Feedback on dissertation
of Rysmagambetova Aina Akanovna on the subject -
"Assessment of the boron pollution dynamics of the groundwater and surface water of Ilek river valley" provided to the defense for the degree of Philosophy Doctor (PhD) in the specialty «6D060800 - Ecology"

**1. Relevance of the research topic and its relationship with the general scientific and national programs.**

In the Republic of Kazakhstan, water and land are one of the determining factors in the development and distribution of productive forces. This country is rich in land resources, which are the main reserve for the growth of arable land in the country. Moreover, the lack of water due to its uneven distribution over the territory affects to the development of agricultural production and industry. Water in this country is used in various sectors of the economy, but the most significant consumer of water both at the present level and in the future remains agriculture, as well as water supply to the population. It accounts for about 85% of total water consumption, the remaining 15% goes to industry and water supply to the urban population.

The most acute water problems of the Republic of Kazakhstan are the growing deficit and irrational use of water resources, pollution of surface and ground waters. The quality of surface water, in almost all water bodies, does not meet established standards. The deterioration in the quality of surface and groundwater is due to past wastewater discharges from chemical, oil refining, machine-building and non-ferrous metallurgy enterprises. Surface water pollution by industrial waste is the cause of increased silting of rivers, which has a detrimental effect on the composition of sediments, which form an integral part of the aquatic ecological environment.

The research area within the Aktobe industrial zone, in framework the Ilek River basin, is saturated with industrial enterprises. This is the Aktobe chrome compound plant, its ponds and silt collectors, Aktobe TES and its ash collector, Aktobe ferroalloy plant KazKhrom, its slag dump and old filtration fields. The main sources of pollution in the Aktobe region are historical in nature and arose in 1941, when a chemical plant was launched in the regional center of Alga. Over the next 23 years in a row, the plant dumped contaminated water into the Ilek River. The greatest danger from pollution of the waters of the Ilek basin is boron. The conducted research has focused on the study and evaluation of the content of boron in the water. The

groundwater of the coastal zone of the river Ilek there is a high level of boron contamination. The region constantly recorded an excess of boron concentration in the vicinity of the Bestamak village by 50 times in 2018. MPC boron in the water reservoir area closest to the slurry tank was exceeded 143 times in 2017.

It should be noted that the Ilek River is cross-border and flows into the Ural River, and as a result of contaminated water get into the Caspian Sea to the spawning sturgeon. Groundwater and surface water pollution by boron in the valley of the Ilek River and Aktobe reservoir, which are the main sources of water supply in the Aktobe region, has a negative impact on the socio-economic development of the region and the formation of a dangerous environmental situation in this territory. In humans and animals, long-term consumption of water and foods with a high content of boron leads to violations of the basic life-support systems of the body.

The problem of pollution of the Ilek River with boron is very relevant for the Aktobe region, since boron is transported along the Ilek River and stored at the bottom of the Aktobe reservoir. Active mixing of boron leads to the fact that when water is discharged from the reservoir, boron enters the lower part of the Ilek River, causing damage to the population of species of living organisms (teratogenic effect). Based on the severity of the problem, the study of the dynamics and distribution of contaminated groundwater with boron has a high degree of relevance, especially in the Aktobe region.

**2. The scientific results and their validity**

Research conducted by the candidate of PhD Rysmagambetova Aina Akanovna allowed the following scientific results to be obtained. The main theoretical results include the justification of a number of methods and approaches to solving the theoretical problem of assessing the degree of pollution of groundwater and surface water based on a diffusion model and under changing conditions of pollution sources. The results can be used to develop environmental protection measures. Undoubted interest in theoretical terms are results of analysis of distribution and impact of boron through its concentration in the water to the environment. The author makes a fair conclusion about the significant negative impact of the polluted waters of the Ilek River and Aktobe city reservoirs, which provide water to the city and nearby settlements of the region. The danger of such pollution is that boron-contaminated surface water, settling on the bottom of the reservoir, creating the risk

of long-term exposure. Ultimately, the greatest danger is the use of waters polluted with boron and their impact on the health of the local population.

