Research on the Problem and Protection of Urban drinking water sources

Qingshan Yuan [a], Hanqing Zhao, Xin Xu

Northeast Petroleum University, Qinhuangdao 066004, China

[a]zmedityqs@163.com

Abstract. Drinking water sources refer surface water sources and self-restraints of surface water sources or source region which can meet human consumption about drinking water, including centralized drinking water sources and source regions of self-provided water plant. In Shanxi Province drinking water sources mainly base on groundwater resources and source regions most distribute in the basin. Groundwater quality situation is not optimistic in six basins in the province, and existing problems include unsafe water quality and water quantity, worrying urban drinking water security situation, unscientific division of drinking water sources reserves and so on. Therefore, protection of drinking water sources in Shanxi Province has become urgent. This paper discussed problem in urban drinking water sources in our country and put forward protection countermeasures.

Keywords: Urban drinking water, existing problems, protection countermeasures.

1. Introduction

In the central population resources environment work symposium this year, general secretary Hu Jintao pointed out: "Water conservancy work must earnestly protect drinking water, and consider letting the masses drinking on safe water as the priority". To implement this important indicator spirit, in July 2005, Ministry of Water Resources carried out the “security planning of urban drinking water source” across the country, and planned to spend a year to complete the planning formulation. In August 2005, general office of the state council issued “Notice on strengthening the safety of drinking water security work” , which emphasized "all regions should carefully study and solve drinking water security problem in the region according to unified deployment and requirements, put forward feasible goal and task in combination with facts, and bring it into regional economy and social development plan".

2. Present situation in urban drinking water

As economic and lifestyle center, cities have large wastewater emissions. In addition, urban sewage treatment level is not high in China, which faced serious situation in urban water environment. Now day’s 90% rivers flowing through cities have been polluted and water quality of inland lake waters has become poor. At the same time, nearly two thirds cities in our country have problems in urban water supply and one-sixth cities have severe water shortages. In 2004, the total water consumption was 554.8 billion m3, and domestic water only accounts for 11.7%. Compared to 2003, domestic water increased 2 billion m3. At this rate, drinking water can't satisfy people's growing demand for life. Water environment pollution has intensified drinking water sources crisis. Infectious diseases caused by water pollution has been shocking by the sight. In 187 cities across the country, there are 96 cities with stable water quality, 39 with reduced groundwater pollution, and 53 with increased pollution. There are 50 kinds of disease directly related to drinking water sources pollution, such as increasing morbidity of malignant tumor, hepatitis, and mentally retarded children. Old water supply infrastructure and poor management also caused serious waste of water resources.

2.1 Serious shortage of water source.

China's per capita water resources accounts for 1/4 of the world per capita. According to statistics, urban daily water deficit has reached 16 million cubic meters in China. In water scarcity cities, assurance rate of daily peak water supply only is 65%-70%. More than 60% buildings in Shenyang

are short in water above three floors. Peak shaving consumers reach 200 thousand which account for 30% of whole city's water supply; In Anshan, timing peak shaving area has accounted for 87.5% of whole city; In Xi'an average daily water deficit has reached $4.0x10^5$ m^3 In Changchun, daily water demand is $7.6x10^5$ m^3, but daily water supply is only $5.0x10^5$ m^3 which is lack of $2.6x10^5$ m^3. So the government have to borrow money from World Bank to solve t water shortage in the Songhua River. China is a rapidly urbanized country. With dramatic increasing urban population, especially improvement of people's living standard, urban water supply shortage of resources has become a serious problem restricting urban development and affecting people's normal life.

2.2 Severe situation in excessive groundwater exploitation.

Due to surface water pollution, increasing water consumption of urban industry, public health, domestic life, groundwater exploitation scale and strength increased continually. In 2004, 21 provincial-level administrative region investigated underground water depression funnel (hereafter referred to as a funnel) based on incomplete statistics. The result showed that 76 statistical funnels (38 shallow funnels and 38 deep confined funnels) occupied a total area of 72000 km^3. Compared to early days in 2004, at the end of the year 23 funnels expanded and 21 funnels' center water levels fell; 16 deep funnels expanded and 27 funnels' center water levels fell. In 2005, there were 188 funnels, in which 65 expanded. Especially in Cangzhou, Dezhou, Hengshui region, area of deep funnels expanded and depth deepened continually. In Cangzhou funnels in the third confined aquifer expanded 2089 km^3 and the maximum groundwater depth reached 101 m. Excessive groundwater exploitation directly caused land subsidence and ground crack, which lead to ground subsidence, houses collapse and subgrade destruction. It also can lead to declined groundwater level, which caused that surface water infiltration increased, pollutants went down and polluted groundwater.

