the Ecological Culture of Students in Kazakhstan. *Scientific Journal Fundamental Research*, *11*(5), 1107-1110.

Sokolov, E.M., & Sviridova, T.S. (2012). Migration of Radionuclides in the Soils at Radioactive Pollution of Metallurgical Region. *Life Activity Safety, 12*, 45-48.

SP 2.6.1.758-99. (1999). Radiation Safety Standards (RST-99): Hygienic Standards. The Center of Sanitary-and-Epidemiologic Standardization, Hygienic Certification and Expertise of the Ministry of Public Health of the Russian Federation., 116 p. Moscow.

State Policy Fundamentals in the Field of Ecological Development of Russia up to 2030. (2012). Approved by the President of the Russian Federation on 30 April.

Till, J.E., & Meyer, H.R. (1983). Radio-ecological Assessment: A Textbook on Environmental Dose Analysis. NUREG/CR-3332, ORNL-5968. Washington, DC: U.S. *Nuclear Regulatory Commission*.

Vlasov, O.K. (2013). Radio-ecological Transport Model of Iodine and Cesium Radionuclides on Food Chains after Radiation Accidents Involving Air Emission Intended for Exploring the Regularities of Internal Irradiation Doses of Population. *Scientific Journal Radiation and Risk*, 2(22), 16-34.

Vlasova, N.G., Visenberg, Y.V., Evtushkova, G.N., & Drozd, E.A. (2014). Assessment of Radiation Doses of the Population in the Long-term Period after the Chernobyl Disaster. *Problems of Health and Environment, 4* (42), 129-134.

Vorobiov, Y.L. (2006). Fundamentals of Public Safety Culture Development in Public Activity. Moscow: *Delovoy Express*, 1-29.

Zholdasbekov, A.A. (2012). Exploring Student Ecological Education. *Modern Problems of Science and Education, 1,* 184 p.