Anhui Water Resource Situation and General Plan

Hou Yiqun
Anhui Survey and Design Institute of Water Conservancy and Hydropower

Anhui Province, with a total north-south length of 570km and an east-west width of 450km and a total area of 139.6 thousand km2, accounts for 1.45% of China's total area. The landform and land feature of Anhui Province is diverse, and generally it can be divided into 5 natural regions: (1) Huaibei Plain; (2) Jianghuai Hillocks; (3) Dabie Mountains in the West of Anhui Province; (4) Yanjiang Plain, (5) Mountain Area of southern Anhui Province

Anhui Province is located in the transitional zone of warm and humid zone and subtropical zone, and its mean annual precipitation is 800-1800mm. The province, which has diverse climate, multiple land forms and many rivers and lakes, passes three basins (Huaihe River, Yangtze River and Xin'an River) and has large differences in the time distribution and regional distribution of water resource. Therefore, the development and usage conditions of the water resource in different regions are different.

1 WATER RESOURCE SITUATION OF ANHUI PROVINCE

1) Basic situation

The province's total amount of average water resource in donkey's years is 71.6 billion m^3 and the per capita water resource is around 1100 m^3 (it is less than half of the national average value), which features by south-to-north decreasing distribution and obvious unbalance of the same year or between years.

The water resource of Yangtze River and Xin'an River (the total amount of average water resource in donkey's years is 49 billion m^3) is abundant, which accounts for 70% of that of the province. The per capita water resource is between 1700 and 6800 m^3. Meanwhile, the abundant trans-border water from the mainstream of Yangtze River also can be used. In general, the development and utilization conditions of water resources are advantageous except for partial regions.

The water resource of Huaibei region along Huaihe River cannot follow the rapid economic and social development and ecological environment construction for its relative shortage in water resource. The per capita water resource of this region is 450 m^3, which is less than 1/4 of that of the country and 1/2 of that of the province and far lower than the international per capita water resource standard of 1000 m^3. This region burden the province's 50% farmland, 45% population, 75% power and more than 98% water used for coal production with 20% of the province's water resource. In addition, the water resource available is obviously insufficient due to the its diversity in the same year and between years and the serious water pollution. Therefore, the environmental pollution is rather serious.

2) Water resource situation of Huaibei region along Huaihe River

In view of the development and usage of water resource, the factors that affect the water supply safety of Huaibei region along Huaihe River are various. It is a special and complex region in China, and the water resource situations it confronts mainly include the following aspects.

The gap of water volume is large, and the water volume in low flow period reduces remarkably. The water resource variation of the main rivers of this region may be as large as more than 10 times. Successive dry year or special dry year occurs frequently in this region, and it is one of the 7 basins that have the largest water volume change in China. With respect to yearly distribution, the water resource concentrates in flood season

and appears in the form of flood, which leads to the large difficulty in development and usage. In particular, with the increase of water usage of the upper reaches, the obvious reduction of its water volume in dry year and the increase of river dry-up, the probability of the drought and water shortage of the regions along Huaihe River will be larger.

The prevention and control progress for pollution is slow and the ecological environment is deteriorating. From the early 1980s, with the industrial development and population increase, the water pollution has expanded from local to whole, from the lower reaches to the upper reaches, from urban to rural and from ground surface to underground, and the water environment quality has further deteriorates. In recent years, the country has strengthened the pollution control. However, the pollution prevention and control progress is still slow compared with the economic and social development. Water pollution makes some precious water resource lose the usage function, which further aggravates the shortage of water resource.

The region lacks main riverheads and the development potential of water supply is limited. In view of ecological environment protection, the development and usage degree of surface water of the region is a little high, and middle- and deep-layer groundwater near large- and medium-sized cities is over exploited seriously. Large-area underground filler and ground surface subsidence have formed near such cities as Fuyang, Huaibei, etc. The development potential of the local water resource is rather limited except that some shallow layer underground water in mid-north parts of Huaibei region can be used for agricultural irrigation and that the flood resource along the Huaihe River is to be developed and used by watching for an opportunity. It is hard to bear the economic and ecological environment cost for continuous exploitation and development.

