

Rural Drinking Water Supply in Poverty Alleviation Areas in China

Ji Qinghua, Dong Shuoxun, Cao Xiaofeng, Liu Huijuan, Qu Jiuhui

Center for Water and Ecology, Tsinghua University, Beijing 100084, China

Abstract: Ensuring the safety of rural drinking water is a fundamental component of poverty alleviation in China. Studying strategies for ensuring drinking water safety in areas lifted out of poverty is important for consolidating poverty alleviation achievements and promoting rural revitalization in China. This study examined the current situation and problems of rural drinking water in poverty alleviation areas; analyzed the causes of the problems; and proposed strategic objectives and pathways from the aspects of engineering, policy, and mechanisms. To guarantee the safe supply of rural drinking water in poverty alleviation areas, we suggest that the drinking water safety policies in these areas remain stable and constant, the sanitary standards of drinking water in rural areas should be optimized to meet those in urban areas, and a long-term policy focusing on water prices should be established for rural water supply.

Keywords: rural drinking water; poverty alleviation areas; sanitary standards for drinking water; water price

1 Introduction

The safety of rural drinking water refers to the ability of rural residents to obtain sufficient and clean water for everyday needs in a timely, convenient, and economical manner [1]. Rural drinking water safety is an important aspect of rural residents' health, life, and economic development [2]. At present, poverty alleviation has been fully implemented, but some areas are still unstable, and the level of drinking water safety is not high owing to poor background and weak management. In addition, rural drinking water projects still face challenges, such as scattered water sources, low construction standards, and difficult operation and maintenance. Further consolidation of the safety of rural drinking water in poverty alleviation areas is not only an important element to consolidate the achievements in poverty alleviation with efforts to promote rural revitalization, but also a matter of sustainable development of rural areas and effective implementation of rural revitalization strategies [3].

With the support of the strategic consulting project "Strategic Research on Poverty Reduction after 2020" of the Chinese Academy of Engineering, this study analyzed the development of rural drinking water projects in construction, management, and policies in poverty alleviation areas; summarized the effectiveness and experience of drinking water safety measures in recent years; and proposed strategies and recommendations to strengthen drinking water safety in poverty alleviation areas, providing guidance for government decision-making.

2 Current status and problems of drinking water safety in poverty alleviation areas

2.1 Current status

Recently, China's efforts toward rural drinking water safety in poverty alleviation areas have achieved remarkable results and have greatly improved the drinking water situation in rural areas. In 2015, since the Communist Party of

Received date: August 20, 2021; **Revised date:** September 12, 2021

Corresponding author: Qu Jiuhui, professor of Center for Water and Ecology of Tsinghua University, member of the Chinese Academy of Engineering. Major research field is environmental engineering. E-mail: jhqu@tsinghua.edu.cn

Funding program: CAE Advisory Project "Strategic Research on Poverty Reduction after 2020" (2020-ZD-06)

Chinese version: Strategic Study of CAE 2021, 23(5): 163–168

Cited item: Ji Qinghua et al. Rural Drinking Water Supply in Poverty Alleviation Areas in China. *Strategic Study of CAE*, <https://doi.org/10.15302/J-SSCAE-2021.05.021>

China Central Committee and the State Council issued the *Decision on Winning the Battle against Poverty*, the main focus of rural drinking water safety has been concentrated on the weaknesses of drinking water projects, such as water quantity, water quality assurance, and long-term operation [4]. During the 13th Five-Year Plan Period, the consolidation and improvement of rural drinking water safety projects were carried out using different measures, such as water quality monitoring and protection of water sources, urban and rural pipe network coverage and public water supply services, and rural centralized water supply projects, with a total investment of 29.606 billion RMB by the central government [5]. During the poverty alleviation action, the total number of rural residents with safe drinking water and the number of water supply projects has continued to increase, and the rural population with safe drinking water increased from approximately 620 million to 930 million during 2005–2015. By the end of 2020, China's rural centralized water supply rate reached 88%, and the tap water rate reached 83%. The problems of fluoride and brackish water for 9.75 million and 1.2 million rural people were solved, respectively [6]. According to the current standard, China has comprehensively solved the problem of drinking water safety for the poor population.

