
Study on the Layout of Water Diversion Projects Influenced by China's Macro Developing Strategies

Xiang Peng*

Bureau of South-to-North Water Diversion of Planning, Designing & Management, MWR, Beijing, China

ABSTRACT: A country's macro developing strategies will greatly impose upon its water resources allocation. Based upon the relationship between national macro developing strategies and water diversion projects layout, the paper discusses the vital influence of water diversion projects caused by China's food security and sustainable development strategy implemented in recent years, and points out that it is an inevitable choice of constructing inter-basin water diversion projects in north China in view of local water resources can't meet the demand of socio-economic development and eco-environment protection, and then recommends China's water diversion projects layout in the current and future, which attaching most importance to the South-to-North Water Diversion Project.

Key Words : Macro Developing Strategies; Food Security; Water Diversion Projects; The South-to-North Water Diversion Project (SNWDP); Layout

1 Introduction

Regional water resources endowments vary greatly in China with the performance that there are abundant water resources in south areas and scarce in north regions. With the consecutive growth of population, continuously accelerating of urbanization, industrialization and global economy integration, together with gradually adjustment of China's macro and regional developing strategies in recent years, water crisis emerges increasingly in north China. Thereby, it's very necessary for Chinese government to construct a series of water diversion projects moderately according to the requirement of national socio-economic development, in order to achieve the goal of rational water resources allocation in the whole country.

* Corresponding author:
E-mail: pengx@mwr.gov.cn

2 China's macro and regional developing strategies

A country's macro and regional developing strategies are closely related to water resources allocation. Judging from the water consumption structure in China recently, the proportion of gross agriculture water use accounts for nearly 70% of the gross water utilization, and industry and domestic water accounts for 20% and 10% respectively. Although the proportion of eco-environment water use is very small but its water demand debt is tremendous, accounting for less than 2% on the current (MWR, 2004). Therefore China's food security and macro developing strategies will greatly impose upon the construction of water transfer projects.

2.1 China's food security strategy

According to some research analyses launched by the China Academy of Engineering (Zhengying Qian, etc. 2002) and the Ministry of Agriculture (MA, 2006), it is forecasted that the total grain consumption will reach about 0.6 billion tons when China's population climbs to its peak, while the current grain production capacity is 0.5 billion tons.

China's grain producing areas concentrate on three major grain bases which are named Northeastern Song-Liao Plain, Yangtze Coastwise Hill Plain and Huang-Huai-Hai River Plain respectively. It's estimated that northeastern regions can develop another 2.7 million *ha*'s irrigation districts (ID). In addition, plenty of water resources can be used in the coastwise of Yangtze's middle and lower reaches to expand irrigation areas, and to carry out continued construction or renovation and water saving rehabilitation of large and middle scale irrigation system. Then the grain comprehensive production can be increased, and China will further strengthen its grain productions.

Thus it can be seen that the key grain production areas are located in the northeastern and north China to ensure China's food security in the future.

2.2 China's regional developing strategies

Since the foundation of People's Republic of China, China's regional development has experienced three strategy transition processes from equilibrium developing, un-equilibrium developing and harmony developing (Haifeng Huang, etc. 2006).

During 1950s~1978, in order to change un-rational industrial layout of that time, Chinese government launched tremendous investments in the middle and western

regions. The equilibrium developing strategy had been continued for nearly 30 years.

Since 1978, China formulated opening up policy which facilitating a large-scale transition of key developing regions from middle & western regions to southeast littoral by reason that the latter regions possessed more developing advantages. An important evolvement had happened from pursuing regional equilibrium development to seeking regional un-equilibrium development, characterized by setting efficiency on the first position. And this un-equilibrium developing strategy had lasted for 20 years approximately.

Around 2000, Chinese government launched a series of strategies including the large-scale development of western regions, the work of rejuvenating northeastern China and other old industrial bases, and boosting the development of the central regions. The goal of implementing harmony developing strategy is to realize concordant development by way of mutual promotion between eastern and western regions and advantage supplement to each other.

It can thoroughly be forecasted that northern regions, especially north China, will become hotspot of regional economic development.

3 Analysis on the status quo of water resources development and utilization in China's water scarce regions

Although China's gross water resources volume is abundant, the usable water resources per capita are very scarce. The distribution of water resources emerges obvious difference between northern and southern regions, which unmatched the distribution of population, other resources and productivity. According to the statistics (Zhengying Qian, etc. 2002), the population in southern regions accounts for 54.3% of national gross population, the cultivated areas and GDP accounts for 39.4% and 55.2% respectively, yet the water resources accounts for 81.5%. While in the northern regions, the population accounts for 45.7%, the cultivated areas and GDP accounts for 60.6% and 44.8% respectively, while the water resources accounts for 18.5%. Especially in Huang-Huai-Hai River Regions, the population accounts for 35% of national total, the cultivated areas and GDP accounts for 39% and 32% respectively, yet the water resources accounts merely for 7%, the water resources of per capita are less than $460 m^3$. Huang-Huai-Hai River Regions have been seemed as the most water scarce regions and its contradiction between water supply and demand is unconventionally acute.

