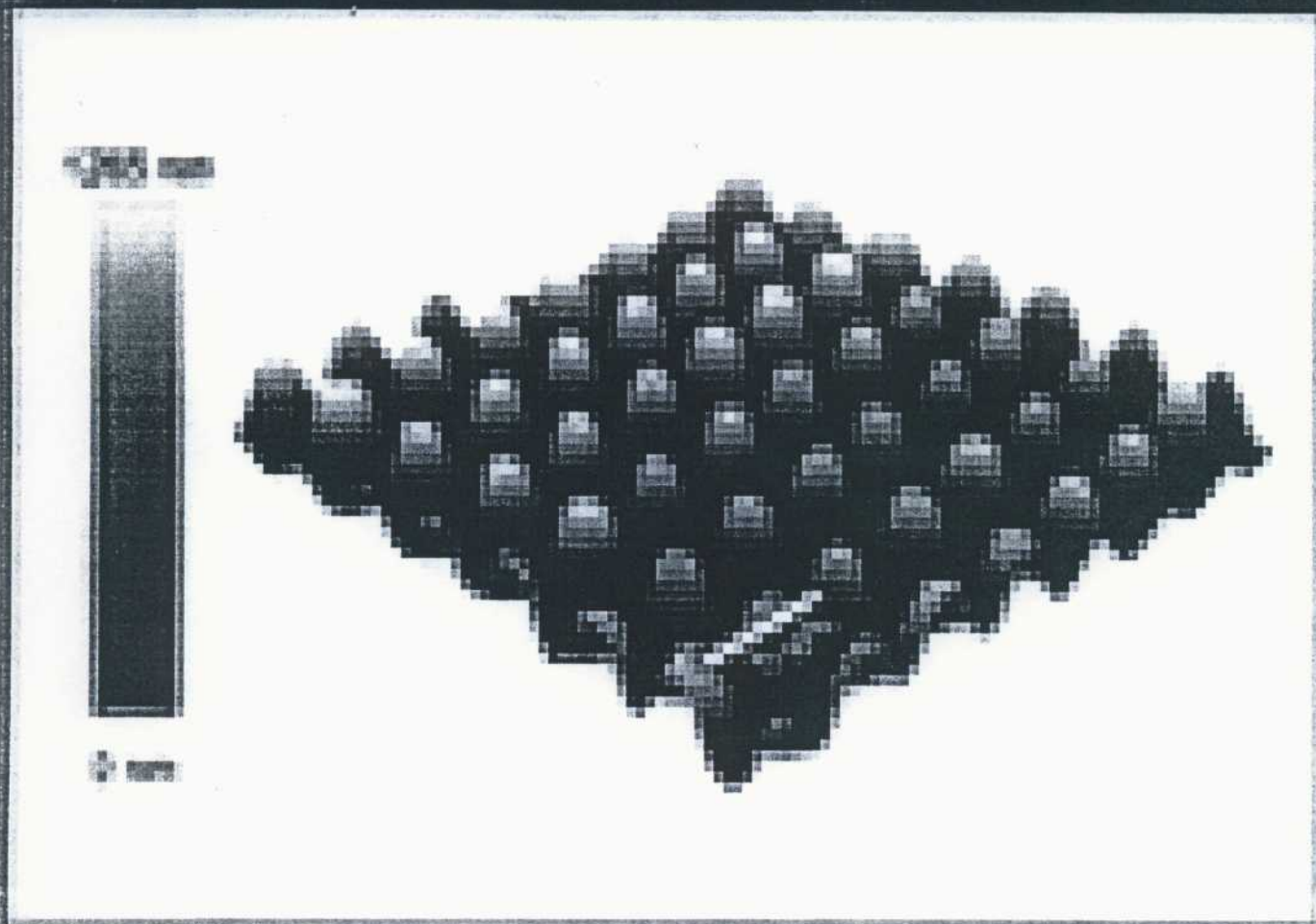


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Environmental assessment of contamination with heavy metals and air contamination

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Abstract

This paper studies the method of environmental assessment of environmental contamination by heavy metals outside of Northern Kazakhstan region. The estimation of air pollution of the Northern Kazakhstan region. The results of a study of soils of North Kazakhstan region for heavy metal content was conducted and analyzed. Substantiated, and an inventory of anthropogenic changes in ecosystems and create an electronic database to assess the ecological status of the North-Kazakhstan region by the level of

anthropogenic load on landscapes. Theoretically substantiated and developed a set of measures on air quality and soil of North-Kazakhstan region. Materials research is recommended to use the service of ecology and nature departments, health services, and monitoring of the natural environment, as well as for the development of legislation to improve the environmental situation in the region and the development of regulatory geochemical indicators for assessing the quality of the environment.

