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Hygienic assessment of drinking water from underground sources of centralized water supply systems of Fergana City

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Abstract. One of the urgent tasks of workers in the preventive medical sphere is to assess the environmental and hygienic aspects of optimizing the water supply to the population. Determination of the characteristics of groundwater formation and the most important factors of imbalance of drinking water, conditions for the population to use groundwater sources as drinking water and environmental and hygienic assessment of water quality, health status of the population and the role and importance of water as a factor in the occurrence of disease, conducting and analyzing a sociological survey of the population on the problem of drinking water supply and the development of a set of measures to optimize the conditions for providing the population with drinking water.

1 Introduction

In recent years, comprehensive measures have been taken throughout the world to rationally use water, ensure its quality and safety, introduce modern innovative water consumption metering systems, and effectively use groundwater sources, but despite the measures taken, in some regions the problem of clean water persists and worsens drinking water. To ensure effective regulation of water use, new water resource management structures have been formed, active work is being carried out to attract the private sector to the production and provision of drinking water, however, “...due to global climate change, the duration of hot, dry seasons is increasing in some regions, in the mountains the areas of snow reserves are decreasing, low water levels are increasingly observed, all this, in turn, increases the risk of water deficiency...." [1-12]. According to the UN, 40% of the world's population lives in places with water scarcity. By 2025, 6 out of every 10 people will live in areas with a shortage of drinking water, more than 80% of infectious diseases will arise due to poor quality of drinking water and violation of sanitation and hygiene rules. Currently, the world's population has reached 8 billion people, of which almost 3 billion consume contaminated water, 2 billion are susceptible to various diseases.

Recently, clean drinking water has become a geo-ecological limiting factor in human development, which is intensifying as a result of anthropogenic environmental pollution, as

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well as the global economic crisis. As a result, the quality of life of people decreases, especially their immunity to various infectious diseases transmitted through water decreases [1, 3, 6].

The problem of providing drinking water to the population of rural settlements of the Republic of Uzbekistan is not only getting worse, but is also becoming a factor of depopulation in some regions. It should be noted the peculiarities of drinking water supply in rural areas compared to cities, where there are local sources of water supply using underground water sources, as well as centralized systems operating in large settlements. Motor vehicles are used to deliver drinking water, and this water in many cases does not meet sanitary and epidemiological requirements [2, 7, 11]. In this regard, increasing the efficiency of fresh water use and, in particular, the rational organization of water consumption, which requires a comparative approach to water consumption and treatment, is an important condition for the modernization of existing ones and the development of new ones drinking water preparation technologies [4, 5, 8, 13-34].

Underground water sources are the only source of drinking water supply in most rural settlements, since the high level of pollution of open reservoirs and their hydrogeological characteristics indicate that open reservoirs have become unusable and limit their use as a source of water [9, 10].

The object of the study was the sources of drinking water supply for the population of the city of Fergana, living in a certain natural and socio-economic environment, as well as demographic indicators and the morbidity rate of the city's population.

The subject of the study was a comprehensive analysis of the functional relationship between public health, water resources, drinking water quality, drinking water supply conditions based on environmental analytical and mathematical cartographic methods.

2 Research methods

When assessing the environmental and hygienic aspects of optimizing the water supply to the population, sanitary-hygienic, sanitary-chemical, microbiological, instrumental methods and a statistical research method were used.

Fergana region is considered one of the first regions formed on the territory of the Republic of Uzbekistan (date of formation – January 15, 1938). Geographically, the region is divided into 15 districts and 4 cities. These are Baghdad, Besharyk, Buvaida, Dangara, Yazyavan, Oltiarik, Koshtepa, Sox, Rishtan, Toshloq, Uchkuprik, Fergana, Furqat, Quva, Uzbekistan districts and the cities of Fergana, Margilan, Kokan, Kuvasay. The area of the region is 6.76 min km^2. Population – about 4 million people (as of 2021 - 3,819,963 thousand people) (11.0 percent). In terms of demographic capacity throughout the republic, Fergana ranks third after the Samarkand region.

The administrative center of the region is the city of Fergana (until 1907 it was called Yangi Margilon; in 1907-1924 it was Skobelev), area 0.09 m^2, population 293,512 thousand people (as of 2021). The city is located in the south of the Fergana region at the foot of the Alai Mountains at an altitude of 580 meters. The climate is continental.

Fergana region is one of the industrialized regions of the country. The region provides 12.7 percent of the country's industrial and 10.6 percent of agricultural production. The region has developed light, food, oil, oil refining, chemical, sericulture industries, cultivation and procurement of fruits and vegetables.

In the Fergana Valley, groundwater occurs at different soil depths; in areas with ordinary gray soil, the depth of groundwater is 15-20 meters; in areas with light gray soil, the depth of groundwater is 4-6 meters; and in areas with hydromorphic soil - 0 .5-2.0 meters (see Table 1).

Table 1. The level of mineralization and chemical composition of groundwater in hydromorphic soils of the Fergana region.