3. Serious waste of running water.

Plumbing leakage phenomenon is very common in northern cities in China because of poor, aging water supply infrastructure and adverse freezing weather conditions. Especially in urban water supply, only 5%-10% water can be drank directly or indirectly. Most running water are used in industry, fire protection, construction, municipal administration and resident's miscellaneous use. However, water plants ignore different water demands and measure all water quality with the drinking water standard, which not only increased water treatment costs, but also caused a huge waste. Within today's more and more serious water pollution, water treatment has become more and more difficult and costs become more and more high. In order to reduce living cost effectively, improving the safety and reliability of drinking water is imperative.

4. Problems analysis on urban drinking water sources.

Water environment pollution sources are usually divided into point and non-point pollution source, and water source pollution is primarily non-point pollution. For a long time, the key point of environmental protection in China mainly focus on terminal treatment of enterprise pollutant discharge and ignored non-point source pollution. Because that non-point source pollution affected by hydrological cycle and randomness of control, discharge point of pollutant source is not fixed and have characteristics of discharge intermittency, large change scale in pollution load time and space, which make its monitor, control and treatment difficult and complicated.

4.1 Surface eluviation and erosion of rainstorm runoff.

Rainstorm runoff is a motive factor facilitating process of slope surface erosion, is also the outward material carrier of soil particles and agricultural chemicals. When rainfall intensity exceeds soil water infiltration capacity, it will produce slope surface runoff. Main factors influencing slope runoff size are rainfall, landform, soil and vegetation, etc. Our country is one of the most serious soil erosion countries in the world and soil erosion area has reached 3.56 million km2. A third land has been harmed by water and soil loss, and annual loss of N, P, and K nutrient is equivalent to more than 4000 ten thousand tons of chemical fertilizer.

4.2 Loss of agricultural chemicals.

Along with increasing population, people have more and more high demands on the number of land products. In China agricultural land resources development has nearly reached super strength, so increasing agricultural chemicals becomes an important way to improve land output. Water is the essence of agriculture, so upstream is the major farming area. Increase of pesticide and fertilizer is bound to raise artificial chemicals content in the soil. Extensive management in agriculture especially caused low utilization ratio of agricultural chemicals and eutrophication of lakes and reservoirs.

4.3 Nonattainment discharge of medium-small enterprises pollutants.

Since the reform and opening, small and medium-sized enterprises have been developed rapidly. The proportion which industrial output value accounted for national industrial output also increased gradually. Small scale township enterprises (especially in the north) have characteristics of low level technology, and inadequate environmental protection measures. Only few of them implement the system of environmental impact assessment. Besides, simple and crude equipment and serious resource waste and pollution in township enterprises caused large number of emissions and low pollution treatment success rate. Complex pollution types in township and village enterprises (including individual mines), which vary from urban to rural, from point to non-point, increased difficulty in environmental governance and non-point source pollution load.

4.4 Migration cycle of synthetic chemicals.

In order to meet demands of civilization, the human synthesized thousands of poisonous and harmful substances by various producing activities. These organic compounds eventually enter into surface water environment through processing of raw material manufacture, disposal, process and other diffusion pathway. products use a variety of diffusion way. The world paid a lot attention on organic pollutant because of the large variety, toxicity, refractory and other reasons. In 1980s, we monitored the 26th sampling point in Songhua river and detected 152 kinds of organic pollutants. There were 32 compounds belong to American environmental bureau, which accounted for 21%; 14 compounds had carcinogenicity and mutagenicity, which accounted for 9%. The data was enough to reflect the status of organic pollution of rivers in the north. At present, it has been found more than 2000 kinds of organic compounds in running water, including 2.7% carcinogenic substances and tumor promoters, 2.5% mutagenic material. Nitrate is one of the most common pollutants in running water, excessive amounts of nitrate intake can lead to infant methemoglobin. Nitrate and nitrite can change into nitrosamines, which can cause carcinogenic, mutagenic and teratogenic effects on human body.

4.5 Urban and rural domestic sewage discharge.

Limited to the level of economic development, in China small towns and countryside were lack of drainage facilities, a large amount of domestic sewage flow into water with surface runoff after floodplain emission, and organic pollution is very serious. High concentrations nitrogen may be associated with polluted livestock and poultry excrement, high concentrations phosphorus is mainly caused by detergents. Washing wastewater emissions increased phosphorus load and will pay an important role in Lake Eutrophication process.

5. Countermeasures of drinking water source pollution

Drinking water source is the indispensable material basis for human and all lives, is a necessary condition to survival. Human need to develop and utilize water resources continuously, and also need to protect water supplies constantly. We should emphasize intimate relation between ecology and water, take measures to repair river basins with serious ecological problems to conserve water source, including saving-water, anti-fouling and water transfer. In regions where groundwater was overexploited, we should seal or restrict wells. For ecologically fragile regions, we should utilize nature's self-recovery ability, return farmland to forest, seal mountains, ban grazing, reduce deforestation, create conditions for natural restoration. In pastoral areas we should improve water conservancy construction, implement grazing prohibition, rotational grazing, rest grazing in natural grassland to protect and restore grassland. It is also necessary to establish water resources security system maintaining ecological security. We should according to requirements of sustainable development and ecological environment protection, allocate water system reasonably, minimize

human activities impacts on ecological environment, strive to build a beautiful living environment which human and nature can be harmonious coexistence.