Keywords: methodology, environmental assessment, airborne industrial pollution, heavy metals, ambient air, the North-Kazakhstan region.

Introduction

The experience of recent decades shows an increase in the number of natural and man-made disasters, carrying serious environmental and socio-economic consequences. A prerequisite to the emergence of disasters are environmental risks associated with the presence of dangerous natural and anthropogenic factors. Identification of the main environmental risks affecting the economy of Kazakhstan makes it possible to design and conduct more effective public policies in the field of greening the economy, production and the development of environmentally friendly technologies, especially in key industries (Baimbetov N.S., Idirisova B.Sh., 2012).

The transition to environmentally sound and sustainable development in now it is becoming one of the major priorities of the strategy Development of

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RESEARCH ARTICLES

Kazakhstan, one of the areas which is to protect environment.

To this end, we consider the information about air condition cities and industrial centers, water sources, waste production and consumption, as well as state regulation of natural resources and Environment (HSE) in Kazakhstan.

An analysis of the state of the country's environment conducted using the results of audits of the Accounts Committee for Control over Execution of the Republican Budget of the Republic of Kazakhstan, on the results of which are set out the main findings and recommendations to improve the environmental and ecological security (*Analytical information on the environmental condition. State regulation of natural resources and conservation the environment in the Republic of Kazakhstan*, 2014).

Environmental safety, as part of the national security in the Republic of Kazakhstan, is a prerequisite for sustainable development and is the basis of preservation of natural systems and maintenance of an appropriate quality for the environment and living standards (Doskenova B.B., Baymasheva Sh.M., 2009). Problems arising from environmental factors are of paramount national importance. This is specifically important for Kazakhstan with its large complex of environmental problems. In order to prevent and eliminate the negative human impact on the environment, the creation of high quality human environment is necessary. First of all, reliable, objective and timely environmental assessment of the situation only in this case is the possible, rational and most correct decision to regulate the quality and quantity of environmental status (Agar N., 2001; Gao Wei Kuan, 2009; Gao Xiaolu, 2009; Innocent N. M. et al, 2009; Pirages, D., Cousins K., 2005; Xiao D.-N. et al, 2002; Yan-Zhi Zhao et al, 2005; Yong-Min Zhang, Xiao Liang, 2009).

The ecological status of the territory of North-Kazakhstan region is largely due to anthropogenic and natural factors. These pressures often exceed the ecological environmental features and violate its

normal functioning. This has a negative impact on the biota of existence, including human (Doskenova B.B., Baymasheva Sh.M., 2009).

The investigated area is characterized by high morbidity and mortality, a difficult demographic situation which is even against the background of the unfavorable state of the republic's health in general and characterized by the rising incidence of many human diseases, high incidence and above all, cancer pathology which has been occurring for a long time has also been steadily growing.

Particular attention is paid to assessing the risk to the health of the population of the North-Kazakhstan region due to the fact that the region is characterized by high levels of morbidity, as well as an accelerated growth which is significantly higher than the average parameters that greatly disturbs the society. This determines the relevance of our research on necessary environmental assessment of air pollution and soil of North-Kazakhstan region in the Republic of Kazakhstan with heavy metal and the need to evaluate the air pollution in the North-Kazakhstan region. It is necessary to carry out and analyze the results of the study of soils of North Kazakhstan region for heavy metal content. It is necessary to make an inventory of anthropogenic changes in ecosystems and create an electronic database to assess the ecological status of the North-Kazakhstan region by the level of anthropogenic load on landscapes. At present, not only a complex of measures on protection of atmospheric air and soil of North-Kazakhstan region, it is also necessary to carry out a complex study on the influence of man-made industrial transformation of landscapes of various geo-ecological conditions with significant natural resources. It is necessary to carry out a study of anthropogenic ecosystem changes in air and soil pollution with heavy metals in the North-Kazakhstan region of the Republic of Kazakhstan. To substantiate ecological soil monitoring, it is necessary to evaluate its risk to human health when heavy metals are exposed, polluting the air and the soil of North-Kazakhstan region. It takes

organization and carrying out further monitoring of the environment in North-Kazakhstan region of the Republic of Kazakhstan. As noted by foreign researchers (Llewellyn R.V., Williams J.R., 1996).

Materials and Methods

The basic techniques for organizing and conducting research on environmental assessment and analysis of the data, describe the methods of selection and preparation of soil samples. The objects of study are defined soil and air of the North-Kazakhstan region, as well as the population of this region. The starting materials become an evidence of environmental study of the soil and air; its forms are of statistical reporting and laboratory data. For the analysis of the original data descriptive, laboratory instrumentation, mathematical and statistical methods are used for the construction of cartograms MapInfo program, EPIMAP, COREL.

