

THESIS ABSTRACT

by

Omarova Alua Oralovna

on the topic of

**Assessment of safe drinking water provision in rural areas of Karaganda region:
a case study from Bukhar-Zhyrau district**

is submitted in fulfillment of the requirements for
the degree of Doctor of Philosophy (PhD)
in 6D110200 – Public Health

Scientific Supervisors:

PhD Tussupova K.M.

Candidate of medical science, professor Kalishev M.G.

Foreign Scientific Supervisor:

PhD, professor Ronny Berndtsson

Relevance of the research. Access to safe drinking water is the first aspect of public health, which significantly reduces incidence of disease and mortality. It also improves life expectancy, school attendance and gender equality, as well as reduces poverty and ensures social and economic development of the country. However, the benefits of access to the improved source of drinking water can only be fully realized if there is access to improved sanitation and personal hygiene (Mbah F., Nkenyi R., Fru D., 2019; Omarova A. Бухара, 2019; Omarova A.O. Медицина, 2019; www.unwater.org).

The burden of diseases associated with water, sanitation and hygiene (WASH) accounts for 4% of all deaths and 5.7% of the total disease burden in the world (Bartram J., Cairncross S., 2010). Improved WASH could prevent the deaths of more than two million children under the age of five annually, since the main cause of death among them is diarrhea (Pruss-Ustun A., Bos R., Gore F., Bartram J., 2008). During diarrhea, water and electrolytes are excreted from the body, which may result in dehydration (Boschi-Pinto, C., Velebit L., Shibuya K., 2008; Omarova A., Tussupova K., Berndtsson R., Kalishev M., Sharapatova K., 2018; Omarova A.O. Вестник Южно-Казахстанской медицинской академии, 2018; www.who.int). Diarrhea also indirectly affects stunting in children under five years of age, which, in turn, leads to increased susceptibility to infectious diseases of various etiologies (Figure 1) (Efstratiou A., Ongerth J.E., Karanis P., 2017; Baldursson S., Karanis P., 2011; Park C., Martirosyan A., Frehywot S., Jones E., Labat A., Tam Y., Opong E., 2019).