The urban and rural water needs are increasing continuously and the carrying capacity of water resource is insufficient. With the economic and social development, as well as the population increase, and in particular, with the improvement in urbanization ratio and living standards and the implementation of such key projects as "transmit power from Anhui to east" and coal chemical base of north and south of the Huaihe River, in the future 10-30 years, the needed water volume will be still increasing at the rate of 3%-4% for each year, which is higher than the 1% national increase level of the same period, while the water volume used in agriculture is basically kept at the current level and water saving is strengthened and the industrial structure is adjusted. The needed water volume in medium dry year will increase from the current 10 billion m^3 to 13 billion m^3 in 2010 and 15.5 billion m^3 in 2030. The ratio of water for urban civil use and industry will increase remarkably. The dependence of economic development, social progress and environmental improvement to water resource will further increase.

Water shortage situation is more serious and water supply safety is threatened seriously. According to the primary analysis, in medium dry year, the current lacked water volume in Huaibei region along the Huaihe River is about 2 billion m^3. While sufficiently considering water saving and tapping the latent power, water deficiency is more serious for the increase in water needs. The water deficiency will separately reach above 3 billion m^3 and 4 billion m^3 in 2010 and 2030. In special dry year or successive dry year (such as 1966 ~ 1967, 1978 ~ 1979, 1999 ~ 2001), the current water deficiency is around 3.5 billion m^3, and to 2010 and 2030, the water deficiency will separately reach above 5 and 6 billion m^3. The large-area drought and lasting water deficiency will have a significant impact on the economic and social development of Huaibei region along Huaihe River and the whole province.

From the view of long-term development, with the overall development of economy and society and the continual increase of population of the province, the water resource situation confronted by Huaibei region along Huaihe River tends to be severe. Water resource deficiency has become the main factor that hampers economic

and social development and ecological environment improvement, and it will become one of the most serious problems in economic and social development of the future.

2. GENERAL PLAN

1) Guiding ideology and target

Perform on the principle of planning regional and industrial water use as well as considering both economic and social environment benefits. Properly dispose of the relationship between the near term and the long term, life and production, urban and rural areas, industry and agriculture, income increase and expenditure decrease and development and protection. Positively research the program for proper water resource arrangement, and plan the sequence for the layout and construction of key water resource projects on a whole view. Make the support of the economic and social development and ecological environment construction of Huaibei region along Huaihe River be a target, and ensure the safety of water for civil use of urban and rural residents and the basic water use of important and high-efficiency industries. Properly arrange the water use for agricultural irrigation, general industries and ecological environment improvement. In special dry year and successive dry year, the water for civil use in urban and rural areas shall be guaranteed, the important industries shall be able to operate, the ecological environment of key regions shall not deteriorate and the economic development of the whole province shall not suspend.

2) Basic ideology for water resource arrangement

The basic ideology for the safety system construction of water resource of Huaibei region along Huaihe River is: tap the latent power to save water, and then implement the policy of transferring water from other regions.

First, the water saving awareness of the whole society shall be strengthened, and water saving measures shall be continually strengthened. Sufficiently exert the macro-control function of water price and government, and restrain the improper increase of water demand.

Second, pay great attention to exploit the use potential of the flood along Huaihe River and reinforce water resource protection. Gradually improve the water quality of rivers and lakes, and implement the policy of encouraging reclaimed water utilization, further increasing the amount of available water.

While saving water and tapping the latent power, we shall further reinforce the uniform management for water resource and strictly control the out-of-order exploitation of middle- and deep-layer groundwater. Produce scientific emergency water supply, and orderly arrange the water for civil use of urban areas and the water for production use of important industries during special drought or sudden incident.

From the view of the demand of economic and social development as well as the local water resource conditions, trans-basin water transfer projects must be implemented so as to radically ensure water supply safety and maintain good ecological environment.

