

Study on Rural Drinking Water Safety and Measures in Heilongjiang Province

*Tienan Li, Jingbo Lang , Dawei Wang

Water Resources Research Institute of Heilongjiang Province, Harbin, 150080, China

*Correspondence author: Email: 719287576@qq.com

Abstract: According to the current situation of drinking water security in rural areas in Heilongjiang Province, the overall distribution feature and the spatial distribution characteristics of population drinking unsafe water in rural areas, the cause of different drinking water security issues and the main factors of impacting the drinking water safety are analyzed. In view of the distribution feature of rural drinking water safety and the existed problems, some measures are presented such as strictly control point source and non-point source pollution, strengthen the protection of water sources, select project model in line with local conditions and steadily promote the reform of rural water and the electricity price adjustment to ensure the engineering construction of rural drinking water safety and healthy operation. [World Rural Observations 2009; 1(1):29-34]. ISSN: 1944-6543 (print); ISSN: 1944-6551 (online).

Key words: rural drinking water safety; exceeding water quality standard; Heilongjiang Province; water resources protection

1. Introduction

The main performances of urban-rural difference are transportation, water supply and education. And water supply has become the key issue that needs to be solved urgently in the modernization of rural areas in China. Recently, the nation pays high attraction to rural drinking water safety issue and carries out water safety management measure and a series of projects such as “the difficulty solution of rural drinking water”, “rural drinking water safety” and “Demonstration County of rural drinking water safety”. Many protection projects of rural drinking water safety have been established, which solved many drinking water security issues of some rural residents. But there are also many other rural drinking water problems in Heilongjiang province such as water shortage, the water quality endemic illness, water inconvenience and the low guarantee rate of water supply, which are a serious threat to people's health.

2. Rural drinking water safety and the overall situation of Heilongjiang Province

2.1 The concept of rural drinking water safety

The drinking water safety is a kind of social state that means everyone can obtain water that meets the requirements of clean and healthy timely, convenient, and economically^[1-2]. According to the development status of rural economic in China and the basic requirements of drinking water safety at home and abroad, Ministry of Water Resources and Ministry of

Health work out the evaluation index system of rural drinking water safety and health, in which rural drinking water is divided into two grades, safety and basic safety. Water quality, water quantity, convenience degree and guarantee rate four indicators are evaluated. As long as one of the four indexes is under the safe or basic safe value, the water is unsafe.

2.2 The overall situation of rural drinking water safety in Heilongjiang province

The main problems of rural drinking water safety are the shortage of water and drinking water quality exceeding standard. Drinking water quality exceeding standard includes two types. The one is natural water quality exceeding standard which is that some materials such as F, Fe, Mn exceed standards and some like Se and I are lower than the standards, and the other is caused by artificial pollution which contains surface water and groundwater exceeding standards. Some villages, located at the front of mountains or gentle hilly region, are often in the conditions of water stress throughout the year in drought season because of the small water of drinking wells, and even exists various endemic at the same time.

At the end of 2008, the total number of rural population (including state farms and forest and industry) in Heilongjiang Province is 21.36 million. Among them the total population of the centralized water supply and decentralized water supply is 12.65

million (account for 59.2%) and 8.71 million (account for 40.8%) respectively. The popular rate of tap water is 45%. The population drinking unsafe water in rural is 9.5 million, accounting for 44.5%. It is estimated that the standard-reaching rate of water quality of the rural water resource is 85% in 2010, in 2020 is 95% and in 2030 is 100%.

3. The distribution characteristic of different drinking water safety problems and its analysis

3.1 The distribution characteristic of drinking water safety problems

3.1.1 The population drinking fluoride content exceeding water

The upper limit value of fluoride content in standard drinking water is 1.0mg/L. If fluoride content is higher than 1.0mg/L, then the water is high fluoride water. If people drink high fluoride water for a long time, they will have endemic fluorosis, which will threaten people's health directly. In Heilongjiang Province the rural population drinking high fluoride water is up to 1.33 million, accounting for 14% of drinking unsafe water and 87% of drinking high fluoride, which is mainly distributed in Songnei Low Plain area and mostly distributed in some counties of Suihua, Daqing and Qiqihar. What's more, the ration in Zhaozhou County and Zhaoyuan County of Daqing city is more than 40% and the ration in Zhaodong of Suihua city is even more than 70%.