Cut	Depth, cm	Dense sediment	HCO_3	Cl	SO_4	Ca	Mg	Na	Salinity level	
		gr/l							Type	Level
7	150	2.395	0.317	0.224	1.107	0.460	0.036	0.199	x-s	weak
8	170	3.605	0.665	0.196	1.785	0.540	0.306	0.033	s	average
13	150	2.820	0.262	0.203	1.522	0.470	0.210	0.022	s	weak
19	170	2.830	0.592	0.070	1.399	0.450	0.198	0.047	s	weak
20	130	2.490	0.409	0.203	1.183	0.420	0.194	0.003	x-s	weak
21	170	2.870	0.268	0.056	1.769	0.500	0.210	0.013	s	weak
22	154	2.995	0.354	0.063	1.761	0.630	0.138	0.033	s	weak
23	106	3.160	0.317	0.070	1.921	0.500	0.264	0.011	s	average

Analysis of the data in Table 1 showed that in the pasture areas of Central Fergana, groundwater is located at a depth of 106–170 cm, the mineralization of these waters in terms of sediment density is 2.395–3.605 g/l, and in terms of chloride content it ranges from 0.056–0.224 g/l. The salinity of these groundwaters is mainly due to the high volume of sulfates.

From the presented data we can conclude: to improve the ecological and reclamation conditions in the region, a set of measures should be applied to prevent minerals from entering groundwater through the soil, improving drainage work and reducing the volume of water used for irrigation.

Information provided by the Fergana hydrogeological expedition "Uzbekhydrogeology" in the Fergana region identified 5 underground sources, and their predicted water reserves amount to 8169.1 thousand cubic meters/day According to state monitoring of groundwater conducted by the Fergana field hydrogeological expedition "Uzbekhydrogeology", 9290 engineering wells are registered in the region (of which 6823 are in working condition), the total amount is 5087.8 thousand cubic meters/day.

From this:

- drinking – 1236.45 thousand m^3/day;
- for technical and production - 629.64 thousand m^3/day;
- for land irrigation – 1539.87 thousand m^3/day;
- for reclamation – 1669.32 thousand m^3/day;
- and for the rest – 0.36 thousand m^3/day.

At the same time, in recent years, negative changes in the quality of groundwater have been observed in a number of regions due to the development of agriculture and other economic objects and the lack of measures aimed at protecting nature.

Today, as part of the state monitoring of groundwater in the Fergana region, there are 331 observations, 150 production wells and 7 springs in the region, constantly monitoring the quality and quantity of water resources and assessing their condition. Information on the work and results of the work carried out in this direction is submitted to the State Committee for Ecology and Environmental Protection of the Republic of Uzbekistan at the end of each quarter.

According to groundwater monitoring data carried out by the field hydrogeological expedition "Uzbekhydrogeology", 9290 wells are registered in the region (of which 6823 are in working order), the volume of water extracted from these wells is a total of 5087.8 thousand cubic meters per day. On April 7, 1990, the State Reserve Commission established that the volume of daily water consumption from the Pakana-Logon water structures, the largest sources of drinking water for the city of Fergana, amounted to 504.1 thousand cubic meters. The territory of the Pakana-Logon water structure, the main source of supplying the population of the city of Fergana with centralized drinking water, is 82,000 m2, the station was operational in 1957 (reconstructed in 2015 in accordance with Decree No. PP-1378 of the President of the Republic of Uzbekistan dated July 30, 2010 year), there are 68 drilled wells in the structure of the station, however, due to changes in the structure of groundwater and excess content of mineral substances, 6 wells are mothballed. Water from drilled wells is extracted from a depth of 130-160 meters using vertical drainage pumps. The static groundwater level is 7-12 meters. At the station, the produced water is chlorinated for preventive purposes and centrally supplied to the population. From the main water supply system Pakana-Logon through five networks (3 water supply lines of 1000 m^3 each, a water supply system of 900 m^3, a water supply system of 700 m^3) the cities of Fergana receive 175 thousand m^3 per day, and from the Kirguli water intake - 57.47 m^3 per day. In total, the population is centrally supplied with 232.47 thousand m^3/day of drinking water.

The city of Fergana is the center of the region; it is home to the largest population of the region - 293,512 people. If the daily need for drinking water supply for residents of cities in climatic region IV is 250 l/day, then the daily need for centrally supplied water for residents of the city of Fergana is 73,378,000 l/day. However, the capacity of the central drinking water supply station in the city of Fergana is not designed for such water consumption, which leads to failure of wells.

In the course of scientific research, together with the departmental laboratory of the Fergana City Administration "Water Supply", 1,500 samples were taken from drinking water sources to check their sanitary-chemical and sanitary-microbiological indicators, of which 500 microbiological and 1000 were tested to assess sanitary-chemical indicators. 450 (97.8%) samples taken according to sanitary and chemical indicators did not meet GOST 950-2011 requirements for the content of mineral substances and nitrites. In subsequent years, this indicator took the following form: 14.5% in 2019, 22.8% in 2020, 26.2% in 2021; (R2 = 0.9673). In our opinion, this situation indicates excessive work of distribution networks, frequent accidents and hydrodynamic changes in water levels.

3 Conclusion

1. In conclusion, we can say that in the future the capacity of the city's existing water treatment facilities will not be enough to centrally provide drinking water to the residents of Fergana, and this means searching and designing other alternative options for providing the city's residents with drinking water and indicates the need for its implementation.

2. Water extracted from underground sources scattered throughout residential areas of the city of Fergana is not purified by special purification methods and is supplied directly to the population as drinking water. All this leads to a negative change in the situation with centralized drinking water supply to the population and an increase in the number of infectious and non-infectious diseases associated with drinking water among the population.

3. Currently, it is not allowed to use the Pakana-Logon water source, a centralized supply of drinking water to the city of Fergana, as a domestic and drinking water source; for this it is necessary to use special water treatment methods.

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