3) General plan for water transfer projects

The general plan for the solution of water deficiency in Huaibei region along Huaihe River can be concluded as: "use tapping the latent power to save water as the basis, use the water transferred from other regions as supplementation, and use the scientific management for water resource as guarantee". On the basis of tapping the latent power to save water, implement such basic projects as flood resource utilization, transfer the water from Huaihe River to the north, leading water from Yangtze River to Huaihe River and the ecological

water leading of Chao Lake. Use the project of leading water from Yangtze River to Huaihe River as the backbone to construct the optimum arrangement of the water resource of Huaibei region along Huaihe River.

The introduction to relevant projects as described as below:

(1) Flood water resource utilization of the mainstream of Huaihe River

There are many lakes and billabongs along the Huaihe River, and most storage capacities burden the task of storing flood water for the main stream of Huarhe River. For there are contradictions between flood water storage and flood prevention, drainage and land cultivation, the conditions for increasing water storage by making use of lakes and billabongs are restricted, and the trans-border and local flood water resource has not been developed and used effectively.

To relieve the water deficiency of regions along Huaihe River and store water for civil use and important industries in special dry year and successive dry year, in recent years, our province has positively developed the research for flood water resource utilization by combining the construction of flood prevention projects, and some projects have been planned wholly by combining new regulating projects for Huaihe River. With the smooth performances of migration and relocation of residents in such flood-store areas and flood diversion areas as Wabu Lake, Chengdong Lake, etc., the rectification of flood-store areas and flood diversion areas, the integral regulation of billabongs along the Huaihe River and the solidification of Bengbu Sluice, the engineering conditions for increasing the trans-border and local flood water storage by making use of some flood diversion areas and flood-store areas and billabongs have been primarily prepared. From the view of the available impounding conditions and the increasable water supply, the lakes and billabongs with large usage potential of flood water resource mainly distribute in the upper parts of Huaihe River Bengbu Sluice, including Wabu Lake, Chengdong Lake, Gaotang Lake, the upper river course of Bengbu Sluice. By increasing the storage level of river courses and lakes, expanding normal storage area and adopting other methods, introduce the trans-border flood of the mainstream of Huaihe River by watching for an opportunities and transform the natural disaster to effective utilization based on increasing the utilization degree of local rainfall and flood resources, relieving the water deficiency pressure of recent dry year.

According to the primary analysis based on combining such factors as the project progress and the influence treatment project of regulating Huaihe River and the construction of treatment project, the near-term utilization program is: the average increased water supply in donkey's years is 0.58 billion m^3, the increased water supply is about 0.72 billion m^3 in medium dry year. For special dry year, the newly increased water supply of the year is small because that it usually appears in successive dry year and is affected by the small water volume of the year and the small water storage due to the drought resistance of last year in the early of the year.

Form the research, the flood water resource utilization project has a large impact on relieving water deficiency of dry year. For special dry year, emergency water supply is operated to ensure that the reserved water storage is used to guarantee the water for civil use and some important industries that need normal production.

(2) Project of transferring the water from Huaihe River to the north

The project of transferring water from Huaihe River to the north is a regional water transfer project that focuses on water supply for industries and civil use of urban residents. It main water supply target is to supply water for Suzhou, which is in the eastern part of Huaibei region and for industries of the two cities in Huaibei. Meanwhile, ecological environment improvement and the agricultural water charging along the line are also considered.

In Anhui Province, the regions along and around the Huaihe River at the lower parts of Bengbu Sluice belong to Hongze Lake irrigation area, and are also the water import area of the east-route of south-to-north water transfer project that is being constructed. In a long time, these regions introduce water from Huaihe River or Hongze Lake by Xinbian River, Chongtong River, etc. Now the outlet of Xinbian River and Chongtong River (New Huaihong River) has serious sedimentation, and it is difficult to charge water in dry year. The dredge of rivers and lakes involves the provincial coordination. To solve the water supply in the northeastern part of Anhui Province, it is planned to set up a pumping station near Wuhe sub-sluice of Huaihe Bengbu Sluice to introduce the water of Huaihe River to Xiangjian Lake. The introduced water is pumped to Xinbian River by multiple pumping stations and making use of the natural river courses of Chongtong River and the man-made major grooves in south-north direction, and then the water is sent to Suzhou and Huaibei.