From 2017 to 2020, the Ministry of Water Resources established rural drinking water safety management systems, continuously improved evaluation guidelines, and focused on the following three levels of promotion: the division of responsibilities, assessment indicators, and evaluation guidelines. Four basic rural drinking water safety evaluating indicators, including water quality, water quantity, convenience, and water supply guarantee rate, were established. The guidelines clarify that the local government takes responsibility, with the water conservancy department regulating and water supply departments managing drinking water projects [7]. Four aspects of the assessment index—namely, responsibility implementation, management, water quality assurance, and maintenance mechanism—were specified for the consolidation and improvement of rural drinking water safety projects [8]. Currently, China has established responsibility and management systems for the construction and operation of rural drinking water projects.

2.2 Problems

2.2.1 Health risks related to the rural drinking water quality

Drinking water sources in poverty alleviation areas are widely distributed with small sizes, most of which belong to the scale of below one thousand tons per ten thousand people. Water supply projects in poverty alleviation areas, especially decentralized water supply projects, have difficulty meeting the water quality standards and lack disinfection and water quality test equipment. Owing to the low construction standards, primitive purification facilities, and poor water quality monitoring, the water quality does not always meet the standards of drinking water. In addition, many water supply projects suffer from pathogenic microbes, which reduce the safety of drinking water.

2.2.2 Management and maintenance of water supply project needs to be improved.

Owing to economic conditions and geographic location, rural drinking water projects in poverty alleviation areas are mostly decentralized in distribution and rely on users' self-management. The quality and quantity of drinking water are not guaranteed [9]. To save costs, some projects reduce personnel settings, resulting in poor management, which is not conducive to the development of a rural water supply. In some areas, the ability to manage rural drinking water projects is weak and lacks a long-term maintenance mechanism. Owing to the lack of management institutions and maintenance funds, effective regulations for the sustainable maintenance of water supply facilities have not been formulated [10]. To achieve good management and long-term benefits of rural drinking water projects, we must improve the management system; implement management institutions, personnel, and funds; and improve the operation and maintenance system to ensure that rural drinking water projects are guaranteed in terms of policy, management, and funding.

2.2.3 Insufficient funds for operation and maintenance of water supply project

The rural drinking water project is part of the rural public infrastructure, with quasi-public goods. Owing to the long service time and low construction standards of some projects invested in before the 13th Five-Year Plan, problems such as aging facilities and imperfect functions are encountered. Simultaneously, due to the small size and poor operation of projects, the lack of sufficient government financial support has affected their sustainability. With the continuous improvement of rural living standards, the requirements for drinking water quality and quantity have gradually increased, and some drinking water projects have difficulty meeting these needs. At present, the source of funds for the operation and maintenance of rural drinking water projects relies mainly on central and local governments, and there is a gap between the level of capital investment and the requirements for drinking water in

poverty alleviation areas. In addition, economic development in poverty alleviation areas is low, whereas investment in construction is relatively high. The price of water does not fully cover the cost, resulting in a lack of funds for the maintenance of projects. There is no special fund for these projects, which affects the stable maintenance of water supply projects.

3 Causes of problems for rural drinking water in poverty alleviation areas

3.1 Low construction standards of water supply projects

Some rural water supply projects have low construction standards and poor engineering quality owing to insufficient investment, especially early constructed and small-scale projects, which hinder the performance of water supply guarantee capacity [11]. In terms of rural drinking water sources, there are problems such as seasonal shortage of water supply, low water pressure in the water supply pipeline network, and inadequate protection and monitoring measures, which put pressure on a stable and sustainable water supply. In addition, water supply projects lack the necessary anti-freezing and warming measures in alpine regions. For areas with poor infrastructure, we should improve the construction standards of water supply projects by integrating and improving project construction, facility maintenance, and management when building or rebuilding these projects in poverty-stricken rural areas.

