Environmental and medical and social factors in the quality of life, reproductive health of the population: Priamurye as a case study

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Abstract. Quality of life (QL) is one of the most important indicators of human wellbeing and health. We have developed the systematic approach to analyze natural, environmental, medical and social features of the region. We were aimed to study the factors affecting the QL of pregnant women and women of reproductive age: assessment of drinking water quality, medical and social situation in rural and urban areas of Priamurye. To assess the quality of drinking and surface water, 64 samples were analyzed in different functional zones of five settlements; a sociological survey of women of reproductive age and pregnant women was carried out to study the impact of medical, social and environmental factors on their health and quality of life. The results of the study have shown that the ecological state of surface water and underground drinking water is relatively satisfactory: there is an excess in iron and manganese, which is typical for the Ussuri geochemical province; barium content is insignificant. The use of groundwater for drinking purposes requires special purification. More than a half of women are satisfied with their health status; approximately 40% of women claim that high income can provide a certain set of goods and services necessary to maintain and strengthen their health potential.

1. Introduction
The problems of settlement and preservation of population are among the most important for every region. Increasing birth rate and life expectancy of the population, maintaining women's reproductive health, reducing perinatal losses and overall mortality and, as a result, improving the quality of life of the population are the main requirements for its consolidation at the Russian Far East (RFE).

Quality of life (QL) is the most crucial indicator of public well-being and health [1-7]. Human health and its reproductive component as a complex criterion of QL are considered the most important key for the reproduction of the labor quality and human potential as a whole [1, 3, 7]. In this regard, research focused on the development of medical, social, environmental and climatic indicators and criteria for assessing the health of the population as the main indicator of life expectancy is of fundamental importance.

Environmental and medical-social facets determine the algorithm for assessing the links in the system “life quality – environmental quality and reproductive health of the population”. The center-oriented version of a systematic approach involves a well-defined sequence of steps with analysis of climatic, environmental, health and social characteristics [7]. Environmental assessment includes the identification of the ecological status of its natural components: drinking water, snow, soil cover, and
plant quality [7-11] as well as socio-economic features: social infrastructure, housing, the well-being, and social assistance [1, 3, 6, 7], at the macro-, meso- and local levels.

We understand QL as a system of relations between the population and the environment in a particular area characterized by certain quality conditions for quantitative and qualitative assessment of the population. In the presented context, the prerequisites for the formation of the QL of the population in Priamurye at the RFE are its natural (geographical) environment, the history of settlement and the industrial development. The QL study should be based on a systematic approach to the analysis of relationships between “Quality of life – environmental quality – reproductive health of the population”, considering that climatic, medico-social and anthropogenic impacts disturb these relations.

The aim of this paper is to study the factors affecting the quality of life: assessment of drinking water quality and medical and social situation for testing the approach mentioned above to rural and urban areas of Priamurye at the RFE, at different hierarchical levels: Khabarovsky Krai and the Jewish Autonomous Region (JAR) at the meso-level; Smidovichsky District in the JAR and Nanaisky District in Khabarovsk Krai at the micro-level; municipal settlements at the local level.

2. Materials and methods
To assess the quality of drinking and surface waters, 64 water samples were collected in 2018 from various functional areas of five settlements: Troitskoye in Khabarovsk Krai and Nickolaevka, Volochaevka, Smidovich and Peschanoye in the JAR. Water sampling was carried out both at the outlet of taps of internal water supply, external wells and surface water from the rivers Tunguska, Amur, Bolshoy In and Lake Peschanoye. Since heavy metals and their compounds are the most dangerous in terms of water quality, hydrochemical analysis of drinking water for the content of heavy metals (iron, manganese, zinc, copper, lead, cobalt, cadmium, nickel), phosphorus, calcium, barium, chromium was carried out using an ICP-MS Elan 9000 (Canada) mass spectrometer in the Khabarovskiy Innovation and Analytical Center. The results were evaluated relative to the maximum permissible concentration (MPC) of certain substances in drinking water and the toxicity degree of all elements according to SanPiN 2.1.4.1074-01 “Drinking water. Hygienic requirements for water quality of centralized drinking water supply systems”.

Sociological survey (questionnaire) was carried out in 2018 in urban and rural areas of Khabarovsk Krai (village Troitskoe and Khabarovsk) and the JAR (Smidovich, Nickolaevka, Volochaevka, Danilovka, Aur, and Peschanoye). It included women of reproductive age to study the effects of medical, social and environmental factors on their health and quality of life as well as pregnant women to establish the causes of the negative impact of socioeconomic and behavioral factors on quality of life of expectant mothers. Questionnaires were developed according to the questionnaire of the international program Medical Outcomes Study Short Form (SF-36). In the survey, 92 pregnant women were interviewed; 16 of them were indigenous women from the Nanai people of the Troitskoe settlement, Khabarovsk Krai, and 246 women of reproductive age, 27 of which were the Nanai people.