The total water transfer route of the project of leading water from Huaihe River to the north is about 130 km, and the total irrigation lift is about 20m. The project sufficiently exerts the storage function of Xiangjian Lake and Xinbian River by making use of the existing lakes and rivers, which reduces the engineering work load and investment. The project is planned to be implemented in two phases. The near-term water transfer scale is determined by the new added water for industry of Huaibei and Suzhou in the near term and by considering gradually replacing the exploited underground water volume. The near-term average increased water supply in donkey's years is 124 million m^3, and the long-term average transferred water volume is about 406 million m3.

(3) Project of leading water from Yangtze River to Huaihe River

The project of leading water from Yangtze River to Huaihe River is a large trans-basin water transfer project that mainly focuses on the water supply for civil use and industry, and also has other integral benefits, such as shipping, agricultural charging, improving water environment, etc. The range of water supply covers Huainan, Bengbu, Fuyang and the surrounding irrigation areas, and can extend to Huaibei, Suzhou and the irrigation area along the line.

The total direction of the water transfer route of the project of leading water from Yangtze River to Huaihe River is the self-transfer of Yangtze River or transferring the water of Yangtze River to Chao Lake. The water is pumped in the west bank of Chao Lake, and the water goes through Jianghuai watershed area and comes to Huaihe River by Wabu Lake. The total water transfer route of the project of leading water from Yangtze River to Huaihe River is above 290 km. There are natural rivers and lakes that can be used from Yangtze River to Chao Lake and from Wabu Lake to Huaihe River, except that a 65 km water transfer channel and a 4 km tunnel need to be built in the two sides of Jianghuai watershed. In addition, Chao Lake and Wabu Lake can be used to store the water of Yangtze River, so as to reduce the scale of transferred water. From the view of engineering technology, the construction conditions of the project of leading water from Yangtze River to Huaihe River is advantageous: sufficient riverhead, simple project, small investment, easy to arrange construction in phases, etc. At the same time, it can sufficiently exert its function by combining flood prevention and drainage construction. For the whole project is within Anhui Province, the project is easy to manage and the water transfer is safe and reliable compared with the 3 routes of the south-to-north water transfer project.

The project is planned to be implemented in 2 phases. The average increased transferred water in donkey's years is 1 billion m^3, and in medium dry year, the transferred water is 1.5 billion m^3. If the particularly large dry year (as 1967) appears, the transferred water can reach above 2.5 m^3. At present, according to the general plan, the relevant projects of the project of leading water from Yangtze River to Huaihe River have been implemented and some have been finished by combining the construction of the flood prevention project and waste water treatment of the province.

(4) Ecological water leading of Chao Lake

The serious pollution of Chao Lake is focused by the world, and this lake is one of the "3 rivers and 3 lakes" key pollution regulating basins determined by the country. The cause of the pollution of Chao Lake is complex and the rectification is rather difficult. In recent years, the pollution prevention and control has achieved certain progress by rectification in limited time. However, the pollution is still rather severe. The assumption of improving the water environment of Chao Lake by making use of water project has proposed for many years. With the primary dredge and rectification of West River, Yuxi River and Niutun River, the completion of Huangluo River sluice, the completion of the solidification of Chao Lake sluice, as well as the improvement of forecast and dispatch level, the conditions of implementing the ecological water leading of Chao Lake have been primarily prepared based on properly disposing of such complex problems as flood prevention, drainage, irrigation and operation management. While continuous reinforcing pollution rectification, lead the water from Yangtze River to Chao Lake by making use of ware project system; increase of capacity of water environment; accelerate the water flow of Chao Lake and improve the self-purification capacity of water body, which has a significant meaning for improving the ecological environment of Chao Lake; maintaining the healthy life of rivers and lakes; guaranteeing safe ware usage; promoting the development of the economic circle around the lake and the construction of cities beside the rive; accelerating the progress of the project of leading water from Yangtze River to Huaihe River, as well as promoting the overall and lasting economic and social development of the province.