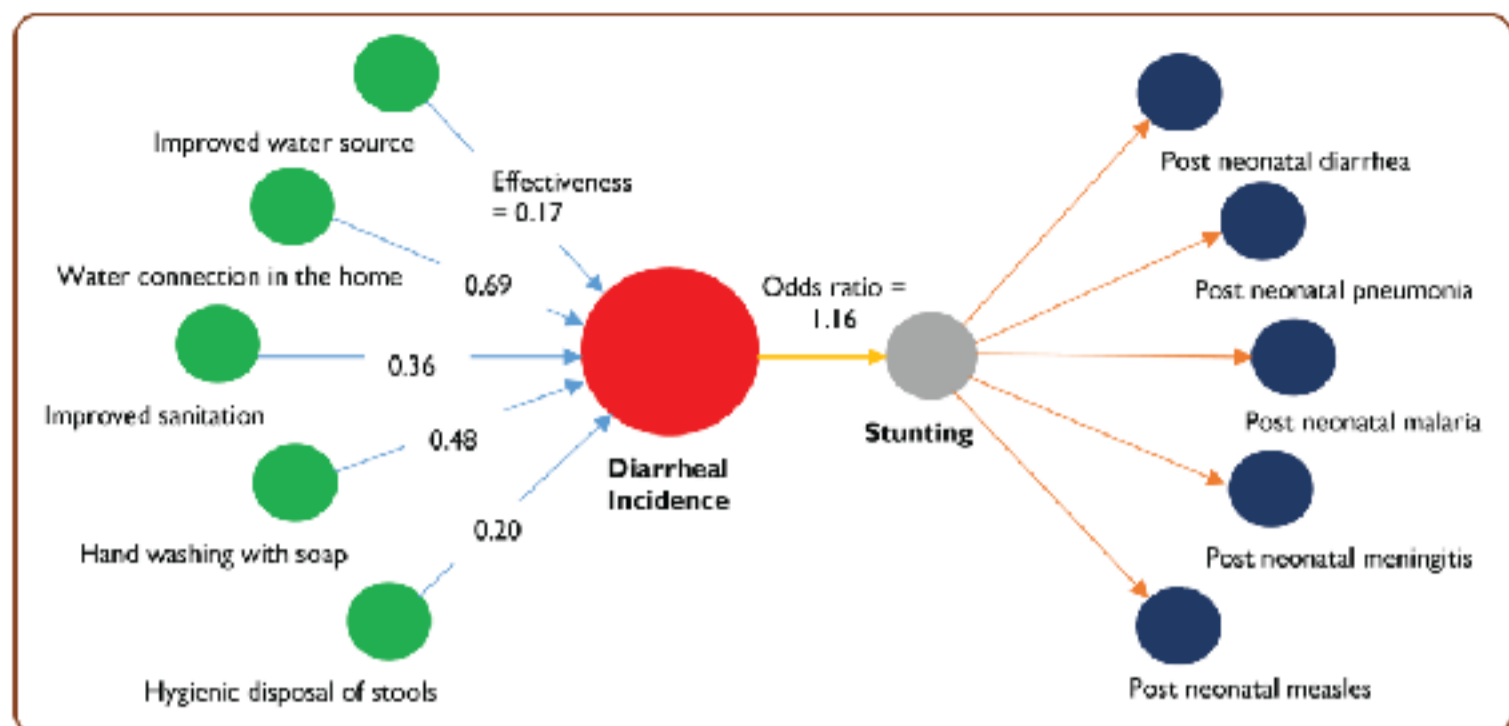


Figure 1 – The effectiveness of WASH components in reducing the cases of diarrhea among children under five years old (Park C., Martirosyan A., Frehywot S., Jones E., Labat A., Tam Y., Opong E., 2019, p. 4)

WASH concept means both the availability of technical means (drinking water, toilet, washstand and soap), and the development of human potential contributing to the improvement of conditions directly in households and hygiene skills among the population. It is often difficult to distinguish the direct cause of WASH-related diseases due to the intimate and complex relationships between the different WASH components. This may be one of the reasons why increases in water supply and sanitation service coverage sometimes does not reduce diarrheal infections (Pruss-Ustun A., Bos R., Gore F., Bartram J., 2008, p. 15). Therefore, to achieve any sustainable results in WASH, it is necessary to improve not one, but all the components (Omarova A., Tussupova K., Berndtsson R., Kalishev M., Sharapatova K., 2018, p. 2).

The target task of the Millennium Development Goal (MDG) 7.C was to halve a number of the population with no access to safe drinking water and basic sanitary facilities by the year 2015 (Clasen T.F., 2012; Shaheed A., Orgill J., Montgomery M.A., Jeuland M.A., Brownd J., 2014; www.un.org). Through implementing this target, the proportion of people with access to a basic drinking water service grew from 81% to 89% from 2000 to 2015 (www.unwater.org; www.files.unicef.org). However, a weakness of the MDGs monitoring was an insufficient attention to water safety (Clasen T.F., 2012, p. 1178; Bain R.E.S., Gundry S.W., Wright J.A., Yang H., Pedley S., Bartram J.K., 2012), which became a key element of the target task for water supply and sanitation upon design of the Sustainable Development Goals (SDG 6) (Omarova A., Tussupova K., Hjorth P., Kalishev M., Dosmagambetova R., 2019, p. 1).

According to the United Nations (UN) Resolution 64/292: “The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses” (Shaheed A., Orgill J., Montgomery M.A., Jeuland M.A., Brownd J., 2014, p. 283; www.un.org). Therefore, water safety is the integral element of achievement of the SDGs. SDG 6 aims to “ensure

accessibility and sustainable management of water resources and sanitation for all" and includes six engineering purposes relating to drinking water, health affairs, wastewater management, water use efficiency, integrated water resources management and aquatic ecosystems protection (www.undp.org). SDG 6.1 call for full coverage of safely managed drinking water by 2030. The "Safely managed drinking water" indicator includes three following conditions: accessible on premises, available when needed and free from contamination (Omarova A., Tussupova K., Hjorth P., Kalishev M., Dosmagambetova R., 2019, p. 1; Hutton G., 2016; www.washdata.org).

