# Water resource utilization and the agricultural economy development in rural China

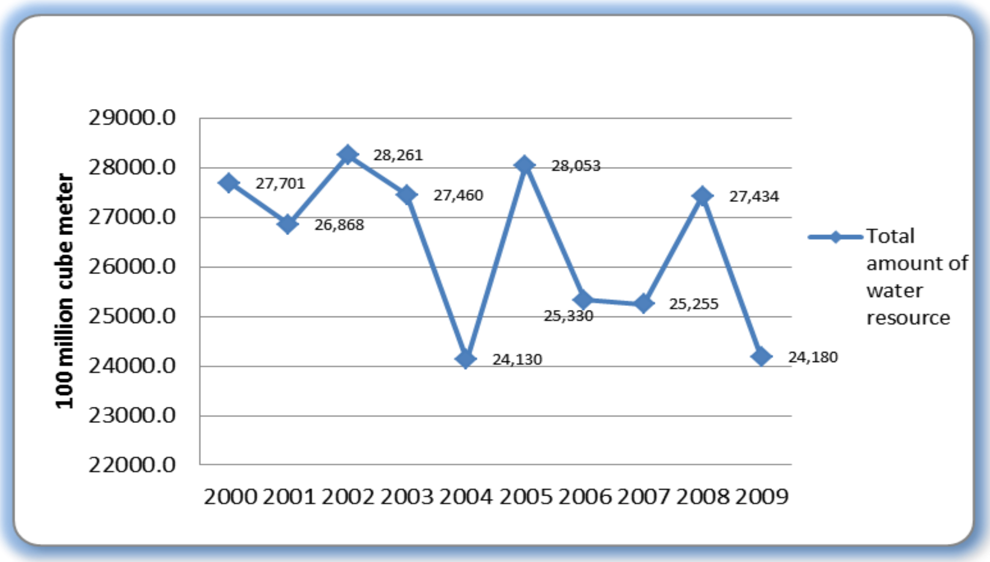
**Abstract:**Our paper firstsystematically classifies the acquired water resource data of rural China. Then, based on the classified data, we construct an evaluation index measurement system, in which we describe and assess the situation of water resource of rural China in two different but correlated aspects, elaborating different stages of supply and consumption of water resource of rural areas in China. In addition, we offer some suggestions base on our descriptive statistics. We do hope that the recommendations derived from our research can benefit both the government and experts in pertinent research fields.

Historically, of all natural resources, water is the major factor shaping the rise and fall of a great civilization. In modern time, as it is known to all that water resources, especially fresh water, is extremely important to a country's economic and social development. In this way, we would like to first exhibit the water resource data that we have collected, from which we are inclined to construct an indicators measurement system. This particular system is examined to show both the general situation of China's water resource and the more specific aspect of China's water resource.