In the study of the ecological state of air and soil in the North Kazakhstan region of the Republic of Kazakhstan, we used a system of evaluation of the ecological state of the region and developed a program for the environmental assessment of the state of the research environment of the North-Kazakhstan region, a systematic review of published data and research materials. We used the method of field research, the method of mapping and survey, retrospective analysis, sanitary and Epidemiological research and statistical material processing techniques.

In accordance with the program "Improvement of the environmental situation of Petropavlovsk and the North Kazakhstan region", jointly with the National Research Centre of air protection we carried out work for the Environmental Assessment of Petropavlovsk and region. These studies included evaluation of atmospheric air in the region based on the results of summary calculations of the level of pollution of the air basin, taking into account all fixed and mobile sources of emissions.

We have carried out field research on the 28 key areas of North Kazakhstan region with soil sampling and plant matter on the chemical and spectral analyzes. Analysis of data for ten years (1997-2007) established 28 key areas of the region to raise the level of general population cancer rates, and various cancer pathologies.

The method of field research was to study the environmental and geochemical conditions in the region in key areas. Sites were selected on the basis of differentiation of the administrative regions, with average and maximum levels of morbidity within which the study of soils was conducted and the comparison of indicators which reveal the causal relationships between environmental factors and disease. A method for evaluating the ecological state of air and soil in the North-Kazakhstan region, held in the selection of 260 samples - 130 soil samples and 130 samples - plant mass in the North Kazakhstan region on the spectral and chemical analysis. This is a total of 18-20 samples per key area (respectively - 9-10 soil samples and vegetation). Basically soil sampling and plant mass was conducted at one site (pairs "soil-plant"), which is suitable for tracking the migration of chemical elements from soil to plants.

For research allocated especially valuable substances influencing biochemical processes in the body. These are lead, cadmium, arsenic, iodine, selenium, zinc, copper, molybdenum, lithium, nickel, iron, calcium, chromium, mercury, vanadium, manganese, cobalt, - a total of 17 elements. Tests conducted in the laboratory of physical methods of research CJSC "Central geo-lanalit" in Karaganda.

The technique works on the processing of statistical data was to collect primary information on overall morbidity and mortality, and was carried by main classes of disease division by sex, age groups, categories of urban and rural residents. Particular attention is paid to the collection of information on cancer incidence. Information basis was the base of the patients with malignant neoplasms of the data for a certain period of time, established on the basis of

RESEARCH ARTICLES

official data recording and reporting of medical records: registration form number 7 "Data on malignant tumors" and number 35 "Information on patients with malignant tumors," checklists of follow-up patients with malignant tumors form 030-6/V, the notice of the sick for the first time diagnosed malignancy form 090/y, an extract from a medical card of the inpatient malignancy form 027-1/V protocols in case of detection of a patient of advanced forms of cancer (clinical group III-IV) form 027-2/V, registration cards of the individual monitoring of patients with malignancies, hospitalizations samples from magazines of different health care facilities, which hosted the examination and treatment of patients with neoplasms, lists of patients taken to register with newly diagnosed, archives data and expert opinions.

Results

When evaluating the ecological state of air and soil of North-Kazakhstan region, in most cases, the condition was considered separately in Petropavlovsk and in rural areas. Only about 15% of the North-Kazakhstan region occupied by aspen-birch groves with meadows, rivers, lakes, roads and settlements. In the course of work we have first studied the city transport structure, to determine the intensity of traffic on the main highways, you perform a full inventory of all stationary sources of pollution of the area, an electronic database of enterprises of urban atmospheric pollution and road revealed areas exceeding pollution standards, a map of Petropavlovsk pollution and based on this, an electronic quality management system Petropavlovsk air. The maps of North Kazakhstan region "classification according to the degree of anthropogenic load of land", "Absolute environmental stress", "Relative environmental stress" and others. Allocated areas in excess on the basis of pollution standards of the research to 17 macro and micro elements in soil samples and vegetation. Electronic databases of population was

created and demographic processes on the state of the environment in urban and rural areas which allows us to conduct automated processing of specific indicators in the organization of further comprehensive monitoring data.

In accordance with the objectives, main directions of work were reduced to the evaluation of the ecological state of air and soil of North-Kazakhstan region with the work on the evaluation of the environmental situation in terms of its impact on public health.