3.1.2 The population drinking iron and Mn content exceeding water

Fe and Mn are the essential elements of human body. The health standards for drinking water in China regulate that Fe content should not be higher than 0.3mg/L and Mn content should not be higher than 0.1mg/L. It is said that daily edible food and vegetables can meet the needs of Fe and Mn. The more intakes of Fe and Mn will have a chronic poison role on the human body. If the concentration of Fe in the body exceeds the binding capacity of Hemoglobin, deposition will be produced that leads to Metabolic acidosis, Hepatomegaly, Liver dysfunction and diabetes. Physiological toxicity of Mn is more than that of Fe. According to recent studies, more intakes of Fe and Mn also destroy artery wall and cardiac muscle and form atherosclerotic plaque even coronary heart disease. The population drinking Fe and Mn content exceeding water is consistent with people drinking unsafe water in space. This indicates that the

population drinking Fe and Mn content exceeding water is relative concentration, mainly in the Songnen Plain, Sanjiang Plain and mountain foot of Xiaoxing'anling, mostly in some counties of Harbin, Qiqihar, Suihua, Daqing, Yichun, Jiumusi and Qitaihe. The population drinking Fe and Mn content exceeding water is 3.79 million, accounting for 57% of water quality unsafe and 39.9% of drinking water unsafe. The Fe and Mn content in drinking water in Suiling and Qin'an counties of Suihua city is up to 100%.

3.1.3 The population drinking other water quality unsafety

The population drinking other water quality unsafety is 1.53 million, accounting for 23% of water quality unsafety and 16.1% of drinking water unsafety. This is mainly because of selenium and iodine deficiency and drinking contaminated water etc. Endemic goiter accounts for 1% of water quality unsafety; kashin-beck disease accounts for 2%; keshan disease accounts for 1%; drinking IV and ultra-IV contaminated surface water accounts for 1%; drinking bacteria content exceeding and untreated shallow groundwater accounts for 4%; drinking serious pollution and untreated groundwater accounts for 8%; and drinking other water with exceeded water quality accounts for 6%. Drinking contaminated water can seriously endanger human health. Except for some common illnesses, drinking water contaminated by heavy metals, nitrite and organic even can lead to cancer. This population drinking water unsafety distributes separately in Heilongjiang Province.

3.1.4 The population lacking of water

Seasonal shortage of water and lack of drinking water cause great inconvenience to rural residents which limit the development of rural economy. The population drinking water unsafety brought by water quantity, guarantee rate and convenience degree is 2.85 million in the country in Heilongjiang Province, accounting for 30% of drinking water unsafety. The population mainly distributes in Songnei High Plain, big and small Xing'anling and so on.

3.2 The analysis of main drinking water safety problems

3.2.1 The significant difference and complex cause of area drinking water safety problems

From the spatial distribution of rural drinking

water safety issues in Heilongjiang Province, we can see that the significant difference of regional drinking water safety issues is caused by many reasons such as climate, water resources, economic development, topography, population distribution, hydro-geological conditions etc.

Water quality exceeding standard is the main problem of rural drinking water safety. High fluoride water area is closely related to characteristics of fluoride and hydro-geological conditions. Fluoride is an active element and easy to dissolve in water, widely distributes in the crustal rocks and mainly buried in shallow area. The dissolve of fluoride salt is the main reason for the formation of high fluoride groundwater in water system. The causes of Fe and Mn content exceeding water is mainly the common role of water back-irrigation, ancient geography, topography, climatic conditions, geological structure and salification. With the rapid development of economy and urbanization, a large number of untreated industrial effluent and domestic sewage is discharged. At the same time, a large number of pesticides and fertilizers, as well as the solid, gas emissions and other waste, results in serious point source and non-point source pollution in the agricultural production. The main reason of water deficiency and low guarantee rate is that less precipitation and uneven distribution, water source deficiency, scattered rural residents in mountain areas, economic backwardness and lack of water supply facilities.