**Section 1.General situation of China's water resource**

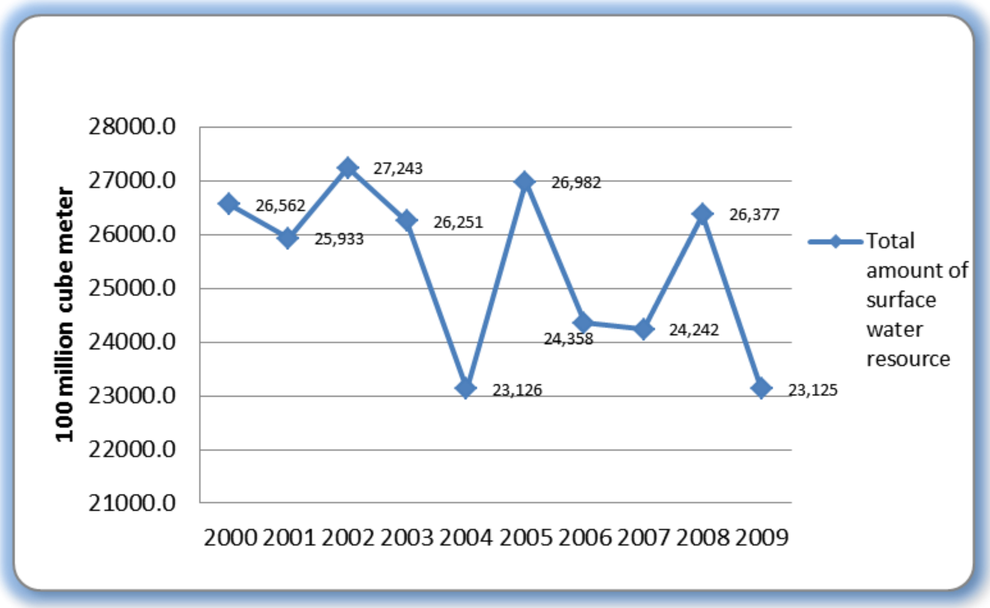
In the following passages, four charts are drawn using collected data to reflect the general situation of water resource of China from different aspects. We hope all of the charts created can help readers to have a big picture about the general condition of China's water resource.

The first chart is below,showing China's annual total amount of water resource from 2000 to the year of 2009.



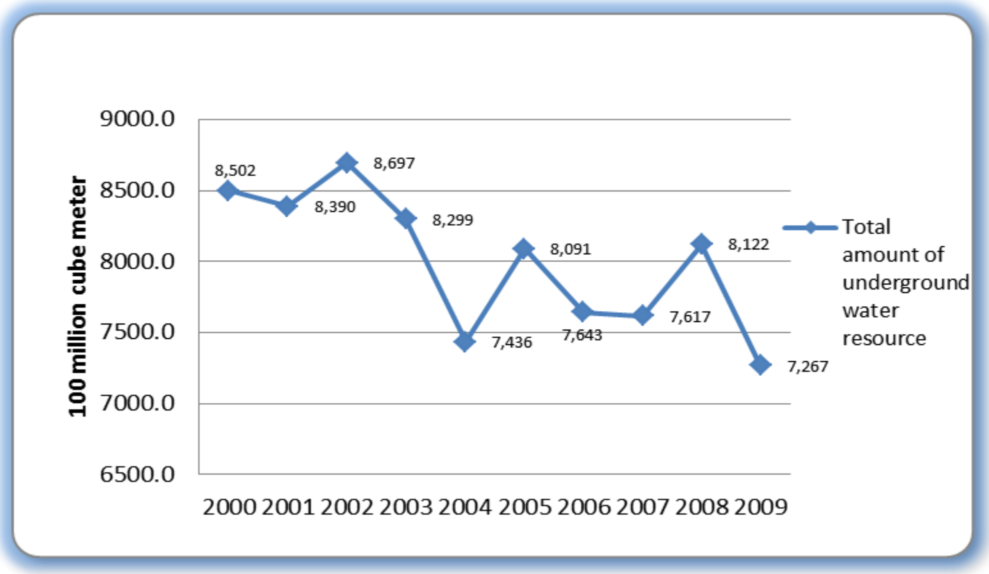

In this time series chart, we can clearly spot that the total amount of water resource in China reached its peak in the year of 2002. That is 2826 billion cube meters. And the total amount of water resource is 2746 billion, 2805 billion and 2743 billion in the year of 2003, 2005 and 2008 respectively, in which the data was very close to the peak. However, the total amount of water resource drops to its lowest point in the year of 2004, showing just 2413 billion cube meters. The range of the data set is 413 billion cube meters. Generally speaking, the collected data of China's annual total amount of water resource shows some stability.

The next chart is one that is much specific. This chart reveals China's total amount of surface water resource in the interval of 2000 to 2009.