In the near term, the project is planned to flow by itself of pump water from Yangtze River by making use of Baidang sluice and Fenghuangjng sluice, transferring water to Chao Lake by Luochang River or West River and Zhaohe River. The subsiding water is drained to Yangtze River by Yuxi River and Niutun River.

3. KEY WORK IN PROPHASE

1) Plan the regional development and accelerate the construction of the project of leading water from Huaihe River to north

Make good use of the advantageous conditions of the water flow and water storage of the New Huaihong River, combine the construction of influence treatment project of the high store level of Hongze Lake and the water log control project of billabongs along Huaihe River, promote the construction and management mode of "government organization, market operation, enterprise management", accelerate the construction of the project of leading water from Huaihe Rive to north according to the principle of "the one who benefits shall invest and bear the expenses" and positively expand financing channels, trying to finish the project in 2007. It is estimated that the investment of the 1st phase project is 529 million Yuan and the annual average water supply is 124 million m^3.

2) Positively implement flood water resource utilization by combining Huaihe River regulation

In the precondition of guaranteeing the safety of important flood prevention projects and the implementation of influence treatment project, the project dispatching management shall be perfected and strengthened by the flood early warning system. Combining the progress of Huaihe River regulating project, positively create water store conditions; perform trial in different regions and develop gradually, so as to continually increase the flood water resource utilization amount of the lakes and billabongs along Huaihe River and exert the integral benefits of water project, trying to achieve essential progress in 2007. It is estimated that

besides the arranged investment for regulating Huaihe River, additional 2 billion Yuan will be added, and the annual average water supply capacity is about 0.7 billion m^3.

3) Exert the integral functions of water project and try to develop the ecological water leading of Chao Lake

By strengthening rainfall forecast and optimizing project dispatch, sufficiently exert the integral functions of water project based on guaranteeing flood prevention and safe water supply and on the principle of "focus on pollution rectification, eliminate pollution with dynamics and dilute pollution with fresh water". Plan the relationship among flood prevention, drought resistance and water environment, so as to effectively improve the water quality of Chao Lake. Fully develop the ecological water leading of Chao Lake and improve the ecological environment of Chao Lake by making use of the control capacity of the water projects formed around Chao Lake after the founding of the People's Republic of China and the sufficient water in Yangtze River, promoting the construction of the economic circle around the lake. The ecological water leading of Chao Lake is not only the demand of improving the ecological of the lake itself, but also one of the preconditions for the construction of the project of leading water from Yangtze River to Huaihe River. First, the relevant prophase demonstrations and experiments shall be finished. Properly implement the water transfer and accelerate the ecological environment improvement of Chao Lake by combining the pollution rectification from point to face.

4) Support the long-term development and accelerate the project of leading water from Yangtze River to Huaihe River

The project of leading water from Yangtze River to Huaihe River is the reliable strategy riverhead project of the Huaibei region along Huaihe River and the water transfer route, and is also ecological protection project. According to the general arrangement of the prophase work of the project of leading water from Yangtze River to Huaihe River, further reinforce the leadership of prophase work and increase the investment of the prophase work on the basis of referencing to the experience of the prophase work of the south-to-north water transfer project, and positively promote the research on relevant key subjects; start to develop the compilation of project proposal and the investigation of construction management and policy; accelerate the construction of relevant projects of the project of leading water from Yangtze River to Huaihe River, trying to start with the main project around 2010. It is estimated that the total investment of this project is around 8 billion Yuan, and the annual average water transfer is 1.5 billion m^3; and in special dry year, the water transfer is about 3.5 billion m^3. The near-term investment is about 5 billion Yuan, and the annual average water transfer is 1 billion m^3; and in special dry year, the water transfer is about 2.5 billion m^3