Assessment of health depending on the ambient air quality Petropavlovsk included: - monitoring and inventory of the urban area of air pollution sources to recount its quality, taking into account the recorded changes. An assessment of the state of health of the population - mapping forms of morbidity, the most determined air quality: collection of statistical and other materials from previous studies to be used in the present work; the creation of cartograms of air quality and the health of geographical parameters (airway diseases, oncological diseases, etc.). One of the most important environmental issues of our time should be called the decline of the natural soil fertility (Diaz, S. et al. 2006; Gao Wei Kuan, 2009) including in the North-Kazakhstan region, associated with a decrease in the content humus in the plow layer of soil. The analysis of data on fertilizers and pesticides represents a significant increase in the volume of chemicals used in agricultural production in recent years. The current situation in the North-Kazakhstan region is the situation in the sphere of neutralization, storage and disposal, the use of various waste products. It is one of the main reasons for the dangerous pollution of the environment, which represents a real threat to public health. The current waste management system also causes significant economic damage in the form of lost profits from the recycling of valuable raw materials in the North-Kazakhstan region satisfactorily addresses issues of storage and processing of waste. The total volume of household waste per year is more than 30 mln. m³, which come in organized

landfills (27 pcs.) and stored at the site in the city of Petropavlovsk. Recycling is performed. In general, there is no point for metallic mercury from mercury-containing products become unfit for use.

Analysis of the data on the degree of use, modification and pollution of natural components suggests that there are differences in the degree of chemical (poison), radioactive and other contaminants on administrative areas and natural landscapes. In general, we can talk about a certain degradation of natural ingredients, such as soil and vegetation (Paudyal G.S., Thapa G.B., 2002; Pirages, D., Cousins K., 2005). The sanitary and epidemiological situation can be assessed as satisfactory. There is diversity of natural resources which leads to the formation of modern landscapes of new structural and functional properties and the level of anthropogenic transformation (Xiao D.-N., et al., 2002).

The current level of anthropogenic transformation of North-Kazakhstan region is quite high. Studies evaluating the effects of pollution on the health of the population outside of Petropavlovsk have shown that the greatest risk comes from the high level of suspended solids and the highest number of cases of cancer, in particular lung cancer, stomach, and skin, where the state of the atmosphere is influenced by industrial enterprises, including grain processing. In general, the city is under the influence of a suspended hour.

Original results

Assessment of the severity of the ecological situation is carried out by determining the degree of contact degradation or violation of the individual components of the landscape. One of the integral indicators in geosystems is a violation of the norms in an excess of MPC, the biochemical processes in the human body which directly or indirectly determines the state of his health. During the study, average concentrations, median and inter-quantile scope for each metal, the excess of maximum permissible concentrations of three heavy metals is

noted: lead exceeded 4.9 times, 3.2 times cadmium, vanadium and 2.1 times.

Excess typical background values for vanadium of 1.2 times, 1.1 times of chromium, iron, 1.1 times, 1.6 times of cobalt, copper, 2.1 times and 1.4 times of zinc. Analyzing data from studies of soil samples and vegetation on the content of macro and micronutrients in key areas of comparison of their baseline values, and to MAC standards makes us conclude - that the region has maximum permissible concentration norms twice on the content of heavy metals in almost all areas (mainly this lead, vanadium, cadmium, etc.). There is an insufficient level of iodine and selenium on the key areas of Timiryazev, Shal bard and G. Musrepov areas (in the field of background values in the normal range (by - 4.6).

Differentiate zones with the maximum soil pollution, which is directly connected with the need for further analysis in connection with ecological trouble. Significant excess of MPC for cobalt, which is a carcinogen, in the area of residential development determine the need for inclusion of the metal in the study of soil samples. For nickel was not observed or exceeded MPC or background values.

In the study of total forms of heavy metals and their quantitative estimates DCS and the MPC are used, in mg/kg. Further analysis was conducted on the functional areas of Petropavlovsk, on the key areas of each administrative district of the North-Kazakhstan region, as well as for each of macro and micronutrients background of chemical elements in different landscape-geochemical conditions of Petropavlovsk North Kazakhstan region in 2007, within the normal range.

MPC excess of zinc is not mentioned, while in all the administrative districts of the region, its concentration above background (1.9 times). The highest zinc values in soil samples marked in the residential area (134.8 ± 75.5 mg/kg). The special situation on the content in the soil of arsenic and lead.

RESEARCH ARTICLES

The average arsenic content in all areas, including the background, is in the range 8.5 - 11.3 mg / kg (MAC - 2.0 mg/kg). Apparently, such a feature field soils when assessing pollution need not compare to the result with the MAC, and with the value of the background on field of 10.0 mg/kg. The level of arsenic, according to our study is consistent with Russian and Kazakh neighboring regions. Maximum arsenic concentration values observed in the living area (11.8 ± 3.9 mg/kg).

Exceeding the maximum permissible concentrations of lead content in the soil samples was 33% of the total number of tests. When checking the maximum permissible concentration of residential areas identified in 47% of samples, and on highways - in 55% of cases, there were elevated levels of lead compounds in soils is due to the close proximity of highways, long-term use as an anti-knock additive tetraethyl lead to gasoline vehicles, which have accumulated in these soils.