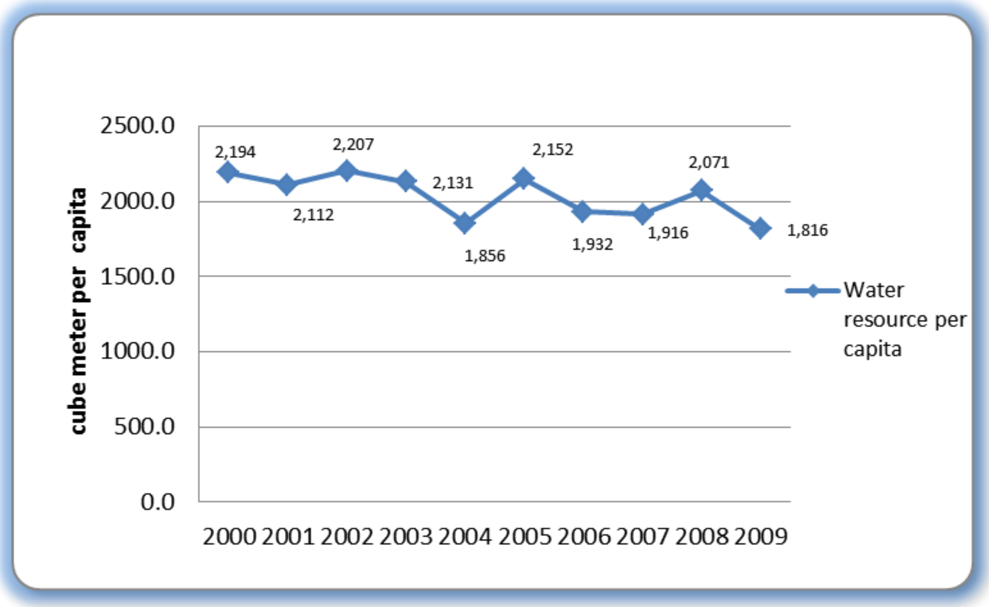

We can compare this chart with the first chart we drawn. The shape is much the same. The total amount of China's surface water resource reached its highest point in the year of 2002 and dropped to its nadir in the year of 2004. It also shows some stability. Moreover, the range of this data set is 412 billion, which is very much close to that of China's total amount of water resource.

The third chart is here, showing the total amount of underground water resource.




In this time series chart, we can clearly spot that the total amount of underground water resource in China reached its peak in the year of 2002. That is 869 billion cube meters. However, the total amount of water resource drops to its lowest point in the year of 2004, showing just 744 billion cube meters. The range of the data set is 125 billion cube meters. Generally speaking, the collected data of China's annual total amount of underground water resource shows some stability.

Our last chart is the one that can demonstrate the water resource per capita.

