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China, Factor 2: Water Scarcity

### **China: Water scarcity of North China Plain**

North China Plain is an important part of China's large eastern plains. It's located at latitude  $32^{\circ} \sim 40^{\circ}$ , longitude  $114^{\circ} \sim 121^{\circ}$ , which spreads across Beijing, Tianjin, Hebei, Shandong, Henan, Anhui, Jiangsu 7 provinces, covering an area of 300,000 square kilometers. It has been China's political, economic and cultural center ever since ancient times and plays an important role in agriculture. The population and the cultivation area of the plain occupy one-fifths of the total China. The average annual temperature is  $8-15^{\circ}\text{C}$ . The soil is thick and fertile, generally being brown or umber. As the cultivation activities pass on from generation to generation, all sorts of natural soil are growing into farming ones. The plain is one of China's most important agricultural regions, producing corn, sorghum, winter wheat, vegetables, and cotton, of which are harvested 3 times per year, some 2 times a year. In the year 1999, the grain output of North China Plain accounted for 23.4% of the national total output, the cotton reaching over a half.

North China Plain is flat, containing numerous rivers and lakes, including Luanhe River, Haihe River, the Yellow River, Huai River etc, which makes it convenient for transportation. All rivers, excluding Huai River which flows into Yellow Sea, run into the Bohai Sea since rivers are in control of the terrain. River system of the North China Plain belongs to the following three: Hailuanhe River basin, Huaihe River basin and the lower reaches of the Yellow River basin.

North China Plain belongs to a warm temperature monsoon climate. The seasons changes significantly, and the temperature during the hottest time and the coldest differs a lot. Not much rain falls upon the plain but its intensity is strong. The annual amount of precipitation is 500-1000mm which summer takes up about 80%. Obviously the rainfalls are too concentrated in summer thus it raises the possibility of floods in seasons with pouring rains while in summers and springs the amount of rainfalls decrease greatly, bring about threats to those areas under no irrigation condition.

Although the soil of the North China Plain is fertile, the weather is unpredictable, being at the intersection of humid winds from the Pacific and dry winds from the interior of the Asian continent. This makes the plain prone to both floods and drought. Moreover, the flatness of the plain promotes massive flooding when river works are damaged, which has largely promoted underground water to become the major supply to the development of economic society of North China Plain. The inappropriate emission of Industrial and living wastes and t using pesticide and chemical fertilizer as an agricultural practice have, to some extent, brought pollution to underground water, causing severe droughts which greatly challenges the agricultural productivity and agricultural security.

Wang Xiaodong is a 63-year-old farmer in Wei County, belonging to Handan, a city in Hebei Province. His wife, Liu Yun, is 60 years old. They raise 2 boys and the older son works in the Hadan and the younger one have gone far away from home to the southern China in order to earn more money to

feed the family. They rent houses, live near their workplace and the elder brother comes home whenever he gets a leave while the younger brother could only make it once a year in spring festival. Meanwhile, Wang's 2 daughter-in-laws together with his 2 grandsons live in the farm with the old couple. The kids are studying in the Wang Xiaodong and Liu Yun have no Medicare meanwhile they've joined the new rural cooperative medical care system which provides them with 110 yuan per person yearly. Liu Yun and Wang Xiaodong are both uneducated. The daughter-in-laws have all finished high school and their children are currently in primary schools.

Like most northern families, cooked wheaten food, such as steamed bun and noodles, is the main staple food of the family. Their farm includes about 2 acres and the profit they gain from the farm makes up only a little part of the family income since most of it comes from the sons' jobs in the urban. The crops they usually grow are peach trees, corn and wheat. First, in autumn, they sow the land with wheat seeds. Afterwards they irrigate the seeds for the first time. Before long in the early spring, they irrigate the wheat for the second time. When summer comes, the crops are by the reaper. It comes the best time to sow the corn seeds, which would be right after the harvest of the wheat. At the end of autumn, the reaper harvests the corns. After a year of hard work, the average wheat yield is about 10 kilograms per square meter.

