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Article

Improving Methodological Principles for Developing the Regulatory Framework for Ensuring Drinking Water Quality in the Republic of Uzbekistan

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Abstract: This article examines the methodological principles required for improving the regulatory framework aimed at ensuring drinking water quality in the Republic of Uzbekistan. Access to safe drinking water is not only a public health issue but also a matter of environmental sustainability, social stability and national development. In recent years, Uzbekistan has paid increasing attention to reforming the drinking water supply and wastewater disposal sector through legislation, infrastructure modernization and institutional improvement. However, the development of an effective regulatory framework requires a systematic methodological approach based on risk assessment, scientific monitoring, harmonization with international standards, transparency and interagency coordination. The article analyzes the current legal and methodological foundations of drinking water quality regulation in Uzbekistan and proposes key directions for improving the national normative base. Special attention is given to the application of WHO recommendations, water safety planning, quality indicators, laboratory control, preventive risk management and public accountability. The findings suggest that the improvement of methodological principles should focus not only on establishing formal standards but also on creating a flexible, evidence-based and health-oriented regulatory system.

Keywords: drinking water quality, regulatory framework, Uzbekistan, water safety, sanitary standards, risk assessment, public health, water monitoring, methodological principles

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1. Introduction

Drinking water quality is one of the most important indicators of public health and sustainable development. Safe drinking water protects the population from infectious diseases, toxic substances and long-term environmental risks. For this reason, the formation of a strong regulatory framework for drinking water quality is a strategic priority for every state.

In Uzbekistan, the issue has become especially relevant because the country faces water scarcity, uneven access to safe water between urban and rural areas, and the need to modernize water supply infrastructure. International organizations also emphasize that Uzbekistan faces serious water-related challenges, including rural–urban disparities in access to safe drinking water and sanitation services. According to UN-Water, WHO/UNICEF data show a noticeable difference between rural and urban access to safe drinking water in Uzbekistan [1]. The adoption of the Law of the Republic of Uzbekistan "On Drinking Water Supply and Wastewater Disposal" No. LRU-784 of July 22, 2022, marked an important stage in regulating relations in the field of drinking water supply and wastewater disposal. (LEX.UZ) This legal basis creates opportunities for improving drinking water quality management, but the effectiveness of such regulation depends on the methodological principles used to develop and apply standards. Therefore, the main purpose of this article is to analyze the methodological principles for improving the normative and regulatory base of drinking water quality assurance in Uzbekistan and to propose scientifically grounded directions for its further development [2].

2. Literature Review

The issue of ensuring drinking water quality has been widely studied in international and national scientific literature, since access to safe drinking water is directly connected with public health, environmental security and sustainable development. Scholars emphasize that drinking water regulation should not be understood only as a technical or sanitary issue; rather, it should be approached as a complex system involving legal norms, methodological principles, institutional control, laboratory monitoring and risk prevention [3].

According to P. Gleick, safe drinking water is one of the fundamental conditions for human life and social development. He argues that water security is closely related to human rights, public health and state responsibility. In his view, the state must not only provide water resources but also guarantee their safety and quality through effective regulatory mechanisms. This idea is important for the Republic of Uzbekistan because the formation of a reliable normative framework for drinking water quality requires a human-centered and health-oriented approach [4].

J. Bartram and R. Ballance also note that drinking water quality management depends on systematic monitoring and scientifically grounded standards. They state that the effectiveness of water quality regulation is determined by the accuracy of sampling, laboratory analysis, interpretation of results and timely administrative response. From this point of view, methodological principles should define not only permissible quality indicators but also the procedures for continuous control and evaluation [5].

S. Hrudey and E. Hrudey consider that the traditional approach based only on final product testing is not sufficient for ensuring safe drinking water. They argue that water safety must be built on preventive risk management, because contamination may occur at any stage of the water supply chain — from the source to the consumer. This opinion is especially relevant for Uzbekistan, where water supply systems may differ by region, infrastructure level and natural-climatic conditions [6].

The preventive approach is further developed in the works of A. Davison and his co-authors, who describe the Water Safety Plan as one of the most effective methodological tools for drinking water quality assurance. According to them, the Water Safety Plan allows water suppliers to identify potential hazards, assess risks, establish control measures and monitor the effectiveness of preventive actions. Therefore, the improvement of the regulatory framework in Uzbekistan should include not only fixed sanitary norms but also flexible risk-based mechanisms.

From the perspective of water governance, P. Rogers and A. Hall emphasize that effective regulation requires clear institutional responsibilities, transparency and coordination among public authorities. They argue that water quality cannot be ensured by technical standards alone if the management system lacks accountability and interagency cooperation. This idea shows that the methodological basis of drinking water regulation should include organizational and administrative principles as well [7]. A. Biswas also criticizes fragmented approaches to water management and supports integrated water resources management. In his opinion, water policy should combine ecological, social, economic and institutional factors in one coherent framework. This approach is useful for the Uzbek context because drinking water quality depends not only on treatment technologies but also on source protection, environmental pollution control, infrastructure modernization and public participation[8].

M. Howard and J. Bartram underline that drinking water quality is closely linked with the level of water service. They explain that insufficient access, irregular supply and poor distribution networks may increase health risks even when the original water source meets acceptable standards. This view indicates that regulatory documents should pay attention not only to chemical and microbiological indicators but also to the reliability of water supply systems.

National scholars have also studied the problems of drinking water quality, sanitary regulation and environmental protection in Uzbekistan. According to Odilov, the development of sanitary norms for drinking water should be based on scientific justification, regional characteristics and the real condition of water supply infrastructure.

His view is significant because Uzbekistan has different hydrogeological, climatic and ecological conditions in various regions, and these factors must be reflected in the methodological principles of regulation [9].