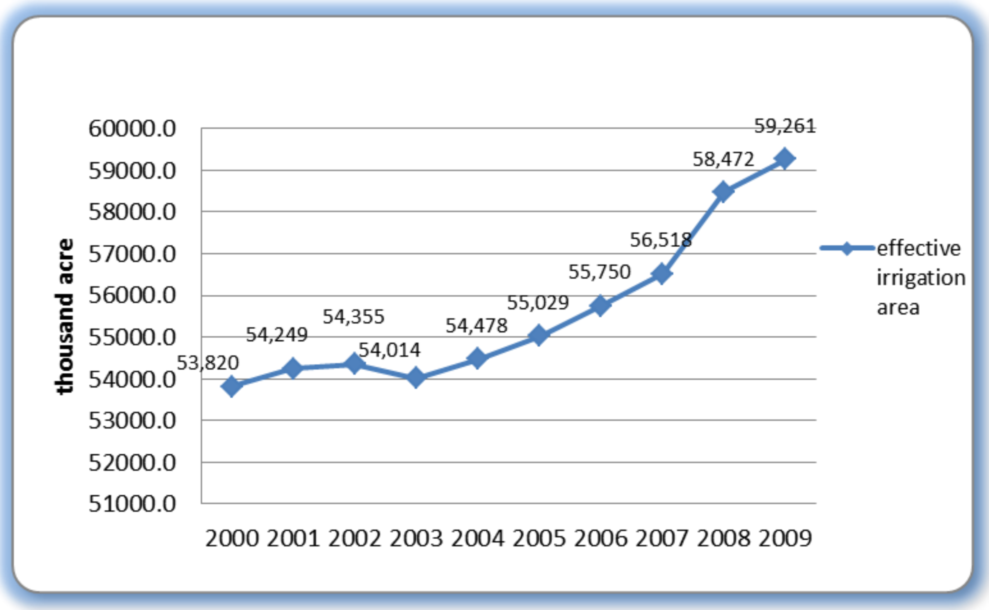



In this chart, it is absolutely clear that the water resource per capita is the most stable in the four charts we have drawn. The range of this data set is just 391 cube meters. Importantly, this chart also reflects a very serious phenomenon that is due to China's large population, the water resource per capita is very low. This factor should be well noted by the government.

**Section2. Specific aspects of China's water resource**

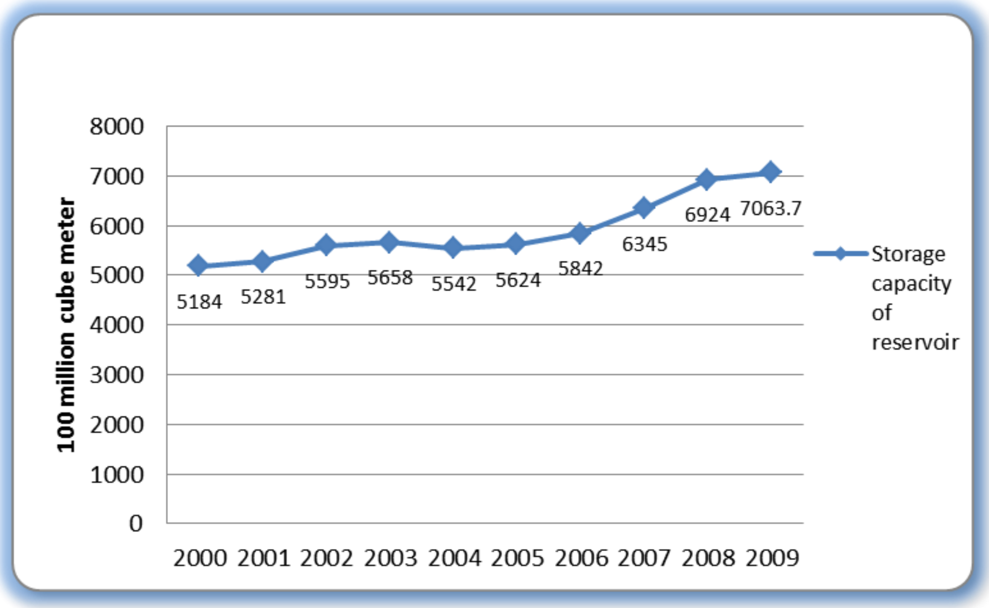
In this section, we will also draw four charts to show much specific aspects of China's water resource.

The first chart is here, exhibiting China's effective irrigation area from year 2000 to the year of 2009.