Peach tree growing in the Wang family takes patience and manpower. Before the peach trees start to harvest once per year, they spend 3 years growing up, from saplings to mature trees. During this period it's of great importance to take good care of the trees from the beginning to the end. In spring the trees need to be fertilized. During the year the trees grows so when it comes to winter, pruning becomes necessary. After doing this for 3 years, the trees finally grow up, and when the harvest season comes, the Wang family hires laborers in order to finish picking the peaches during the best period with efficiency. Normally 10 laborers would be hired and be paid with 50 yuan per day. The output of peach is usually 1500 kilogram per acre.

Wang's farm gets the water supply mainly from the well. In fact, it's a common phenomenon in his village that every family uses a well to support their daily life and farming. But the abuse of groundwater will bring a vicious cycle to the environment and the development of agriculture. The water from the underground seems to be inexhaustible and according to my inspection in the village, irrigation practice that the farmers take is very original, basic and backward, which worsen the problem of water scarcity. Wang told me that the production of corns and wheat are reducing every year and the quality of crops are decreasing all the time, for some crops are irrigated well while some are not. Also, the lack of food market and means of selling crops is another factor that restricts the family income. In the end, Wang said that the employees are negative on working sometimes but the current situation wouldn't allow him to raise their wage. Meanwhile he said that harvesting is always in a muddle because there are not enough employees.

Generally speaking, 3 main factors caused the water shortage of North China Plain and still affect the water, land, soil and agriculture. The first one is the significant reduction of regional precipitation. From 1956 to 2009 the average precipitation amount of North China Plain is  $372 \times 10^8 \text{ m}^3/\text{a}$  and the maximum amount was  $518 \times 10^8 \text{ m}^3/\text{a}$  in 1964. From 1980 to 2009 the average precipitation amount is  $325 \times 10^8 \text{ m}^3/\text{a}$ . The precipitation in 1979 is  $94 \times 10^8 \text{ m}^3$  less than that in 1956.