Achieving SDG 6 is a huge challenge for all countries, not only for low- and middle-income ones (Omarova A., Tussupova K., Berndtsson R., Kalishev M., Sharapatova K., 2018, p. 2). The commitment to "leave no one behind" requires a focus on rural areas, which is typically neglected (www.unwater.org; Kabeer N., 2016; Satterthwaite D., 2016; www.undp.org; Omarova A., Tussupova K., 2018; Moriarty P, Smith S, Butterworth J, Franceys R., 2013). Tens of millions of rural residents face ongoing problems with water systems, which results in loss of resources and false expectations. Many of those who supposedly use the improved service, de facto face poor quality, constant interruptions in the system and premature failure (Mbah F., Nkenyi R., Fru D., 2019; Omarova A., Tussupova K., Hjorth P., Kalishev M., Dosmagambetova R., 2019, p. 2; Moriarty P, Smith S, Butterworth J, Franceys R., 2013, p. 330). About 844 million people in the world still do not have access to basic water supplies, and 79% of them are rural residents (www.apps.who.int). At the same time, 2.1 billion people have no safely managed drinking water supply system service. This means that 14.9% of the urban- and 45.2% of the rural population need improved services (Omarova A., Tussupova K., Hjorth P., Kalishev M., Dosmagambetova R., 2019, p. 2; www.washdata.org).

Kazakhstan is one of the countries on the Eurasian continent that experiences the most severe water shortages. Water shortage and its poor quality have been determined as vital issues threatening the future prosperity of Kazakhstan. Therefore, the above UN goal was integrated into a number of state programs, such as "State Program for the Regional Development 2020", "State Program for the Regional Development 2020-2025" and "Auyl – el besigi" (Omarova A., Tussupova K., Hjorth P., Kalishev M., Dosmagambetova R., 2019, p. 2; www.apps.who.int; Bekturganov Z., Tussupova K., Berndtsson R., Sharapatova N., Aryngazin K., Zhanasova M., 2016; Ryabtsev A.D., Madramootoo C., Dukhovny V., 2011; www.akorda.kz). In the Republic of Kazakhstan, *water withdrawal* was about *800-900 million cubic meters* for the last ten years. Furthermore, the coverage of water supply in the urban and rural areas of Kazakhstan differ significantly. Whereas the actual water consumption for household and drinking needs per an *urban resident is 100 liters a day on average*, it is only 32 liters for a villager. About 88% of urban residents have access to centralized water supply and 84% of them to sewerage, while in rural areas these rates are only 52% and 11%, respectively (www.files.unicef.org; Omarova A., Tussupova K., Hjorth P., Kalishev M., Dosmagambetova R., 2019, p. 2; www.un.org; Omarova A., 2016; Omarova A., Kalishev M., 2017).

Despite the enormous state efforts to provide rural areas with safe drinking water, no sustainable solutions have largely been found. Consequently, rural areas represent

the biggest challenge in achieving SDG 6. Any alternative strategies of water supply management are currently being sought to increase resistance and reduce the vulnerability of the population to water supply problems.

The aim of this research was to study and analyze the provision of drinking water to the rural population in order to develop further recommendations on how to improve access to safe drinking water in rural areas.

The following objectives have been set to achieve this aim:

1) to study the provision of rural population in Karaganda Region with centralized water supply;

2) to analyze WASH-related health issues in rural areas of Karaganda Region;

3) to analyze the results of the population's assessment of the current access to and water quality in the villages with various types of water supply;

4) to develop recommendations for improving access to safe drinking water in rural areas.

Scientific novelty and theoretical significance of the research. This thesis examines the access of rural households to safe drinking water, the spatial and temporal reliability of water supply sources, as well as unfulfilled needs and demand for tap water in villages through the lens of public health. This work also attempts to suggest possible environmentally sustainable and cost-effective ways to improve access to safe WASH facilities and practices in rural areas in order to enhance health indicators. Moreover, the problem of safe water supply to the rural population was studied in the specifics of the social and economic conditions of Kazakhstan.