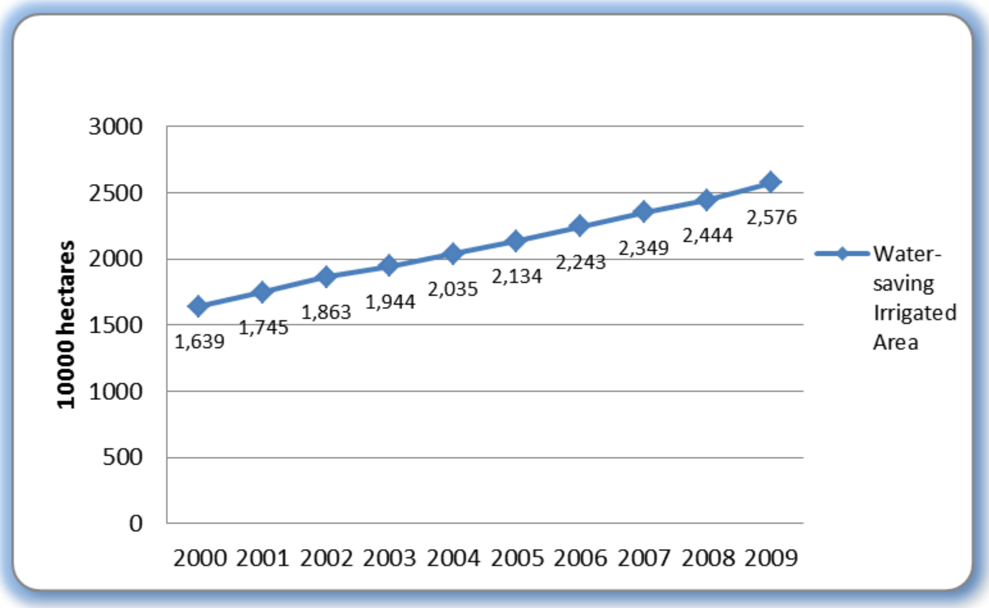

From this chart, we can see an increasing trend with its lowest point in the year of 2002 and its peak in the year of 2009. Spline can be employed to well fit this trend. The nadir of China's effective irrigation area is 53820 thousand acre and top amount is 59261 thousand acre. The range is 5441 thousand acre.

Next chart is the one that reflects China's storage capacity of reservoir.



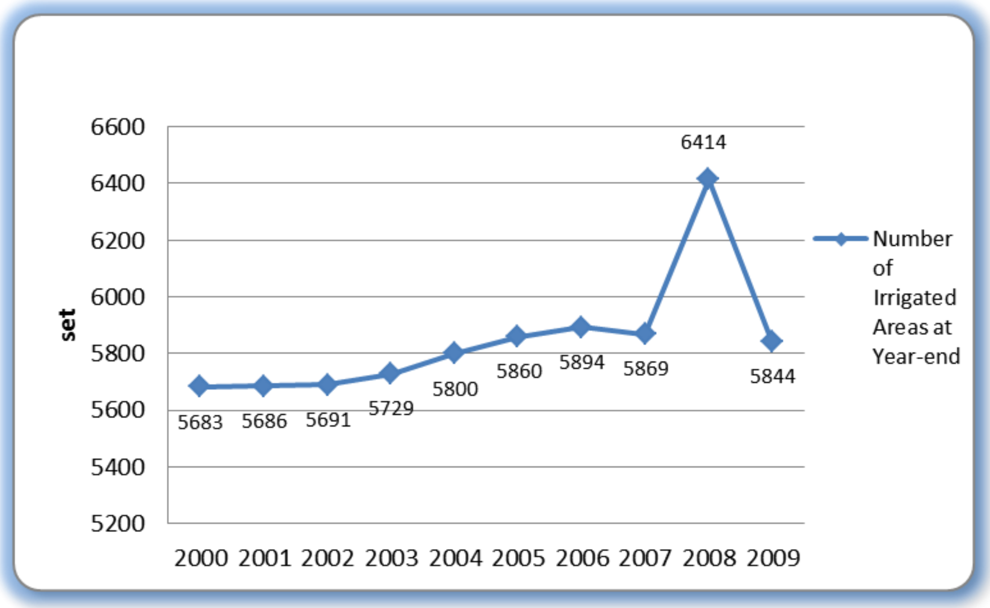

In this time series chart, we can clearly spot that China's storage capacity of reservoir reached its peak in the year of 2009. That is 706 billion cube meters. However, the China's storage capacity of reservoir drops to its lowest point in the year of 2002, showing just 518 billion cube meters. The range of the data set is 293 billion cube meters. Generally speaking, the collected data of China's storage capacity of reservoir shows some stability.