3. Results and discussion

3.1. Environmental assessment of water
Natural water quality of surface and underground reservoirs is typical of the Ussuri geochemical province, which has an excess of iron and manganese as well as lack of magnesium, iodine and fluorine; anthropogenic pollution is caused by industrial and wastewater from housing and communal services, energy, and transport enterprises, metal, timber processing, light, food, and construction industry. In addition, the water quality was significantly affected by the catastrophic flood of 2013, after which residents in severely affected settlements, such as Volochaevka, Smidovich and Nikolaevka, cannot use well water for drinking purposes, but only for technical needs. The main
controlled pollutants in water were phosphorus, iron, manganese, chromium, cobalt, nickel, copper, lead, cadmium, and barium.

Analysis of the water samples showed that 80% of the population use groundwater with high iron and manganese content; the total consumption of such water is approximately 10 thousand m$^3$ per day or 25% of the total water consumption in the JAR. The main pollution in winter is due to the formation of natural barriers (freezing of soil horizons), which prevents the seepage of water and its exchange with groundwater. Pollution in summer is associated with floods. The settlements located on the banks of the rivers influence their ecological state: the flow of wastewater as well as the destruction of floodplain vegetation, which can cause flooding, flushing the shores and shoaling. The main agents of changes are roads, buildings and recreational activity.

Quality of tap water samples with unsatisfactory chemical parameters is 72% in Smidovich, 47% in Nickolaevka, 64% in Volochaevka, 39% in Peschanoye, and 48% in Troitskoe. Water in wells used for technical and drinking needs is of poor quality: unsatisfactory samples of well water are 81% in Smidovich, 57% in Nickolaevka and 17% in Troitskoe. The quality of the rivers is assessed as satisfactory: the Tunguska River (the excess of Fe – 2.9 MPC and Mz – 4 MPC), the Amur River (Fe – 3 MPC), and the Bolshoy In River (Fe – 4 MPC and Ca – 1.1 MPC). The highest concentrations of iron, up to several tens and hundreds of milligrams in one dm$^3$, were found in the groundwater of Smidovich in winter: Fe was 168 MPC with pH 4.7. In tap water (Smidovich), Fe content was 96.6 MPC with pH 5.1 (in winter); in Volochaevka – 51 MPC with pH 4.7 (in summer), and in Nickolaevka – 11.6 MPC with pH 5.3. We have not detected water pollution with lithium, phosphorus, copper, lead, cadmium, cobalt, chromium; barium contamination was insignificant.

In general, the condition of surface water is relatively satisfactory. However, in most cases, the quality of drinking water does not meet the standards. The main reasons are as follows: the lack of the necessary sources of water supply ready for operation; the catastrophic quality of water in the water-supply system; the lack of sanitary protection zones; intense natural and man-made pollution of water; significant shortcomings in the operation of existing water treatment facilities; and weak implementation of modern technologies.

### 3.2. Medical and social situation

Representatives of 17 indigenous nationalities live in the national villages of the Khabarovsk Krai; their total number is 23 thousand, or 1.7% of the population. 11 thousand of the Nanai people live in villages located on both banks of the Middle Amur River and its tributaries. The Nanai rural population was 16.3 thousand in 2016, and 4469 of them were the Nanai people. The population reduced in 1.1 times (885 people) in 2012-2016, mainly due to migration. The fertility rate in 2016 was 18.8 births per 1000, the mortality rate – 17.4 per 1000. In 2016, 4686 people lived in Troitskoye, the Nanai District, and approximately 500 of them were the Nanai people (439 in 2010). The natural growth rate was positive in 2016 (3.7‰), but it was –7‰ in 2010. In 2016, the birth rate was 19.4‰; the highest value of 20.8‰ was recorded in 2014. The mortality rate for this period reduced in 1.3 times, which is 15.7 deaths per 1000 in 2016.

The structure of mortality of indigenous population has its characteristics. Injuries and poisoning, diseases of the circulatory system and respiratory diseases are among the main causes of death. The main reasons are the destruction of the traditional lifestyle and family relations; a low standard of living; professional activities not peculiar to the people of the North; the influence of the non-indigenous population.

The population of the JAR in January 2016 was 164.2 thousand, of which 68.6% were the urban population. Rural population exclusively inhabit three districts (Birobidzhashsky, Oktyabrsky and Leninsky Districts). Birobidzhan is the administrative and economic center with a population of 74095 people in 2016 (45.1% of the total population in the JAR). Unlike other regions of the RFE, the entire population is non-indigenous.