5.1 Strengthen construction of water-saving society.

In now days firstly we should improve regional governments, enterprises, public awareness of the serious situation of water resources, increase publicity, make people fully understand scarcity of water resources, which prevent phenomenon that people do not save water just because they don't lack water. We should turn traditional extensive social into water-saving society and realize sustainable utilization of water resources. It is also necessary to further increase investment in water conservation, strengthen water saving engineering construction, adopt widespread water saving technology, equipment, technology and standard, improve water sources utilization efficiency, popularize water saving product technology and apparatus. Appropriate raise prices, which is using economic means to control prices can promote water-saving leverage and control waste. The proportion beyond water planning should adopt cumulative price system. Develop water-saving equipment production in enterprises, replace old equipment with new water-saving equipment freely in old village households. Compared to water transfer and pollution control, water saving is not only of low cost, but also has a high ecological environment protectiveness because that water saving is equal to pollution reducing. Through efficient use, reasonable configuration and effective protection of water resources, we can realize sustainable development of regional economy and ecology.

5.2 Influence of wastewater discharge control on water source.

Water pollution problem is directly caused by human inappropriate way in production and living. Currently most cities in our country have not formed a complete, closed system and it is universal to discharge wastewater directly or indirectly into rivers, which polluted underground water. Therefore, we should improve sewage treatment technology, increase sewage plant construction and investment, increase sewage treatment capacity and support pipe network facilities and sewage reuse facilities construction. On the basis of greatly improved urban sewage treatment ability, we should emphasize sewage reuse and realize wastewater reuse. Relevant departments should increase penalties of enterprise discharge, draw out those factories who consider sewage treatment equipment as displays. Environmental protection departments should pay more attention to water quality changes, timely monitor water indicators, found out pollution sources and minimize pollution. Reform outdated production mode and adopt less-waste, no-waste technology to realize clean production and reduce wastewater emissions. It also should put wastewater recycling facilities back into important position, increase investment, arrange wastewater recycling facilities construction with priority, and underlay pipe network system of reclaimed water utilization. We should implement clean production in our country as soon as possible, strengthen industrial pollution control and turn terminal-treatment into whole production process control, to achieve dual roles of reducing pollution and improve water resources utilization.

5.3 Develop depth water treatment.

With economic development, people demands more and more high water quality. It also increased toxic and harmful substances and organic species in water dramatically. Only depth water purification treatment can remove organic pollution and toxic and harmful substances in drinking water. In developed countries and regions in the world, there has been many researches and applications about advanced water purification works, including ozone, active carbon, catalytic oxidation and purification system made of both of them. It has been deeply researched on application and gained rich experience. With decades industrialized membrane separation device and membrane separation technology development, introducing various membrane technology field into drinking water depth treatment has showed strong vitality, especially in organic pollutant removal. Development in deep water treatment in regions with mature conditions can make people drink safer water.

5.4 Expand direct seawater use and promote desalination technology.

Desalination belongs to emerging industry, so it has difficult in technology development market and key equipment manufacture, in which country should enact supporting policy and corresponding preferential measures to promote seawater desalination and industry development. In order to promote relative industry to develop, we should give subsidized loan on equipment and technological

transformation purchase for desalination production enterprises, reduce taxes appropriately and provide preferential policies. Qualified fresh water can be directly into city running water pipe network. For enterprises who using seawater as cooling water and seawater desalination as boiler water, the government should implement reward policy. Introducing guide and encourage policy, combine qualified manufacture desalination equipment manufacturing enterprises with relevant scientific research units to form a consortium; Manufacture complete sets of seawater desalination technology equipment by development cooperation and technical research, take industrialization path, promote seawater desalination technology, and make seawater become the new drinking water source.

6. Conclusion

In our survival environment, water is scarce, but water is the source of life, the root of all things. In limited water resources we must protect our friends "water source" by our best. Start to protect environment and save water around us. States and local agencies should formulate suitable long-term development and utilization planning carefully. Enterprises should improve technology to increase water use efficiency. The government should adjust water prices and sewage charges, build water audit system, enact industry, agriculture and urban domestic water standard, carry out clean production, improve sewage treatment, encourage application of water-saving technology and innovation. So we can develop seawater as a new drinking water sources. In the future these technologies need to be strengthened and perfect, and it will be a learning process for all of us.

References

[1] Bozhi REN, Zhengwei XIONG, Water resource utilization and protection[M]. China Machine Press, 2010.
[2] Petra Na, The politics of water[M]. Social Sciences Academic Press, 2011.
[3] Chenhong GE, Honesty is a kind of social resources[J]. Jianghai Academic Journal, 2013(3).