The third chart shows water saving irrigated area.



This chart is nearly linear. The highest point is 2576 and the lowest point is 1639. Linear regression can be best fit this data set.

Our last chart is demonstrating number of irrigated areas at year-end.




Generally speaking, this data set is smooth except the data of year 2008, in which the amount is 6414 of irrigated areas at year end. We are doubting that the amount of year 2008 is an outlier, just because the number of irrigated areas at year end shall not be fluctuating so much unless there exists strong effecting factors.

## Section3.Impact of China's water resource on agriculture

### 1.The impact of uneven distribution of water resources on agriculture

The precipitation of China is controlled by the southeast monsoon and southwest monsoon, which change greatly within one year. Besides, the distribution of precipitation of each season is uneven. The precipitation mainly happens from June to September, which accounted for 60% to 80% of total amount of annual precipitation. In some northern areas the share could reach up to 90%. Considering the spatial distribution of precipitation, areas whose annual precipitation is less than 400mm make up 2 / 5 of total land area and above. Southeastern coastal areas have an annual precipitation of up to 2600mm or more, whereas the northwestern inland areas have an annual precipitation of less than 5mm, a difference of 500 times. Area in northern China have a share of 64% of total land ,and the arable land area and the population of which are 65% and 46% of total, but the water resource of which is only 18.5% of total water resource. On the other hand, the southern area occupied 36% of the country's total land, and the arable land area andpopulation of which occupy 35% and 54% of total, but the water resource of which is 81.5% of total. Therefore, thewater resource of China is characterized by the fact that the southern part is more than the northern part, the eastern partis more than the western part as well asduring flood season the precipitationcould be fierce. This is the reason for the frequent occurrence of floods and droughts, severe water shortages in northern and extremely fragile ecological environment. In terms of agriculture in China, this is also the reason for the difference ofconcentration and distributionagricultural productive areas. The factorsof water resources on agriculture are just the opposite of the northern part and the southern part.

## 2. The impact of floods on agriculture

Most arable land of china are within the reach of floods. Whenthese rivers bursttheir banks, it will bring about a large number of flooded farmland , broken houses ,lost or damaged property and displaced people. From 1950 to 2005, floods inChina hasaffected 83.4 million mu of cultivated land, 1.49million mu annually; they have brought about flooded area of44.4 millionhectares, 8,000 hectares annually. Although after 1998 China has intensified the control of big rivers, most farm land have a drainage standard lower than resisting flood once in 5 years.With the adjustment of agricultural planting structure, the share of food crops is declining, while the share of economic crops is increasing. The proportion of economic crops loss caused by floods also showed an upward trend.

## 3.The impact of water shortages on agriculture and the safety of rural drinking water

Agricultural industry isthe major water users, and it is also most affected by the watershortage. From 1949 to 2000, the total area of farmland affected by drought is more than 150 million mu, an average annual affected area of 3.2 million hectares ,averageannual decrease of 0.13 million tons of grain. Since 2001, the loss caused by shortage of water remains a high level. For example, in 2005,the area of land suffered from droughtis of 2.4 million hectares, and this year saw a decrease of 19.3 million tons of grain, the direct economic losses caused by drought is of 198.6 billion yuan,more than the economic losses caused by floods in the same year.

There are nearly 800 million people living in rural areas of China. Due to the difference of natural conditions,economic and social development as well as infrastructure constructions, many places are lack of water supply facilities which reach modern standards, thus resulting in the problem of shortage of watersources, in adequate water supply, substandardwater quality and other issues. In recent years, as the government is working hard to increase the investment in rural drinking water, more than 6000 million people have benefited from the projects. In accordance with national safety standards for drinking water established in 2015,the government of China will try to resolve the issue on the safety of ruraldrinking waterof more than 300 million rural population.