The main findings to be defended:

– existing centralized water supply systems in rural areas is not able to satisfy the needs of the population for drinking water completely. That is why a significant number of people use water from alternative sources of unknown quality;

– the population's satisfaction with the quality of drinking water and the reliability of the source depends on its convenience of its operation; therefore, the borehole is recognized as the best quality and most reliable source of water supply, and tankered water is considered to be of poor quality and unreliable;

– to improve access to safe WASH facilities and practices among the rural population requires a systematic approach to implement of measures for the organization of water supply, control and monitoring of their completeness and effectiveness. It will cover the entire chain of the water supply system from the intake to the consumer and the discharge of wastewater from the consumer to natural sources.

Practical significance of the research. The practical significance is to develop recommendations for improving access to safe WASH facilities and practices among the rural population. The findings of this research have been adopted by Akimat (local council) of Bukhar-Zhyrau District in Karaganda Region (the adoption deed is available), and two intellectual property certificates have been obtained.

The author's personal contribution. The collection of primary material, a questionnaire construction, processing and statistical analysis of the data, formulation of the main findings and conclusion of the thesis belong to the author. The author has personally organized, documented and formalized all the materials in the thesis.

Thesis approbation. The main results, findings and conclusions of the thesis were reported and presented at:

– “Winds of Change: Towards New Ways of Improving Public Health in Europe”, 11th European Public Health Conference, Ljubljana city, Slovenia, November 28 – December 1, 2018;

– “Modern Technologies of Diagnosis, Treatment and Prevention of Infectious And Parasitic Diseases”, International Scientific and Practical Conference, Bukhara city, Uzbekistan, April 8 – 9, 2019;

– “Fundamental Science and Clinical Medicine – Human and Health, 22nd International Biomedical Conference of Young Researchers, Saint Petersburg city, Russia, April 20, 2019;

– “Prospects for the Development of Biology, Medicine and Pharmacy”, 6th International Scientific Conference of Young Scientists and Students, Shymkent city, Republic of Kazakhstan, December 7 – 8, 2018;

– “PhD Day – 2016” organized by Karaganda State Medical University, Karaganda city, Kazakhstan, December 9, 2016;

– Meetings of the Department of Threpsology and Hygiene of Karaganda Medical University (Minutes No.14 of May 03, 2019);

– Meetings of the Scientific Advisory Board of Karaganda Medical University (Minutes No.12 of June 26, 2019).

Publications. According to this thesis, **thirteen** scientific works were published: **four** articles in some publications recommended by the Committee on the Control of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan; **two** more articles, in an international peer-reviewed journal called *International Journal of Environmental Research and Public Health* indexed in the databases Web of Science and Scopus (**IF=2.44 in 2017 and IF=2.81 in 2018**); **five** abstracts, in materials of international scientific conferences, including **three** ones in materials of foreign conferences (**one** of them, in the international peer-reviewed journal called *European Journal of Public Health* indexed in the database Web of Science (**IF=2.234 in 2018**)). There is also **two** certificates of entering information into the State Register of Copyrighted Items.

The structure and scope of the thesis. The thesis is presented on 98 pages of Microsoft Word text editor and consists of introduction, literature review, descriptions of materials and methods, results of own research divided into two sections, conclusion, practical recommendations, references and six appendices. The thesis is also illustrated with eight tables and twenty-seven figures. References include 275 sources in Kazakh, Russian and English languages.

Materials and Methods. A complex of scientific methods was used to achieve the research aim and the objectives (Figure 2):