Table 1. Distribution table of China's water resources volume, population, cultivated area and GDP

		percentage accounting for national level (%)			
		water resources volume	population	cultivated area	GDP
northern regions	northeastern	7.0	9.2	20.1	10.2
	north China	7.0	34.2	35.5	32.7
	western	4.5	2.3	5.0	1.9
	southern regions	81.5	54.3	39.4	55.2

Source: Zhengying Qian, Guangdou Zhang. (2002).

In order to fulfil the increasing demand of water resources caused by regional socio-economic development, local water resources in northern regions have been greatly exploited in recent years. According to the statistics, available volumes of water resources in northern China accounts for 32% of the nationwide. Water resources utilization ratio in the whole northern areas has approached to 50%, water resources exploitation has enormously exceeded the limit of water resources availability.

Owing to long-term bondage of surface water scarcity, 34% of water supply in northern regions depends on exploiting or over exploiting groundwater, comparing with 95% of total water supply coming from surface water. Groundwater exploitation occur most in the northern and northeastern China.

Current water resources demand and supply gap* in northern China are 44.7 billion m^3 which accounts for 89% of national total, mainly in three main regions: there is 6.6 billion m^3 in eastern regions, 5.8 billion m^3 in western regions, and 32.3 billion m^3 in Huang-Huai-Hai basins (which is the most serious water resources shortage region, accounts for nearly 65% of national total). The local finite water resources can't support the socio-economic development and eco-environmental preservation, so it is very necessary and imperative to construct some water diversion projects moderately.

4 Basic framework of China's water resources allocation and project layout

4.1 Basic framework of China's water resource allocation

The basic framework of China's water resources allocation can be described as the

*Water resources demand and supply gap include three main aspects: firstly, the water demand for national economic and social development; secondly, the rehabilitation of over-exploited groundwater practically; thirdly, the rehabilitation of eco-environmental water in the watercourse which have been occupied for a long term.

following: facing the status quo of water resources development, considering the water demand coming from different sectors and regions pushed by national economic and social development, simultaneously insisting on water resources development and water conservation and putting water conservancy on the premier position, fully boosting water conserving society construction by physical measures and institutional safeguard, constructing a sequence of water resources projects and water diversion projects (Xiang Peng, etc. 2007).

4.2 The major layout of water diversion projects in China

In order to alleviate the status of serious shortage of water resources in northern China, particularly in Huang-Huai-Hai River basins, a large number of investigations, survey, programming, and researches have been implemented by the Ministry of Water Resources (MWR) and other relative units during the past 50 years. As the important results, three water transfer areas have been selected from the upper, middle and lower reaches of Yangtze River in succession. And accordingly, three water diversion routes have been programmed which were respectively named West, Middle and East Route of South-to-North Water Diversion Project (SNWDP). The three routes extract water from Yangtze River to Huang-Huai-Hai plain, Jiaodong Region (denoting eastern part of Shandong Province), middle and upper reaches of Yellow River and partial inland river in northwest of China. The three routes (east, middle and west routes) connect with four rivers (Yangtze River, Yellow River, Huai River and Hai River) mutually, composing of China's macro water resources allocating projects layout which is named "four horizontal and three longitudinal rivers".

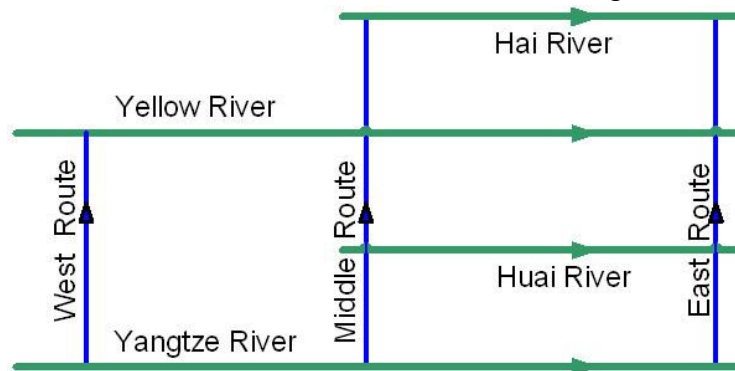


Fig.1. Sketch map of China's "four horizontal and three longitudinal rivers"

Furthermore, Chinese government has planned or launched a series of regional water diversion projects based on the local natural conditions, the requirement of socio-economic development and eco-environmental protection to address subsistent

water shortage issues, ensuring the promotion of local water resources supplying capacity by means of rational water resources allocation.