3.2.2 Pollution is the leading factor to affect drinking water safety

The water quality grade of Songhua River, Neijiang River and Mudanjiang mainly belongs to IV in Heilongjiang Province in 2008. In general, these rivers are polluted slightly, the rivers in Heilongjiang Province suffer different degree pollution, and the downstream of city and some tributary are polluted seriously. The status of surface water quality in Sanjiang Plain is well, which can meet IV grade water quality standards in water environment functional area in high-flow period, but the water quality is relatively poor in low-flow period and it belongs to V grade. The water quality grade of Songnei Plain mostly belongs to III and IV grade and some does not meet water quality standard in function area. Water pollution is not only from point source pollution, but also from non-point source pollution. Our province is in a period of rapid economic development, and then the water pollution pressure brought by development will show increasing

trend. Therefore, pollution will be the leading factor to affect drinking water safety in the future.

3.2.3 Lack of drinking water safety monitoring, emergency and measures

Monitoring water supply process effectively and making response mechanism and preparedness of emergency are an important guarantee for drinking water safety. Many chemical plants distribute near the river in China, which is harmful to drinking water safety. Once emergency happens, a wide range of water pollution would be made. The event that chemical plant explosion of Jihua Company causes serious water pollution of the Songhua River Basin in 2005 is an emergency. Moreover, with the change of global climate, the occurring frequency of extreme weather increased, which leads to water shortage in some areas. After 1980s, the occurring frequency of extreme drought increased markedly in western region and northeast areas. This weather induces that some areas are seriously short of water resources in Heilongjiang, which is a serious threat to the drinking water safety. At present, short of necessary monitoring equipment and network results in poor supervision of drinking water quality in majority rural areas of Heilongjiang Province.

3.2.4 Rural water supply management service lagging behind, as well as higher electricity price and the tax affect the construction and operation of drinking water project

Each relevant department is always lack of supervision to factory and rural drinking water project. In water quality detection, normal collection of water price and water resource protection, although there is a set of complete system, there is no place to monitor and implement. Recently, electricity price of rural water supply adopts electric power price that is very high and increase water supply cost. At the same time, tax also affects the cost in some degree. According to statistics, tax accounts for 6%-13% of construction costs, the average cost of each project is about 0.37 million yuan and the tax is about 25-65 thousand yuan^[3].

4 Strategies and measures

4.1 Raise funds in various ways, increase investment and build water supply facilities

The drinking water safety and the construction of water source areas should be based on national input, but in order to solve rural drinking water safety problem, relevant policies of raising funds such as government guidance, user self-raise; government input, user

management and government fully responsible for funding should be made. For relative developed regions, policy guidance should be adopted that local government raise funds to build and run supply water project. For most of undeveloped rural areas, central government and local government raise funds together to build. At the same time, aim at the status of lacking of water supply facilities in rural areas, the construction of rural drinking water infrastructure should intensify and the construction of rural water supply pipe network should enlarge in order to increase the proportion of concentrated water. Urban and rural water supply network should be built in some conditional areas in order to increase guarantee rate of rural supply water.

4.2 Control point and non-point source pollution strictly, enhance water sources protection

Water sources protection must be combined with water quality treatment, all levels' health, water conservancy and development and reform department should be closely with each other to improve drinking water monitoring system. Base on the current equipment water quality monitoring center should be improved and built and rely on large-scale concentrated water supply stations zonal monitoring points should be set up. Water quality testing and monitoring of water resource, water factory and pipe network tail should be strengthened for concentrated supply water projects and for scattered supply water projects water quality monitoring should be done periodically.

Control Point source pollution strictly and improve comprehensively, at the same time, intensify the harness force of non-point source pollution and follow the eco-agriculture path. Change the extensive economic growth mode and intensify the protection of rural water pollution in order to protect rural drinking water sources. Instruct peasant to implement the technique of balance fertilization and ecological Control rightly, control and reduce the total nitrogen content, promote high concentration compound fertilizer and crop-specific fertilizer, and adopt scientific fertilization and optimized farming system to carry out the integration of agricultural-materials and agricultural-technology. Speed up the construction of urban sewage treatment facilities and factory, make greater efforts to implement cleaner production technology for reducing pollution emissions and realize advanced wastewater treatment and recycling gradually. In water source protection area, contamination is prohibited to discharge and garbage is

prohibited to pile up, industrial and mining enterprises is prohibited to develop.