For removal of lead from the soil would require additional measures. Maximum values were characteristic of the soil samples taken in the sanitary protection zones of industrial enterprises (39.7 ± 38.4). According to the instructions 2.1.7.1287-03 not exceeds the MPC or APC chemical pollution in residential areas, and especially for high-risk areas: children's and educational institutions, sports

gaming, playgrounds residential development, recreational areas, sanitary protection zones of water bodies and coastal zones. These areas must be located on soils belonging to the "pure" category. Background concentration of lead in the province is 25.8 mg/kg, which is slightly below the MRI. (30 mg/kg).

It was established statistically that significant differences in lead content of soil samples collected in the city of Petropavlovsk in the area of residential development ($r = -2.1$; $p < 0.05$). At the same time the content of lead in the area of residential development was not significantly different from the content of this metal in the samples collected in the sanitary protection zones near motorway ($t = 0.7$, $2 - 0.03$; $p > 0.05$). Particularly high levels of lead observed in Kyzylzharsky area (1.5 MAC), in the region of M. Zhumabaeva (1.6 MAC), in Timiryazev (1.2 MAC), in the region of G. Musrepov and Shalakyn (1.3 MAC) total excess of MPC to lead registered in the territories of the seven districts of the region.

Safely on the heavy metal content of the soil (and Akkainsky Esil districts of the region). Also prosperous farmland soil surveyed (Akzhar field and Tainshinsky areas). Petropavlovsk and the districts under the "torch" cereals.

Table 1. The results of environmental studies of soils of North Kazakhstan region on the content of micro-macro elements in 2007 (mg/kg).

Elements	Minimum value	Maximum	Average	Median	25th percentile	75th percentile	Median MPC	The median background value
Pb	136	245	30.8	14.9	21.8	16	15.1	1.2
Cd	125	40	85.4	114	184	170	10	11.1
Cu	309	707	35.2	34.4	40	47	34	10
Mn	2.8	3.55	309	409	707	100	407	34
Fe	58.9	89.7	2.8	3.5	3.55	2.5	2.55	407
V	32.8	40	58.9	61.8	89.7	90	55	2.55
Ni	436	589	32.8	37.5	40	58	30.6	55
Ca	17	16.8	436	454	589	650	377	29.6
Li	60	123	17	16	16.8	19	9.5	377
Zn	0.075	0.099	60	68	123	83	69	9.5
Hg	11.7	17.3	0.075	0.08	0.09	0.07	0.05	6.0

Co	54.1	70.4	11.7	13.9	17.3	18	7.56	1.054
Mo	1.6	2	54.1	53	70.4	34	30	7.56
Cr	35.3	40.0	60.0	40.0	80.0	100.0	14.5	1.2
As	10	8.0	5.3	11.6	8.7	11.3	4.4	3.0
Se	30.2	40	60	70	0.6	83	1.0	0.3
I			1.2	-	40	30	34	0.5

Discussion

Kazakhstan has large uranium-bearing provinces hydrological, many small uranium deposits and occurrences, which cause elevated levels of natural radioactivity (also waste accumulated in the uranium mining enterprises and in the field of nuclear explosions). Although carried out transportation of 210 tons of nuclear fuel for safe storage, disposal of this work needs to continue on. In 30% of the territory of Kazakhstan there is a potential for an increased allocation of natural radioactive gas - Radon, which poses a real threat to human health. Dangerous is the use for drinking and household water needs, contaminated radionuclides. It is necessary to continue working on a comprehensive solution to the Program on the Elimination of radioactive dumps of uranium mining industry, in their processing and disposal, in order to reduce public exposure and radioactive contamination of the environment (Baimbetov N.S., Idirisova B.Sh., 2012; Bashkin V.N., 2007).

The greatest amount of emissions from stationary sources recorded in Karaganda, Pavlodar, East Kazakhstan, Aktobe, Atyrau and Kostanai regions. These regions are well-developed production associated with the mining and oil industry, as well as heat and power plant. To assess the level of pollution of atmospheric air in the past month following air quality index used: standard index (SI),

maximum frequency (NP) and the air pollution index (API). Standard index is defined as the ratio of the maximum one-time concentration of any pollutant to its maximum permissible concentration. The highest frequency is determined as a percentage as an indicator of determining repeatability exceeding the pollutant in the air of the village; air pollution index is defined as the sum of the ratio of the average value of the concentration of the pollutant to the MPC, taking into account the hazard class (Barulina L., 2016).

In the field of more than 400 companies and organizations, whose emissions pollute the air, about 3,000 stationary air pollution sources was registered, including those organized by 2740 which is the most polluted air basin of Petropavlovsk, which supplies 54% of total emissions in the area.