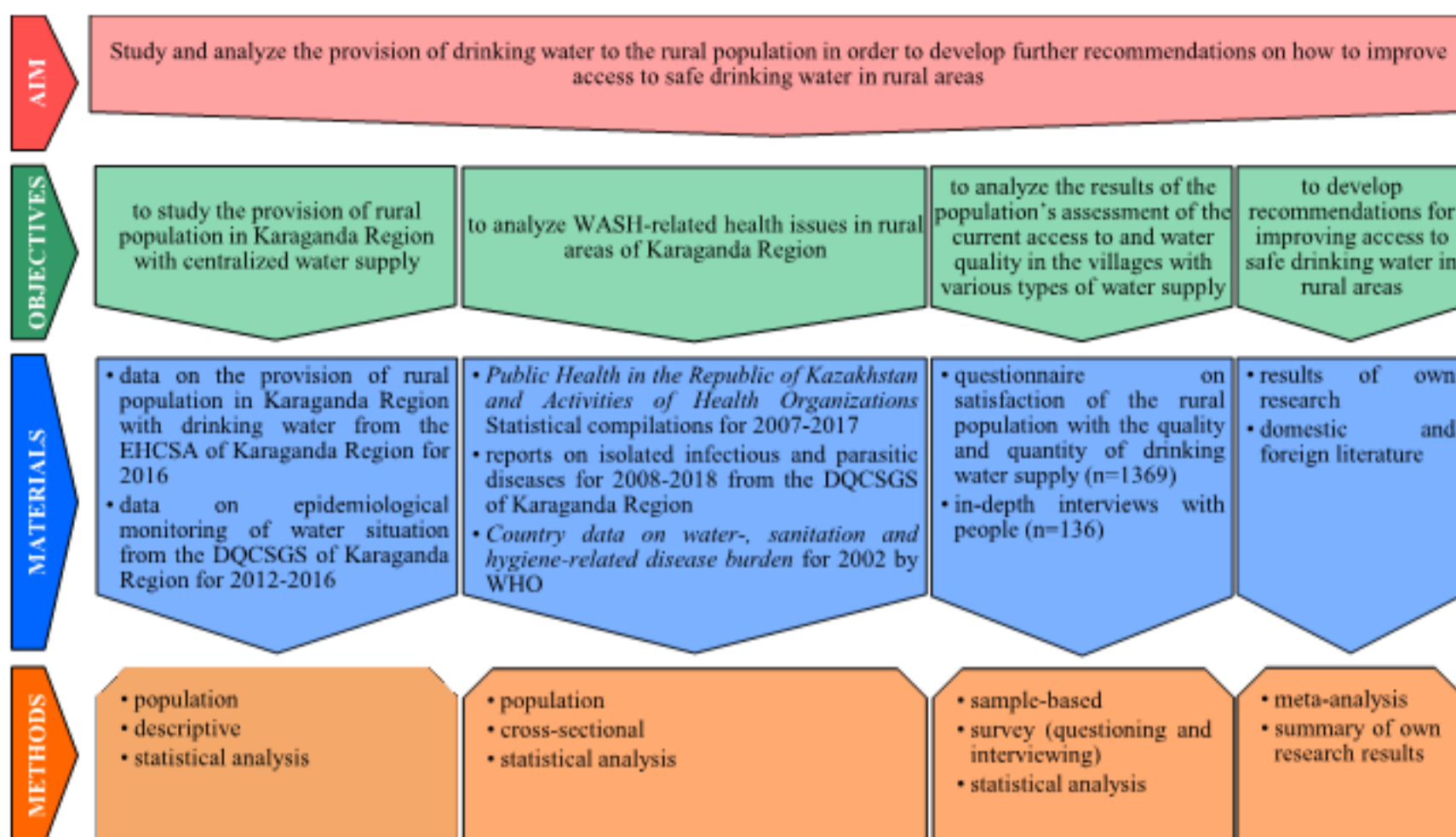


Figure 2 – Research design

The study was carried out in Bukhar-Zhyrau District (49°57,21' N – 73°43,01' E, 500-700 m elevation, 14,576 km²) located in Central Kazakhstan. The climate here is continental with an average temperature of +19 to +21°C in July and –15 to –17°C in January, in addition to an average annual precipitation of 300-350 mm. The topography is flat and most of the territory of the district is covered by the Kazakh Uplands. Bukhar-Zhyrau District has the largest number of inhabitants compared with other rural areas of Karaganda Region. A population of 64,683 (in 2017) live in 67 villages scattered throughout the Region. Another feature of this area was the availability of all types of water supply (centralized, decentralized and tankered) existed in Kazakhstan. To make a complete pattern of basic advantages and disadvantages of water supply in the region under study, four villages were selected for further investigation (each with the largest percentage of people who use one of three types of water supply): Botakara with mixed (both centralized and decentralized); Dubovka and Karazhar, centralized; Asyl, tankered water supply.