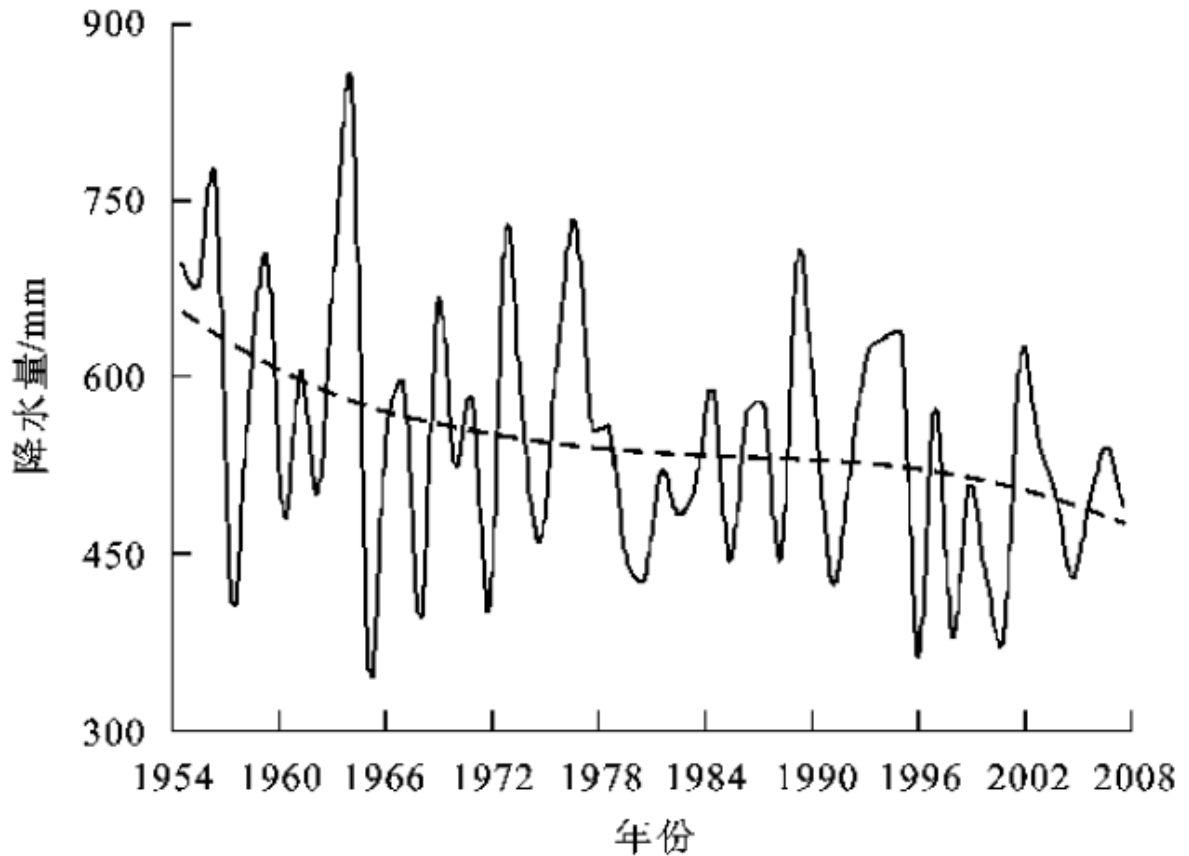


图 1 降水量年际变化及趋势

**Fig. 1 Trend and Variation of Precipitation**

From the table above, we can see that to a short period the precipitation changes yearly without a regular pattern. But seeing it as a whole, the precipitation is decreasing each year, which also leads to the deduction of surface water resource and ground water resource. In particular, the lacking of water worsens this summer both in the northern China and the southern China due to the unusual behavior of the Peru Current. According to the Shijiazhuang local news, on June 22nd, the Gangnan Reservoir, which is the reservoir with the largest storage within Hebei Province, has reached its lowest water level in the past 15 years. On some higher topography, the land has almost dried out. Although the local government has take actions to keep the local families from water scarcity so the drought would not become a threat, yet many farm families within the area are suffering from the extreme and rare drought. The natural cause of water shortage takes up 15.1 %~16.4 % of the total water lack.

The second factor lies in the defective system of water management. The common problems shown in farming family's agricultural practice are that, firstly, more water is used not because more lands are irrigated but because the practice taken was wrong and secondly, much water is polluted, which caused water shortage. These problems are more damaging than natural factors, both to agricultural productivity and the environment. But they are also more controllable and changeable. This factor takes up 22.1 %~ 24.2 % of the total water deficit.

The last factor is the sharp increase of population and the over-speed progress ongoing within the economic society. The increase and development lead to the expansion on demand for water, which has gone beyond the water resources carrying capacity. The water shortage caused by the overwhelming population and the speedy development of economic takes up 59.3%~ 62.5 % of the total water deficit.

Such status quo intensified efforts in exploiting underground water, since agricultural use of water takes up 70% of the total exploitation. The more vegetable and fruits produced, the more groundwater exploited.