G. Musrepov district (9.4%) stands out from the rural areas, Kyzylzhar (7.3), Timiryazevskiy (4.6), Aityrau (4.1), M. Zhumabaeva (4.1). The contribution of the remaining rural areas of less than 4.0% each. The main supplier of pollutants into the atmosphere is Petropavlovsk.

Among the 20 major cities surveyed Kazakh air pollution exceeds the norm ($IZA * 5 = 5$) in 11 cities, including Petropavlovsk, referring thus to cities with higher pollution levels. A summary of the change (API5) air pollution index are shown in Figure 1. Change API5 for Petropavlovsk for 1994 – 2008.

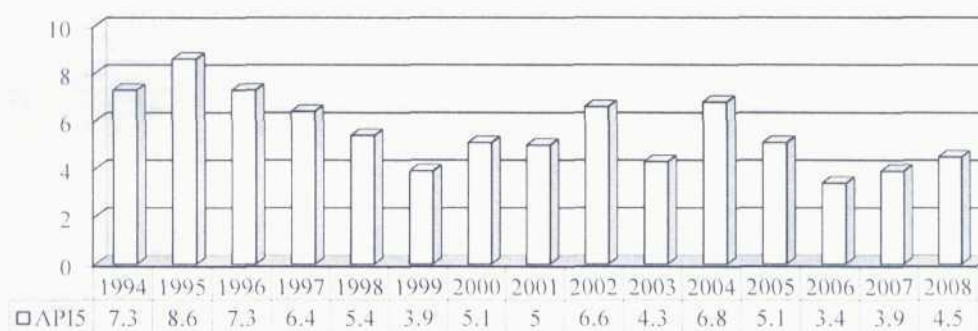


Figure 1. Change API5 for Petropavlovsk for 1994 - 2008

The main sources of emissions are the Peter and Paul thermal power station thermal power station-2 (JSC "Access Energy PTWP-2"), boilers and vehicles. Of the 136 ingredients that pollute the air basin of the city, the first hazard category include nitrogen dioxide, sulfur dioxide, phenol, manganese and its compounds, silica, chromium oxide, the second category of danger - nitrogen oxide, benzo (a) pyrene, heavy oil ash plants based on vanadium, gaseous fluorine compounds based on fluoro et al., a third category includes pollution hazard 53 items. Analysis of observational data confirms the rather high level of 54% of air pollution in Petropavlovsk. So in 2008, we observed the maximum permissible concentration for a carbon monoxide - 2.4 MPC; nitrogen dioxide - 1.2 MAC; Formaldehyde, which is associated with the work of construction enterprises and insulating materials plant. Noted speaker on exceedances of carbon monoxide - 4 MAC 1999, MAC 5.6 - in 2008 ; nitrogen dioxide - 1.4 MAC - in 1999, 3.2 MPC - in 2008, and reduced exceedance phenols - 3.7 MPC - in 1999 ; 1.8 MPC - in 2008 ; 1.7 MPC - in 2007; 1.6 MPC - in 2008, due to the decline in industrial production. When considering the North-Kazakhstan region, air pollution problems pays particular attention to the structure and distribution of pollutants on the territory of the region. Almost all of the sources end up in the atmosphere of sulfur dioxide, dust, carbon monoxide, nitrogen oxides, hydrocarbons, including

carcinogenic. From specific types of production which characteristic of the city, phenol, formaldehyde, benzopyrene, abrasive dust, grain dust and other harmful substances are further ejected. The total amount of the ingredients present in the urban area exceeds 130, many of which belong to the first and second risk category. Special danger fraught emissions, ash and slag and Paul thermal power station-2 (JSC "Access Energo PTWP-2"). Since the beginning of operation PTWP-2 (1961), 33.5 million tons of ash has been accumulated with an annual output of ash of more than a million tons. The total area of ash dumps Petropavlovsk CHP-2 is 440 hectares.

The results of the study revealed that the region is dominated by particulate matter and sulfur dioxide emissions, carbon monoxide and nitrogen oxides. Among other phenols, petroleum products, cadmium, lead, mercury, zinc, beryllium, and others. The excess of the norms of maximum permissible concentrations of heavy metals and the lack of iodine and selenium contributes to the level of oncological diseases (*Millennium Ecosystem Assessment*, 2005).

We found the highest rates of population decline in the North-Kazakhstan region, which accounted for Petropavlovsk (-6.7 per 1,000 inhabitants) and Akkayynsky (-4.4). At the same time, several areas have natural increase - Ualihanovsky (6.8), Akzhar (3.7), Zhambyl (1.8), Tayynshinsky (1.5). The highest rates of different areas Ayrtausky, G.

Musrepov, Petropavlovsk is a measure of 15.4 and a coefficient associated with a greater population.