Indicators of natural population growth are negative since 1992, with −1.8‰ in 2016. The mortality rate is 15.2 per 1000, which is 1.2 times higher than at the RFE (12.6 per 1000). According
to this indicator, the JAR is ranked 69 in the overall rating of subjects of the Russian Federation and 9, i.e. last – at the RFE. The fertility rate in the JAR was 13.4 per 1000. The population decline is characteristic for both urban and rural areas; however, the decline of the urban population is more than 3 times higher than in rural areas. One of the reasons for increased mortality is the prevalence of the elderly population, the early mortality rate of men. As a result, there is a high “sexual dimorphism of mortality”, an indicator of men mortality excess over women mortality, in 1.4–1.6 times.

The permanent population of the Smidovichsky District in 2010–2018 decreased by 4 thousand people; the total population was 24186 in January 2018. During 2010–2015, the District was characterized by a relatively high level of mortality (from 15.3 to 17.0 ‰) and a low birth rate (from 11.5 to 12.6 ‰), summarizing in natural population decrease (−2.6...−5.0 per 1000 people).

Smidovich is the administrative center of the Smidovichsky District with a population of 4279 in January 2018. For 2010–2018, the population decreased by 17 %; the main causes were depopulation and migration, mostly interregional one. Over 2010-2018, the natural growth rate was −6.4 to −8.0 ‰ and birth rate 11.7–13.3‰. The mortality rate of 18.2–20.3 per 1000 indicated a high level in comparison with other municipalities of the JAR and Khabarovsky Krai.

In January 2018, the population of Nickolaevka totaled 6494, which was by 18 % lower than in 2010. In 2012–2016, the rate of natural increase was −3.8...+0.4 per 1000. Compared to Smidovich, the mortality rate here was 12.2–16.0 ‰, the birth rate was 11.4–14.1 ‰.

The results of the sociological survey of women in reproductive age and pregnant women show that decrease in the level of well-being, the growth of stressful situations, unemployment, dissatisfaction with the social and living conditions of the population are the main reasons of limited opportunities to preserve and restore health. 37 % of indigenous and 49% of non-indigenous women have specialized secondary education. The unemployment rate is 31 % and 21 % respectively. In our opinion, the main reason for the high unemployment of the Nanai women is the respect for traditions and customs, as well as the current adverse economic situation. The survey shows that 62 % of women are satisfied with their health level (71 % of pregnant women and 53 % of women of reproductive age); one in five rated their health as “good and very good” (40 % and 23 %, respectively). Social insecurity indicates a decrease in the perceived control over various aspects of women's lives and can indirectly, for example, through unemployment and, as a consequence, poor nutrition, provoke a risk of reduced health status. Thus, the impact of unemployment on health is due to not only its psychological consequences but also the financial problems, which it creates.

Limited financial resources for a decent life and maintaining women’s health is less acute for indigenous women of reproductive age – 39 % against 40.6 % of those of the non-indigenous population. Psychological problems (stress), a lack of housing ownership or poor housing conditions and a lack of qualified medical care are additional elements. The survey has shown that the proportion of the indigenous pregnant women with an income fewer than 10000 rubles (below the subsistence minimum) is 69 %; of them, 42 % are women who already have two or three children in the family. The proportion of indigenous women of reproductive age with incomes below the subsistence level is 38 % compared to 32 % of those of the non-indigenous population. The existing average level of monetary income per family member (13755 rubles) is insufficient to ensure a “decent” quality of life, for health protection and promotion. It is only 45.8% of the minimum limit (20000 to 30000 rubles), which 72 % of pregnant women and 37.5% of women of reproductive age consider necessary for “full” enjoyment of life.

4. Conclusion
At meso- and micro-levels the study region is characterized by “point” settlements, low indicators of health and reproduction of the population as well as weak social infrastructure. The analysis of the quality of the living environment in the region requires prioritizing the groups of risk factors to improve the effectiveness of medical and environmental control and minimize their impact.
At local level environmental assessment of drinking (tap and well) and surface water has shown increased concentrations of iron and manganese in groundwater in the southern and eastern parts of the JAR; water pollution by barium is not significant.

Sociological surveys of women of reproductive age and pregnant women have determined that 62% of respondents were satisfied with their health status (71% of pregnant women and 53% of women of reproductive age); 40% and 23% of women rated their health as “good and very good”, respectively. Nearly 40% of women, regardless of nationality, claim that high income can provide a certain set of goods and services necessary to maintain and strengthen their health potential.

Based on the algorithm proposed, we have developed a comprehensive medical and social analysis of the quality of life of pregnant women, identified the features of environmental, medical and social conditions and life factors affecting the quality of life and assessed the level of well-being and psycho-emotional well-being in the prenatal state.

To improve the reproductive health of women and increase the birth rate in the social policy of the region and Russia as a whole, measures and actions should be taken, aimed primarily to ensure the individual opportunities of women, such as guaranteed income, employment, availability of comfortable housing and qualified medical care as well as investment in education.

Acknowledgements
The reported study was funded by RFBR according to the research project No. 18-013-00923.

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