Conclusion. This work presented the results of assessing the availability of safe drinking water in rural areas of Karaganda Region. In spite of the fact that the government tries to provide rural regions with tap water supply, the findings of our research have revealed various challenges in this endeavour. Consequently, implementation of SDG 6 aimed at availability and rational use of water and sanitation for all in rural Kazakhstan is a tremendous challenge that the government needs to tackle as soon as possible. Problems with access to safely managed drinking water and sanitation entail a deterioration in both the social and economic situation in the country and health and well-being of the population, since unsafe water supply, inadequate sanitation and poor hygiene are considered as public health risks. It is commonly known that SDG 3 aims to ensure a healthy lifestyle and promote well-being for all at all ages. The rural population is in greater need of both affordable and accessible

medical services and training to improve health and prevent disease using safe WASH. Every year the situation is aggravated with the growth of the population and the irrational use of fresh water reserves. Outbreaks and fatal epidemics will continue unless WASH infrastructure and management are improved. Thus, the full achievement of SDG 6 targets by 2030 will also mean the implementation of SDG 3. Therefore, the results of our research can contribute to more effective WASH planning and, thereby, support a sustainable development of rural regions in Kazakhstan.

Based on the research, one can *conclude* as follows:

1) according to the findings, it was found that 84.55% of the rural population in Karaganda Region was provided with centralized water supply by the state; in Bukhar-Zhyrau District this figure was 80.01%. However, 76.74% of respondents in Botakara, 43.71% in Dubovka and only 21.88% in Karazhar actually used it. There were four reasons for this: residents' doubts regarding the tap water quality; use of other sources out of habit, as they were accustomed to it during water scarcity; availability of cheaper or free sources; and scheduled water supply;

2) the obtained data revealed that the long-term dynamics of WASH-related intestinal infections in Bukhar-Zhyrau District from 2008 to 2018 had a tendency to rise (239.7 per 100,000 people in 2008 and 371.4 per 100,000 people in 2018). The group of acute intestinal infections predominated in the morbidity patterns and made 49.78% in 2018. It should be noted that taking into account some fluctuations in microbiological indicators of water quality, the results of assessment of the influence of water factor on health are contradictory, which is due to inadequate control and insufficient number of epidemiological data. This is exacerbated by the lack of data on hygiene factors related to the quality of water supply and their interaction;

3) the findings of this research indicate that due to acute water supply shortage, the population had to use water from unregistered boreholes (23.52% in Dubovka and 28.57% in Karazhar), unprotected wells dug manually (17.34% in Dubovka and 31.31% in Karazhar), and open sources (15.44% in Dubovka and 18.24% in Karazhar), as well as tankered water (100% in Asyl). However, the villagers have no other option, since most of them have never had access to safe drinking water supply due to lack of infrastructure (in villages with tankered water) or technical problems with infrastructure, which leads to regular suspension of water supply;

4) the obtained data allow us to state that the lowest level of dissatisfaction with the quality of tap water and its reliability was observed in Botakara (6.74% and 7.67%, respectively). These rates in Dubovka were almost three times higher (14.25% and 21.38%, respectively). The highest proportion of residents dissatisfied with the quality and reliability of this source was observed in Karazhar (29.48% and 47.11%, respectively). However, the borehole was recognized as the highest quality and most reliable source (according to 86.74% and 76.51% of the respondents in Botakara, respectively), and the tankered water was recognized as poor-quality and unreliable (according to 77.78% and 98.94% of the respondents in Asyl, respectively), since it should be considered only as a temporary solution during an emergency and should not be a permanent and sole source;

5) based on the results of this thesis, to improve access to safe WASH facilities and practices in rural areas, the following is recommended:

- to calculate the indicator of centralized water supply provision as a “proportion of population provided with safely managed drinking water from centralized water supply systems” instead of number of villages connected to this service;
- to introduce a systematic approach that will cover the entire chain of the water supply system from the intake to the consumer and the discharge of wastewater from the consumer to natural sources to implement of measures for the organization of water supply, control and monitoring of their completeness and effectiveness;
- to build capacity among the rural population for transferring knowledge and developing skills in the field of WASH, as well as changing people's attitude to safe water supply and sanitary and hygienic rules.

Presented by Omarova A.O.