In the first place among the causes of death are diseases of the circulatory system, the investigated area on this indicator in Kazakhstan is in the top four, the rate per 100 thousand population in 2008 was 725.7, while the national - 494.6. In second place - the death rate from cancer - 475, at the Republican - 230, the third place - the death rate from respiratory diseases, which is in the North-Kazakhstan region is the highest in the country and in 2008 was 144.8 per 100 thousand populations, at the national level, equal to 65.5.

Effect of pollutants on human health:

Carbon monoxide (CO, carbon monoxide (II)) - a colorless gas with no taste or smell, is considered "the inhaled poison", capable of creating an oxygen deficiency in the body's tissues, which can cause headaches, dizziness, nausea, loss of consciousness and even death. The main source is road transport.

Nitrogen dioxide (NO₂) - Gas yellowish-brown, strongly impairs visibility, gives a brown shade air, is highly toxic, causing bronchitis, and lowers the body's resistance to respiratory diseases. WHO studies show that exposure to nitrogen dioxide can cause both acute and chronic effects on human

health, especially for people suffering from chronic diseases of the respiratory tract, and in children. The main sources are the thermal power plants, industrial plants and motor vehicles.

Dust (suspended particles smaller than 10 microns) can cause diseases of the mucous membranes and respiratory system, as well as conjunctivitis and dermatitis. The main sources are industrial enterprises, transport and open burning of fuel.

Formaldehyde - a colorless gas with a pungent smell in high concentrations irritates the eyes and the respiratory tract, has a general toxic effect, and causes CNS, an irritant, allergenic, mutagenic, carcinogenic effect. The main source is motor vehicles and industrial plants (*The air quality in Almaty in April 2016*, 2016).

Identified disease classes with reliable upward trend for the North Kazakhstan region: the incidence of blood and blood-forming organs (the whole population); disease of the endocrine system (the whole population); respiratory morbidity (adults, adolescents); disease of the digestive system (the whole population); the incidence of skin and subcutaneous tissue (teenagers, children).

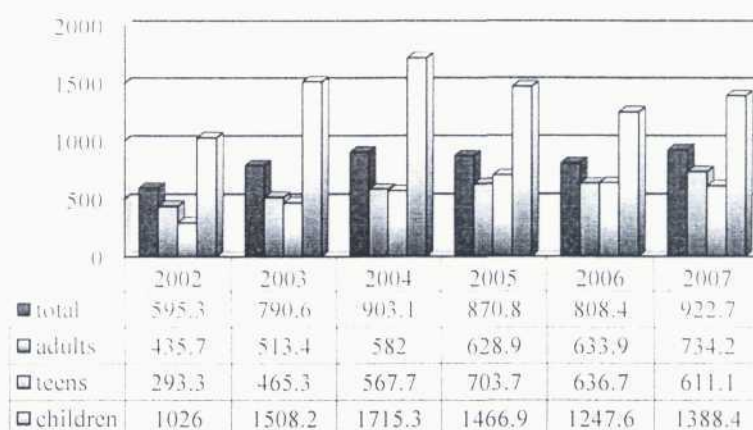


Figure 2. Dynamics of blood diseases and blood-forming organs in the North-Kazakhstan region per 100 thousand inhabitants.

RESEARCH ARTICLES

Analyzing Figure 2 clearly shows that the children predominate among patients with diseases of the blood and blood-forming organs.

The incidence in children is 2 - 3 times that of the level of disease in both adults and teenagers - the amplitude values of 1000-1700 cases per 100 thousand inhabitants. In adults and adolescents, is almost of the same frequency of the disease: it ranges from 300 to 600. In this region, this class of diseases spread very unevenly and with large amplitude minimum and maximum values. The maximum value (734 cases per 100 thousand inhabitants - Kyzylzhar District) is almost 17 times higher than the minimum (44 cases for the same number of inhabitants - Ualihanovsky district). The gradation of up to 100 cases/100 thousand, Akzhar district also gets. In the following gradation - from 100 to 150/100 thousand - get three districts: Aiyrtau, Timiryazevskiy, Mamlyutsky. Also, three districts (G. Musrepov, Shal bard and Esilsky) form a third gradation of scale - ranging from 150 to 200 cases per 100 thousand population. The following graduation group (200 to 250) is Taiynsha District and two areas fall within the gradation 250 - 199 (Akkayynsky, Zhambyl) and 300 (M. Zhumabaeva and Kyzylzhar). Moreover, in the area of M. Zhumabaeva incidence rates twice lower Kyzylzhar.

Areas of the North-Kazakhstan region are different from each other in terms of cancer incidence. Thus there is clearly a strong trend - in the northern regions (M. Zhumabaeva and Kyzylzhar, Mamlyutsky) with area of cancer incidence observed at a high level (more than 200 patients per 100 000 population), the average level is in the south - west region (G. Musrepov, Aiyrtau, Timiryazevskiy) and in the central areas of morbidity is reduced. Human health is largely a reflection of the quality of the environment.