Combined with Building a new socialist countryside, rural well-off environmental protection action plan is implemented. Rural non-point source pollution is controlled and peasants are led to adopt low toxicity, low-residue pesticide and utilize fertilizer rationally; Pollution-free, green, organic food is developed and black soil resource is protected in cold areas; Agricultural wastes such as the manure of livestock and poultry and straw are exploited reasonably. Some environmental issues such as a sweep of pollution made by small coking are checked and supervised strictly in order to prevent industrial pollution from transferring to rural areas.

4.3 select rural supply water mode in line with local conditions

Concentrated and large-scaled supply water system has irreplaceable advantages in water quality safety management and maintenance. It is difficult to build pipe network and promote concentrated supply water comprehensively because of scattered peasants. In view of the scattered, kind-wide, and pollution-complex of water sources, water quality exceeding standard, lower educational level and weak rural economic in the village of Heilongjiang Province, the choice of water supply mode must be in line with local conditions and not adopt high-running-cost and operation-complex equipment.

In the areas of supplying water for majority residents or plain the kind of *concentrated treatment, concentrated supply* should be recommended. This supply mode includes integration of urban and rural water supply model, self-building water supply station and water supply all day or time-sharing mode. In more developed-economy, relative concentrated-rural and lace of urban and village plain areas, advocate the first model; for scattered village, advocate the second mode; for the size of the population more than 1500, advocate the last mode. For extremely scattered rural households such as mountain area, recommend the kind of *distributed processing, local supply, namely, household-based water supply*. In fact developed countries such as America also adopt this mode in scattered areas.

4.4 Promote rural water price reform and electricity price adjustment smoothly in order to the construction and healthy operation of rural drinking water safety project

The low water price of rural drinking water projects is one important factors of constraining the normal operation of rural water supply project. Therefore, it is necessary to reform the current management policies. The policy of full charge and differential treatment to ensure base price, cost price and over water price should be implemented in order to realize paid water, self-sustainable water for drinking water project. It is important to implement the valuation mode of standardized scheme water, unbundling and ultra-use increasing, and establish and improve the hearing system monitoring of rural water price. Taking into account the water cost and reasonable profit of water factory and the bearing capacity of society, rural water reform should be promoted smoothly and reasonable rural water system should be gradually formed.

Appropriate price is helpful to healthy operation of rural drinking water safety project. The popular electricity price of rural drinking water project is 1.05~1.25 yuan/kwh. Electricity charge accounts for 60%~80% in running costs. Rural drinking water works are public, so relevant policies should be made to reduce the supply water electricity price that is suggested to consistent with electricity price of agricultural irrigation and drainage, namely, 0.346 ~ 0.396 yuan/kwh. Preferential electricity price can reduce running costs of rural drinking water project and alleviate peasants' burden, the project can play effectiveness for a long time. Therefore, aiming at the problem of applicable electricity price of rural drinking water safety project, the nation should make preferential policies unitedly.

4.5 Make emergency mechanism and preparedness, establish and perfect effective monitoring network

Managing emergencies of drinking water safety are brought into emergency management System, according to the demand in the State Council The overall national plans of public emergency, overall plan is made, specific measures include carrying out risk assessment to factories and enterprises that are threatening in water resource and according to the results to develop contingency plans, implementing risk design and improving emergency facilities. For the lack of drinking water sources incident under extreme climatic conditions, groundwater, which limits to overdraft and deep mining, should be as emergency water and back-up water.

Establish system monitoring network of the whole

water supply process to dynamic monitor water quality and provide real-time for protection and management in water resource areas. Rural areas should be given priority to establish water quality monitoring network or build a local monitoring center in a place near which the kind of water samples for inspection is implemented in order to improve the monitoring level and network ^[4-8].