3.2 Low guarantee level of small-scale rural water supply projects

In the 1990s, the central government began to focus on the construction of rural drinking water projects. Owing to the early construction of some projects, the problem of insufficient water supply guarantee was exposed. In some rural areas, most water supply projects are Types IV and V, especially in north and northeast China. Some small projects are simple, and they often lack disinfection steps. For example, some drinking water projects using surface water as a water source have no water treatment or disinfection equipment, resulting in bacteriological risks [12,13]. Projects using groundwater as water source are usually not equipped with water purification facilities, but only disinfection. Therefore, there is still a pressure to meet the drinking water standard in poverty alleviation areas.

According to the *First National Water Census Bulletin*, the number of centralized water supply projects in rural areas of China is approximately 922 500, and the number of decentralized water supply projects is approximately 57 952 100, accounting for 98.4% of the total number of rural water supply projects, most of which are concentrated in poor mountainous areas [14]. In alpine regions, due to unstable water quality and lack of project maintenance, the proportion of decentralized water supply is relatively large, which cannot ensure a long-term sustainable and stable supply of drinking water [15]. In addition, some mountainous areas face seasonal water supply shortages. Emergency water supply construction is missing or lagging behind, and it lacks the ability to respond to water shortages or water pollution emergencies [16].

3.3 Lack of funding source for the operation and maintenance of rural drinking water projects

Drinking water projects mainly rely on financial support from central and local governments, with less funding from other sources. There is a gap between the funding and requirements for drinking water [17]. The General Office of the State Council's *Guidance on Innovative Rural Infrastructure Investment and Financing System Mechanisms* and *Measures for the Construction and Management of Rural Drinking Water Safety Projects* proposed that investment in rural drinking water projects should be borne jointly by the central government, local governments, and users. At present, the rural economic development level and residents' income in poverty alleviation areas remain low. Areas lifted out of deep poverty are mostly affected by serious natural disasters or alpine regions with harsh geographical conditions, and the construction of a water supply pipeline network is expensive and difficult to maintain. In addition, the population density in these areas is low, resulting in a high cost per capita [18]. Overall, the contradiction between the maintenance costs of water supply projects and income must be solved through special funds.

Rural users in poverty alleviation areas have weak awareness of water payments or are unwilling to pay, which makes it difficult to charge drinking water [12]. When central and local government funds are not available in a timely manner, it can easily result in a series of problems, such as a break off in the operation and management. In addition, the operation and maintenance investments are generally high, and the gap is large according to the current investment and subsidy standards, which in turn leads to lower operation and maintenance standards for water supply projects, resulting in a low water supply guarantee rate.

4 Development pathway of rural drinking water safety in poverty alleviation areas

4.1 Strategic objectives

During the 14th Five-Year period, based on the new development stage, we should promote the transformation of rural drinking water safety to water supply security in poverty alleviation areas, make up the shortcomings of water supply, strengthen water quality assurance, and improve service levels to meet the diversified water demands of rural residents. We should consolidate the achievements in poverty alleviation with efforts to promote rural revitalization, and create in residents in poverty alleviation areas a better sense of gain, happiness, and security. By continuously improving the level of water supply protection in rural areas and implementing the integration of urban and rural water supplies, the gap between urban and rural water supply is further narrowed, allowing farmers to enjoy the same level of services as urban residents.

By 2025, the centralized water supply and tap water rates in rural areas will be further improved. Rural water-supply projects will be perfect. The distribution will be optimized. Thus, the operation and maintenance levels of water supply projects can be improved. The drinking water standards will be optimized, and the water quality will be improved.

By 2035, large-scale water supply in rural areas will be realized. Water supply equipment will be automated, and operation and management will be more standardized to fully support the diversified water demand in rural areas. The integration of urban and rural water supply will be promoted, and the modernization of rural water supply will be realized.