**3. The degree of justified and reliability of each results (scientific position), outcomes and conclusions of the applicant formulated in dissertations.**

The scientific results formulated in the dissertation are justified and reliable. The accuracy of the results is confirmed as a deep knowledge of the author of the ideas and positions of contemporary applied ecology and environmental taken study by publication's and the author's own research. The provision that the pollution of water resources of the Ilek River valley is the result of the lack of a specific policy for monitoring the state of surface and groundwater, a high degree of boron concentration in water bodies, and especially at the bottom of the reservoir, was achieved on the basis of a comprehensive environmental study undertaken by the author. The output about the effect of the polluted waters of the Ilek River on the state of public health was made possible through direct research by the author, as well as analysis of materials on the state of industrial enterprises and the concentration of hazardous chemical elements in soil and water in the Aktobe region in a historical context. The output about the causes of the long-term negative impact of surface and groundwater contaminated with boron on the environment was made on the basis of a synthesis of Kazakhstan literature, interviews with experts and on the basis of empirical data analysis. The idea of the long-term accumulation of contaminated sludge in the bottom sediments of the Aktobe city reservoir and the need to develop a program of environmental measures to reduce the concentration of boron in water became possible thanks to the analysis of the ideas of foreign researchers, as well as due to the author's "entry" into the field under study on the basis of expeditionary fields research.

**4. The degree of novelty of each scientific result (position) and the conclusions of the applicant formulated in the dissertation**

The first result is relatively new by the author in Kazakhstan applied ecology established the concentration and dynamics of the movement of boron in surface and groundwater within the Ilek River basin. The second position is new, the author first shows the change in the composition of the groundwater as a result of contamination with boron and the development of multi-dimensional statistical model of component analysis based on the solution of some problems. The third position is new, since the conditions for the dilution of groundwater pollution were determined under different wedging conditions and various background concentrations of boron

in the surface waters of the Ilek River based on the turbulent diffusion model. The fourth position is relatively new, on the basis of which the idea of preventing pollution of the Ilek River below the dam of the Aktobe reservoir with the need to remove silt from the bottom of the reservoir and its use as fertilizer was substantiated. Such measures will help change the lower outlet for the method of overflowing water from the reservoir into the Ilek River, in conditions of insufficient ecological capacity of the river itself. The fifth position - a relatively new, as has already been proposed to develop an integrated system of measures to reduce pollution of Ilek River valley.

## 5. Practical and theoretical significance of research results

The practical and theoretical significance of the research results is determined, in my opinion, by the following achievements:

- the reliability of the results obtained by careful study of a number of reports of projects for the protection and purification of groundwater for the period from 2004 to 2012 and its own field studies,
- using descriptive statistics based on available data and on calculations of existing changes and concentrations of chemically active elements in water using statistical models,
- the identification and refinement of modern sources of groundwater pollution, in particular at sewage treatment plants, and the development of proposals for the removal of contaminated sediments below the dam of the Aktobe reservoir.

The study of the cost of removal of contamination of ground and surface waters of the study area allowed the authors to conclude that a significant high cost of their recreational activities and the impossibility of their performance at the moment. I believe that in this case it will contribute to the continuation of research and the preparation of a program for the phased implementation of measures to protect contaminated territories and water bodies.

Practical recommendations of the research results are aimed at developing a conceptual direction in the field of turbulent diffusion of contaminated groundwater, research and applications related to the need to study the content of the level of pollution of groundwater and surface water based on a multidimensional statistical model. The practical significance of the studies made it possible to determine the current level of pollution of water bodies and to outline the prospects for their neutralization.

## 6. Comments and suggestions on the dissertation.

Minor comments to the text of the manuscript of the dissertation relate to designation of initial information: page 5 - instead of words - Definition would be more correct to write - Glossary, on page 12 - instead of words -180 list of references, 180 titles used literature, etc.

Overall among the drawbacks of the dissertation manuscript are the not-so-clear style of citing the sources used: not APA, but closer to MLA, although the list of references is not alphabetical.

I believe that this issue is important both as for the candidate of PhD and for Graduate Studies Office.

## 7. Compliance with the content of the dissertation within the requirements of awarding degrees.

In general, I believe that the dissertation A.A. Rysmagambetova is an independent completed scientific study, containing a new solution of actual problems of general and applied ecology, as well as the specific tasks of studying the emission of pollutants into the soil and water of industrial facilities.

The author's publications fully reflect the main content of the dissertation research. Abstract entirely consistent with the dissertation reveals its main provisions and conclusions.

Dissertation of A. A. Rysmagambetova it is a scientific-qualification work and meets the requirements for the degree of Doctor of Philosophy (PhD) in the specialty "Ecology".

I believe that the dissertation by A. Rysmagambetova on the topic "Assessment of the boron pollution dynamics of the groundwater and surface water of Ilek river valley" can be recommended for defense in the dissertation council, and the author of the dissertation deserves the award of a Doctor of Philosophy (PhD) degree in the specialty "6D060800 - Ecology".

**Doctor of Geographical Sciences, Professor**