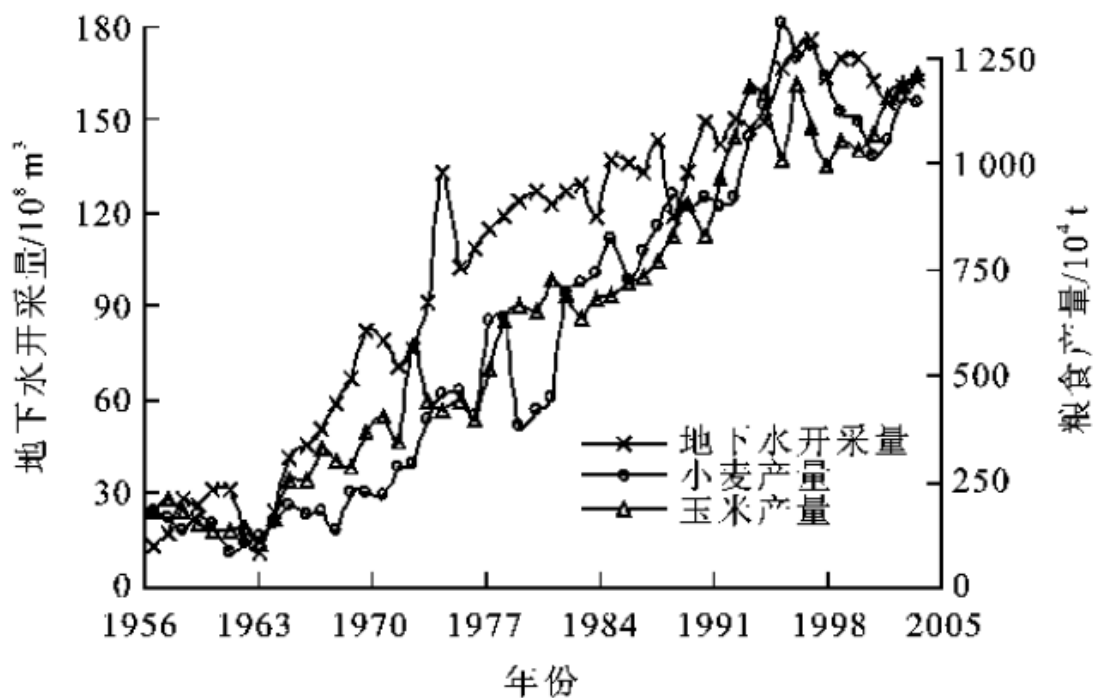


图 2 粮食产量和地下水开采量变化

Fig. 2 Variation of Grain Yield and Groundwater Exploitation

From the table above we could see that in the recent 50 years, there is a positive correlation between the exploitation of groundwater and the production of crops. That is to say, crop productivity is currently very reliable on exploiting underground water, which puts agriculture into a vicious cycle.

After analyzing causes, effects with detailed data, we can conclude that water is scarce in North China Plain because the natural capacity of territorial water resource is unable to supply the water needed for development of economic society. The natural shortage of water account for only a little part of water scarcity and what occupies the majority is the policy and epistemic shortage of water, which is as mentioned above, controllable. The limited and changing water resource of North China Plain is a corollary of evolution of water circulation driven by natural factors. Hence, it's clear that measures should be taken to agricultural practice, supervision, water projects and to public's conception.

The one simple rule we should always bear in mind when settling the problem of water scarcity is to anyhow follow the law of circulation and evolution, which will eventually lead to a virtuous circle of the development of water resource. As far as I'm concerned, there are 4 main solutions to the water scarcity of North China Plain, which will be introduced one by one,

- I. Introduce water-saving irrigation method to people involved in agriculture. Water-saving irrigation means to save water under the circumstance of maintaining or promoting the current crop productivity. From irrigating to harvesting, there are three parts that includes the invalid use of water. The first part is the transporting loss when water is to be transported to the field, including evaporation and leaking. The second part is the loss of storing water in the field which includes deep infiltration and surface evaporation and the last part is the crop transpiration loss, including the invalid loss of water during the formation of crops. To reduce as many losses as possible, all of these three parts should be under control of developed techniques which... To promote people to fully understand, accept it and to realize the technique in agricultural practice, relevant departments should set up propaganda groups in different regions, being responsible for spreading knowledge and methods. Also, the departments should provide financial assistance to the poor farming families that can't afford the expense for irrigation equipments.  
It's for sure that developing water-saving irrigation costs a lot more money than traditional irrigation, especially the cost of saving-water irrigation projects. This part of the fund should be assumed by the government, the collectivity and the farmers jointly. The government should establish relevant policies on the encouragement of water-saving irrigation in order to expect more farming families accept and exercise the method.
- II. Promote the South-to-North Water Diversion Project. The biggest ecological benefit of it is the recharging of underground water. China has been experimenting the artificial recharging of underground water since 1970. The available water resource can come from the river flow and flooding, and the available technology includes ground infiltration, recharging ponds and canals. However, there are few recharging ponds and canals within North China Plain, leading to the huge amount of underground water resource capacity with little water containing. The implementation of South-to-North Water Diversion Project will provide North China Plain with large quantity of water resource which not only meets the demand of water and accelerates the growth of economy and manufacture, but also creates conditions for the recharge of underground water.
- III. Enhance the administration of irrigation for agriculture. According to the current situation, the lacking of water and the misuse of water are the main two causes of water scarcity, so the supervision becomes significant, which needs improving and better execution. To survive, the administrative department puts the purpose of gaining more income as the most important, while saving water means decreasing the income. As a result, they encourage farmers to use more water than the actual needed amount to have a better achievement on the income. Therefore, utilizing economic measures to promote the water-saving irrigation method is going to be valid. The water-charge mechanism needs to be established as soon as possible and needs perfecting and upgrading as time goes by. Differ the water price by water

consumption and limit the usage to a rated usage which fully implements water-saving irrigation technology in order to prevent the waste of water resource.

I believe that with comprehensive legislation and execution, the water scarcity of North China Plain will improve very soon and one day diminish.

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