4.2 Strategic pathway

4.2.1 Technology and engineering support

Decentralized–centralized–large-scale–integrated urban and rural water supply should be the main line of technology, the allocation of regional water resources should be optimized, and the guarantee of water supply projects should be enhanced. According to the current status of regional economic development, natural geographic conditions, and population distribution, planning the distribution and scale of water supply projects and improving the construction level and scale of water supply facilities are essential. The strategic demand for high-quality water supply development and rural revitalization in poverty alleviation areas should be met as well.

4.2.2 Policy assurance

The “plan by central government and implement by local governments” should be adopted as the working mechanism, and the responsibilities between the central and local governments, water supply project maintenance agencies, and users should be further clarified. The financing access for the renovation and construction of rural water supply projects should be expanded. Government funds should play a leading role in attracting social capital to invest in rural water-supply projects. Rural drinking water sanitation standards and power supply policies should be optimized for water supply projects in poverty alleviation areas.

4.2.3 Mechanism guarantee

The property and maintenance responsibilities of rural water supply projects in poverty alleviation areas should be further clarified. The management and special funds for the operation and maintenance of water supply projects need to be explored and refined. Therefore, water fee collection and management rules must be established. Furthermore, a supervisory system should be developed. The establishment of a long-term maintenance mechanism for rural water supply projects in poverty alleviation areas needs to be put forward, along with the integration of urban and rural water supplies.

5 Suggestions

5.1 Maintaining the stability and continuity of the policy for rural drinking water safety in poverty alleviation areas

For the construction of rural water supply projects in poverty alleviation areas, small-scale and decentralized water supply projects should be upgraded to enhance drinking water safety and security levels. The long-term mechanism for drinking water safety should be established to meet local socioeconomic development, including the establishment of effective emergency response arrangements, promotion of rural water prices and collection rules,

and improvement of management for rural drinking water safety. The construction of drinking water sources, public water supplies, and rural centralized water supply facilities should be advanced. Overall consideration needs to be given to water quality protection, agricultural runoff pollution control and reduction, distribution of water sources and water supply facilities, improvement of water purification facilities, and distribution pipeline networks. Policy and financial support to guide social capital in the construction and maintenance of water supply projects, efficient maintenance systems, sustainable investment, and professional management should be enhanced to promote the level of rural drinking water safety.

5.2 Optimizing drinking water standards and integrating urban–rural drinking water supply systems

According to water resources and the level of regional socio-economic development, the rural version of the *Drinking Water Sanitation Standards* should be made to further optimize water quality standards applicable to small centralized or decentralized water supply in rural areas. The quality of water supply and services should be improved by encouraging urban water-supply networks to extend to rural areas. The project should be implemented to promote rural and urban areas with the same water sources, pipe networks, water quality, and water prices. The integration of urban and rural water supply systems needs to be conducted to ensure rural drinking water safety in poverty alleviation areas.

5.3 Focusing on water price to establish a long-term operation and maintenance policy for rural water supply projects.

An appropriate water charge system is the basis for solving the problems of operation and maintenance of rural water supply projects in poverty alleviation areas [19]. The price of rural drinking water should be reasonably determined according to the principle of “compensating for the cost and fair share of the burden.” Furthermore, the water price should be reasonably adjusted in a timely manner according to the changes in costs and fees, as well as the affordability of users. Simultaneously, an incentive system should be established to encourage the collection of water fees and innovation in the maintenance of water supply projects. A series of preferential policies, including water price, electricity consumption, and tax incentives, should be introduced to reduce the cost of maintenance of drinking water projects and to reduce the water expenses of rural residents in poverty alleviation areas [20].

The problem of water price difference between centralized and decentralized water supply should be solved. The water price should conform to the market and consider local development. Rules should be established to promote the collection of water fees and to form a long-term, stable funding source. The collected water fees can be used to maintain water-supply projects and promote water conservation. Additionally, preferential charge rates should be provided to low-income families in rural areas. Thus, rural residents in poverty alleviation areas will have a greater sense of gains, happiness, and security.