Conclusion

1. Assessment of air pollution in the North-Kazakhstan region has allowed us to establish the prior sources of pollutant proceeds, namely thermal

power enterprises Petropavlovsk (JSC "Access Energy PTWP-2") which engaged in emissions of heavy metals into the atmosphere, accounting for 61% of gross emissions.

2. Soil contaminants in the North Kazakhstan region are heavy metals (mainly lead, cadmium and vanadium) are set as a priority. It was noted the excess of: lead 4.9 times, 3.2 times the cadmium and vanadium by 2.1 times, and the proportion of soil samples exceeding the maximum permissible concentration of lead was 33%.

3. Excess norms MPC content of heavy metals in the soil found in almost all areas, hence the need for environmental monitoring of soils of North-Kazakhstan region.

4. Individual chronic non-carcinogenic risk is less than 1 (the maximum value of chronic non-cancer risk for oral exposure reaches the value 0.0119). The carcinogenic risk of oral exposure does not exceed the value of acceptable risk (level 1×10^{-6} more, but less than 1×10^{-4}), inhalation - the value of acceptable risk (level of 10^{-6} or less).

5. Percentage risk to the health of the population of the North-Kazakhstan region under the influence of heavy metals and arsenic polluting the atmosphere and soil, has shown the need to carry out on the implementation of environmental monitoring activities.

The results can be used for the organization of monitoring studies of the state of air basin and the soil of North Kazakhstan region of the Republic of Kazakhstan, as well as to the development of preventive measures to eliminate the negative impact on public health.

Research materials are recommended for use in teaching of environmental sciences (ecology and sustainable development, geo-ecology and environmental protection, protection of the environment from pollution, environmental management, restoration of damaged ecosystems) on natural faculties of universities.

Acknowledgments

RESEARCH ARTICLES

Analyzing Figure 2 clearly shows that the children predominate among patients with diseases of the blood and blood-forming organs.

The incidence in children is 2 - 3 times that of the level of disease in both adults and teenagers - the amplitude values of 1000-1700 cases per 100 thousand inhabitants. In adults and adolescents, is almost of the same frequency of the disease: it ranges from 300 to 600. In this region, this class of diseases spread very unevenly and with large amplitude minimum and maximum values. The maximum value (734 cases per 100 thousand inhabitants - Kyzylzhar District) is almost 17 times higher than the minimum (44 cases for the same number of inhabitants - Ualihanovsky district). The gradation of up to 100 cases/100 thousand. Akzhar district also gets. In the following gradation - from 100 to 150/100 thousand - get three districts: Aiyrtau, Timiryazevskiy, Mamlyutsky. Also, three districts (G. Musrepov, Shal bard and Esilsky) form a third gradation of scale - ranging from 150 to 200 cases per 100 thousand population. The following graduation group (200 to 250) is Taiynsha District and two areas fall within the gradation 250 - 199 (Akkayynsky, Zhambyl) and 300 (M. Zhumabaeva and Kyzylzhar). Moreover, in the area of M. Zhumabaeva incidence rates twice lower Kyzylzhar.

Areas of the North-Kazakhstan region are different from each other in terms of cancer incidence. Thus there is clearly a strong trend - in the northern regions (M. Zhumabaeva and Kyzylzhar, Mamlyutsky) with area of cancer incidence observed at a high level (more than 200 patients per 100 000 population), the average level is in the south - west region (G. Musrepov, Aiyrtau, Timiryazevskiy) and in the central areas of morbidity is reduced. Human health is largely a reflection of the quality of the environment.

Conclusion

1. Assessment of air pollution in the North-Kazakhstan region has allowed us to establish the prior sources of pollutant proceeds, namely thermal

power enterprises Petropavlovsk (JSC "Access Energy PTWP-2") which engaged in emissions of heavy metals into the atmosphere, accounting for 61% of gross emissions.

2. Soil contaminants in the North Kazakhstan region are heavy metals (mainly lead, cadmium and vanadium) are set as a priority. It was noted the excess of: lead 4.9 times, 3.2 times the cadmium and vanadium by 2.1 times, and the proportion of soil samples exceeding the maximum permissible concentration of lead was 33%.

3. Excess norms MPC content of heavy metals in the soil found in almost all areas, hence the need for environmental monitoring of soils of North-Kazakhstan region.

4. Individual chronic non-carcinogenic risk is less than 1 (the maximum value of chronic non-cancer risk for oral exposure reaches the value 0.0119). The carcinogenic risk of oral exposure does not exceed the value of acceptable risk (level 1×10^{-6} more, but less than 1×10^{-4}), inhalation - the value of acceptable risk (level of 10^{-6} or less).

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