4.6 Raise the health consciousness of villagers and research drinking water safety problem actively

Gaining safe drinking water is human basic need, which relates to people's physical health and life safety and relates to the realization of building a new socialist countryside and comprehensive constructing well-off society. Therefore, local leadership is the core of rural water environmental protection, and people are the backbone of rural water environmental protection. It is impossible to solve rural drinking water safety question without great attention of local leadership and people. Therefore, bringing the rural drinking water safety into the agenda, establishing the executive leadership responsibility system, implementing effective measures, popularizing the science and legal knowledge of rural drinking water safety, enhancing the responsibility sense of rational utilization and protection rural water environment and mobilizing and right guiding people to participate in the decision-making of rural drinking water safety projects should be an important task to solve the current problems of rural drinking water safety. At the same time, we should carry out comprehensive investigation and research of rural drinking water systems actively and explore new mechanism of drinking water safety projects management and realizing healthy operation of rural drinking water projects in accordance with the requirements of the scientific concept of development.

5 Conclusion and suggestion

The most serious regions of rural drinking water safety is in the western Heilongjiang Province, Water quality exceeding standard caused by nature water quality pollution and Man-made pollution is ubiquity, which is the main problem of drinking water safety. The form and distribution of nature water quality exceeding standard are mainly related with hydro-geological conditions. In some areas of Daqing, Qiqihar and Suihua, the absolute population and relative proportion of drinking high fluoride water are all in the first place in Heilongjiang Province, where are the disaster area of

high fluoride water. The rapid economic development at the expense of the environment is the main factor of man-made water pollution. Due to lack of water in western poor-water areas, the population drinking water unsafety is more than 40%, and the main factors are climatic conditions, economic conditions and topography, etc. At the same time, lacking of emergency response mechanisms, preparedness and monitoring measures is also an important factor in Heilongjiang Province.

According to the main problem of rural drinking water safety in Heilongjiang Province, it is suggested that protecting the drinking water safety is seen as the main object of water pollution prevention and control. Only by strict controlling water pollution, the drinking water safety can be protected radically. According to the distribution difference, reasonable engineering model and advanced technical measures should be adopted in light of local condition. The science and technology research and promotion of drinking water protection should be strengthened, and the monitoring network, emergency response mechanism and preparedness should be established and improved.

Acknowledgement:

Foundation item: Heilongjiang Province key scientific and technological project (GD07C202-03) .

Correspondence to:

Tienan Li, Jingbo Lang , Dawei Wang

Water Resources Research Institute of Heilongjiang Province, Harbin, 150080, China

Telephone: +86-13359870019

Emails: 719287576@qq.com

References

- [1] Ren Bozhi, Deng Renjian. Safety of Rural Drinking Water and Its Countermeasures [J]. China Safety Science Journal, 2008, vol.18, no.5, pp: 11-17.
- [2] Qin Yuhui, Ling Bo, Zhang Xiaojian. Health and Drinking Water treatment technologies [M]. Beijing: Chemical Industry Press and Environmental Science and Engineering published Center, 2002, pp: 105-254.
- [3] Water Resources Department of Heilongjiang Province. The Rural Drinking Water Safety Project "Eleventh Five-Year Plan" Mid-Term Evaluation Report In Heilongjiang Province [R]. Harbin: Water Resources Department of Heilongjiang Province, 2008.
- [4] Dai Xiangqian, Li Lijuan. Discussion and Countermeasures on Safe Drinking Water in the Rural Areas of China [J]. Acta Geographica Sinica, 2007, vol.62, no.9, pp: 907-916.
- [5] Wang Xiuli. The rural drinking water safety problem discussion [J]. Water Resources and Electric Power, 2009, vol.35, no.1, pp: 29-39.
- [6] Liu Kunpeng. The analysis of rural drinking water safety work [J]. China Rural Water and Hydropower, 2008, no.3, pp: 60-61.
- [7] Li Xuesong, Gao Xin. China's rural drinking water safety problems and system innovation [J], 2007, no.2, pp: 145-148.
- [8] Tian Jing. Construction and Management of Rural Drinking Water Security Project in Binzhou City [J]. Water Saving Irrigation, 2008, no.12, pp: 51-53.