References

- [1] Dai X Q, Liu C M, Li, L J. Discussion and countermeasures of drinking water safety in rural areas of China [J]. *Acta Geographica Sinica*, 2007, 62(9): 907–916. Chinese.
- [2] Xu J. The study on operation status and development mode of rural water supply project [D]. Tianjin: Tianjin University (Doctoral Dissertation), 2015. Chinese.
- [3] Bai M. Construction of healthy countryside under the background of rural revitalization: Current situation, problems and its countermeasures [J]. *Rural Economy*, 2020 (7): 119–126. Chinese.
- [4] Hu J L. Increasing government spending on poverty alleviation to support the battle against poverty [J]. *Administrative Reform*, 2016 (8): 12–15. Chinese.
- [5] Liu H X. Thoughts and suggestions on establishing long-term operation mechanism of rural drinking water safety project [J]. *Water Resources Development Research*, 2011, 11(1): 25–30. Chinese.
- [6] Ministry of Water Resources, PRC, Report of Rural Water and Hydropower Work Conference in 2021, Mar. 2021. http://nssd.mwr.gov.cn/ztd/2021nssdgzh/hywj/202103/t20210303_1502055.html. Chinese.
- [7] Ministry of Water Resources of the People’s Republic of China. The notice of Ministry of Water Resources on *The establishment of rural drinking water safety management responsibility system* [EB/OL]. (2019-01-07) [2021-08-28]. http://www.mwr.gov.cn/zwgk/gknr/202004/t20200416_1441174.html. Chinese.
- [8] Ministry of Water Resources of the People’s Republic of China, et al. Notice of the Ministry of Water Resources on printing

- and distributing *The assessment measures for the consolidation and improvement of rural drinking water safety* [EB/OL]. (2017-07-05) [2021-08-28]. http://www.mwr.gov.cn/zwgk/gknr/201711/t20171116_1442719.html. Chinese.
- [9] Liu J Q. The study on management of rural drinking water safety project [J]. *Technological Development of Enterprise*, 2011, 31(2): 71. Chinese.
- [10] Yi J H, Wang D Q. Research on the problems and countermeasures in operation and management of rural water supply plant [J]. *Engineering Economy*, 2017, 27(11): 48–52. Chinese.
- [11] Zhang H S. The consolidation and enhancement of rural drinking water safety in “13th five-year”, problems and countermeasures [J]. *Water Conservancy Development Research*, 2017, 17(11): 57–60, 81. Chinese.
- [12] Huang Q X. Research and application of PPP Project risk evaluation in drinking water engineering [D]. Nanning: Guangxi University (Master’s thesis), 2019. Chinese.
- [13] Zhang H S. Several ponders about the development of rural water supply [J]. *China Rural Water and Hydropower*, 2011 (12): 76–77, 85. Chinese.
- [14] Zhang Y X, Zhao Y M, Qu X X, et al. Research on the current situation of rural water supply projects in China [J]. *China Water Resources*, 2013 (7): 14–15. Chinese.
- [15] Zhao W. Study on water supply facilities at the end of remote counties with high altitude and cold in Tibet [J]. *Water & Wastewater Engineering*, 2018, 54(12): 85–88. Chinese.
- [16] Ren B Z, Deng R J. Safety of Rural Drinking Water and Its Countermeasures [J]. *China Safety Science Journal*, 2008, 18(5): 11–17. Chinese.
- [17] Li X Y. The related factors analysis of China’s rural water supply development and PPP model applicability [J]. *Water Conservancy Development Research*, 2020, 20(1): 43–48. Chinese.
- [18] Liu K P. Analysis of investment and financing system and mechanism of rural water supply [J]. *Water Conservancy Development Research*, 2019, 19(2): 10–13. Chinese.
- [19] Xu J, Qu J P, Wen T, et al. Preliminary study on constructing reasonable water price mechanism of rural water supply [J]. *China’s Water Conservancy*, 2019 (14): 45–48. Chinese.
- [20] Luo J H. Analysis on the operation and management of rural drinking water safety project [J]. *Hunan Water Resources and Hydropower*, 2018 (6): 66–67. Chinese.