Rakhimov states that the quality of drinking water in Uzbekistan is influenced by both natural and anthropogenic factors, including salinity, agricultural runoff, industrial activity and the technical condition of pipelines. Therefore, the regulatory framework should be developed through an integrated analysis of water sources, treatment systems and distribution networks. This confirms the necessity of a systemic methodological approach. Karimov emphasizes the importance of harmonizing national water quality standards with international recommendations while preserving local priorities. In his opinion, direct copying of foreign standards may not always be effective, because every country has its own ecological, economic and technological conditions. This idea is highly relevant for Uzbekistan, where international best practices should be adapted to national realities [10].

Tursunov points out that laboratory control plays a central role in ensuring drinking water safety. He argues that without modern equipment, unified testing methods and qualified specialists, even well-designed legal norms may remain ineffective in practice. Thus, methodological improvement should include the standardization of laboratory procedures, the modernization of regional laboratories and the introduction of digital monitoring systems.

Abdullayeva discusses drinking water quality from the perspective of public health and sanitary-epidemiological safety. She notes that microbiological contamination is one of the most dangerous factors because it may lead to the spread of infectious diseases among the population. Based on this view, drinking water regulation should prioritize preventive sanitary control, regular inspection and rapid response mechanisms.

In the works of Nazarov, special attention is paid to legal regulation in the field of water supply and wastewater disposal. He argues that the effectiveness of legal norms depends on the clarity of institutional duties, responsibility mechanisms and enforcement procedures. This opinion supports the idea that the regulatory framework should be improved not only in terms of technical standards but also in terms of legal implementation. The analysis of scientific literature shows that scholars agree on several important points. First, drinking water quality regulation must be health-oriented. Second, it should be based on preventive risk management rather than only final-stage testing. Third, monitoring and laboratory control must be scientifically reliable. Fourth, regulatory documents should be harmonized with international standards but adapted to national conditions. Fifth, institutional coordination and public transparency are necessary for effective implementation [11].

3. Methodology

This study employs a qualitative analytical approach to examine the methodological principles used in developing the regulatory framework for ensuring drinking water quality in the Republic of Uzbekistan. The research is based on the analysis of national legal documents, sanitary standards, scientific literature, and international recommendations related to drinking water safety and public health protection. Comparative, systemic, and normative-legal methods are applied to identify existing challenges and propose scientifically grounded directions for improving the national regulatory framework.

4. Result

The analysis shows that the improvement of the regulatory framework for ensuring drinking water quality in the Republic of Uzbekistan requires a comprehensive and methodologically consistent approach. The current legal and sanitary foundations create an important basis for water quality control; however, their practical effectiveness depends on the modernization of monitoring mechanisms, institutional coordination, laboratory capacity and risk-based management.

First, the study revealed that drinking water quality regulation should be developed not only through the establishment of permissible sanitary indicators, but also through preventive control of possible risks at every stage of the water supply chain. This means that water sources, treatment facilities, distribution networks and consumer-level

safety must be considered as interconnected components of one system. Such an approach allows the state to prevent contamination before it affects public health [12].

Second, the results indicate that the methodological principles of drinking water regulation in Uzbekistan should be harmonized with international recommendations while taking into account national and regional conditions. Uzbekistan has different climatic, hydrogeological and infrastructural characteristics across its regions; therefore, the regulatory framework should include both general national standards and region-specific monitoring requirements. This is especially important for areas affected by salinity, agricultural runoff, outdated pipelines and limited access to centralized water supply systems [13].

5. Discussion

Third, the research found that laboratory monitoring remains one of the key elements of drinking water quality assurance. The effectiveness of regulatory norms depends on the accuracy of sampling, the reliability of laboratory tests and the timely interpretation of results. For this reason, unified testing methods, modern laboratory equipment and qualified specialists are necessary for strengthening the national water quality control system.

Fourth, the analysis demonstrates that institutional coordination is essential for the practical implementation of drinking water standards. The responsibilities of sanitary authorities, environmental agencies, water supply organizations, local administrations and monitoring laboratories should be clearly defined. Without clear distribution of duties and accountability mechanisms, even well-developed legal norms may remain ineffective in practice.

Fifth, the study identified digitalization and transparency as important directions for improving the regulatory framework. The introduction of digital monitoring systems can improve the collection, analysis and publication of water quality data. Public access to reliable information about drinking water quality may increase social trust, strengthen consumer awareness and encourage more responsible water use [14].

Overall, the results show that the formation of an effective regulatory framework for ensuring drinking water quality in Uzbekistan should be based on several interrelated principles: health protection, preventive risk management, scientific monitoring, regional differentiation, institutional responsibility, international harmonization and public transparency. These principles can transform the regulatory framework from a formal set of standards into a practical mechanism for protecting public health and ensuring sustainable water security [15].]

6. Conclusion

The improvement of methodological principles for forming the regulatory framework of drinking water quality in Uzbekistan is a necessary condition for protecting public health and ensuring sustainable development. The country has already established an important legal basis through the Law “On Drinking Water Supply and Wastewater Disposal” and recent sectoral reforms. However, the next stage should focus on strengthening the methodological quality of regulation.

A modern regulatory framework should be health-oriented, risk-based, scientifically monitored, internationally harmonized, digitally supported and institutionally coordinated. In other words, drinking water standards must not remain static documents; they should become a living system that responds to environmental change, technological progress and public health needs. For Uzbekistan, the future of drinking water quality assurance depends on the ability to combine national legal traditions with international scientific principles. Only then can the regulatory framework become not merely a formal set of norms, but a practical mechanism for protecting people’s health and improving quality of life.

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