## 4.The impact of water pollution on agriculture and the safety of rural drinking water

Water pollution leads to the deterioration of water quality. Especially in northern part of China, many rivershave a Class V or worse water quality. These rivers are completely beyond the range of drinkable water, thus resulting in thethe water crisis that water supply is inadequate. Although water resources are relatively abundant in the southern part of China, the situation that water pollution led to the shortage of drinkable water is often seen.Because ofdrinking contaminated surface water or undergroundwater , the health of rural residents are affected badly. Water pollution accidentsof major rivers often cause significant harm directly to the safety of drinking water in rural areas.

Currently, the situation of rural pollutant is very serious, rural pollutant is composed of chemical fertilizer, pesticide and sanitary waste. The total amount of chemical fertilizer averagely increases 1,590,000 tons per year and the total level of chemical fertilizer's usage exceeds that of world's average. China's amount of nitrogenous fertilizer is 27.8% of the world's total amount and China's phosphate fertilizer composes of 26% of the world's total amount. The chemical fertilizer amount per acre is about 2 times that of the world's average level. China's amount of pesticide is also among the high level and the use of pesticide is very harm to soil and water resources. Moreover, in China's most rural areas, sewage disposal facility is non-existing, so as sanitary waste discharge into rivers without being disposed.

Sewage irrigation's total amount in China is approximately 500 million acre, among which are Haihe river basin and Liaohe river basin that exist shortage of water resources. Sanitary waste and industrial wastewater are being used to irrigate cultivated land and toxic or harmful substances from them can be very dangerous to human beings. Now, the total amount of cultivated land that is polluted by those substances is 20,000 acre.

## 5. The impact of soil and water loss on agriculture

Between year 1949 to the year of 2000, the total soil and water loss is 40,000,000 acre, averagely 1,000,000 acre per year. The total amount of nutritive materials loss such as nitrogen, phosphate, and potash is 40,000,000 tons. We will use an example to illustrate the serious situation of soil and water loss. The black soil in northeast area is the most rich soil in China, however, the thickness of black soil decreases from 60-100 cm 50 years ago to 20-40cm. The total amount of soil and water loss in Heilongjiang province is 1,120,000 s.q km, which composes of 25% of the whole province's total amount land and the Songnen plain's black soil loss is 66.7% of the plain's total area.

**Section4. The safety of drinking water in China's rural areas**

As it is known to all, China has the most people among the world, mainland has a population of 1.3 billion in 2005, among which nearly 0.9 billion people live in rural areas. The total amount of rural people who can access to safe drinking water is 0.62 billion in 2008, composing 69% of the total rural population, but 31% rural people cannot get access to safe water to drink. In western areas, only 27%-45% people can use tap water. In addition, up to 30% people in China's rural area cannot get safe water, among which, people cannot choose but to drink high-fluorine water, brackish water and high-arsenic water. The level of drinking water safety insurance is quite low in China's rural areas, including just 33.3% people get drinking water from village integration water supply and multi-village united water supply, while, 66.7% people are using hand pump, cistern to get drinking water.

In order to solve the shortage of safe drinking water, there exist many available methods; however, different area and different weather condition should consider different solving projects. In ordinary hilly region, if the weather is humid, it is best to exploit surface water resource, while, if the weather is semi-humid, drill wells can be useful solving method if people live together and if it is hard to drill water out, people can use projects to get safe drinking water. For semi-arid areas, people can channel water or drill wells if people live near rivers or ancient waterways, if not, it is best to gather rain water. In lava hilly areas, spring water can be the best way to handle the problem because surface water is not easy to gather and wells are very hard to drill out. In loess plateau, rain water should be gathered. In high-fluorine water areas, people shall consider high-quality surface water. If rural people can afford high-water fee and other methods cannot be considered, it is possible to use high-cost and high-maintenance fee's water lifting method.