Table 2. Statistics of completed water diversion projects in China

project	water supply object	annual water extracting volume(billion m^3)
water transferring from Dongjiang River to Shenzhen and Hongkong	city	1.74
water transferring from Yellow River to Qingdao	city	0.24
water transferring from Yellow River to Taiyuan	city	0.14
water transferring from Luan River to Tianjin	city	1
water transferring from Biliu River to Dalian	city	1.30 million tons/day
water transferring from Songhua River to Changchun	city	0.3
water transferring from Hei River to Xi'an	city & agriculture	0.38
water transferring from Datong River to Qinwangchuan	agriculture	0.44
water transferring from Yellow River to Jingtaichuan	agriculture	0.41
water transferring from Yellow River to Cangzhou	city & agriculture	0.62

source: the author edited according to correlative data.

5 A brief introduction of the general programming scheme of SNWDP

According to the general programming of SNWDP approved by the State Council in 2002, the three water diversion routes can be described as following:

The East Route (ER):

Water extracting site: nearby Yangzhou city located at the downstream of Yangtze River.

Major water supply objects: supplying water for Shandong Peninsula, offering water for urban living and industry sectors of Shandong, Jiangsu and partial Anhui province, considering some water demand for agriculture, environment, navigation and other water usage, and providing prerequisite condition for Tianjin municipality and Hebei province in case of meeting an emergency.

Water transferring route: enlarging the scale of current water diversion project of Jiangsu which is named Jiangshuibediao, pumping water gradually with Jinghang Grand Canal and its parallel rivers to Dongping Lake, and dividing water into two routes: one way for northern region drilling through the Yellow River nearby Weishan; another way for Yantai and Weihai city by current water transferring channel.

Project scale: the total water diversion scale is 14.8 billion m^3 . This project is implemented in three phases: in the first phase transferring 8.9 billion m^3 , second phase increasing to 10.6 billion m^3 , and ultimate phase reaching 14.8 billion m^3 .

The Middle Route (MR):

Water extracting site: at the head gate of the Taocha Canal from the Danjiangkou Reservoir.

Major water supply objects: offering water for Beijing, Tianjin municipality and Hebei province.

Water transferring route: digging open channels denoted by the programming route, passing Fangcheng Yakou, which is the watershed of Yangtze River and Huai River along with west side of Tangbai River basin, drilling through the Yellow River in Gubaizui located in the west of Zhengzhou city, then continuing running to north along The Beijing-Guangzhou Railway, and ultimately reaching Beijing and Tianjin municipality by gravity.

Project scale: the total water diversion scale is 13 billion m^3 . This project is implemented in two phases: in the first phase transferring 9.5 billion m^3 , second phase increasing to 13 billion.

The West Route (WR):

Water extracting site: collecting water at the upstream of Yangtze River (named Tongtian River) and its two tributaries are named as Yanlong River and Dadu River respectively.

Major water supply objects: offering water for 6 provinces (or autonomous regions) which are named Qinghai, Gansu, Ningxia, Inner Mongolia, Shaanxi and Shanxi, all located at the upper and middle reaches of Yellow River, supplying partial water to Hexi Corridor region, and preparing for Yellow River if necessary.

Water transferring route: excavating tunnels through the watershed of Yangtze River and Yellow River located in Bayankala Mountain, and transferring water from Yangtze River to the mainstream of Yellow River by gravity.

Project scale: the total water diversion scale is 17 billion m^3 . This project is implemented in three phases: in the first phase transferring 4 billion m^3 , second phase increasing to 9 billion m^3 , and ultimate phase reaching 17 billion m^3 .

6 Conclusion and suggestion

Until now, the SNWDP is the largest water resources allocating project in the world.

The implement of SNWDP will greatly conduce to the optimization of China's water resources distribution structures and the acceleration of national socio-economic sustainable development. In recent years, a great deal of changes have occurred to the water receiving areas of SNWDP, water resources volume gradually decreasing, socio-economic quickly developing, eco-environment increasingly deteriorating, water conflicts thoroughly intensifying, the gap of water resources supply and demand constantly expanding. Consequently, the construction progress of SNWDP must be further strengthened. At the same time, a sequence of regional water diversion projects should be programmed or constructed moderately.

Essentially, constructing large scale inter-basin water diversions belongs to public management affairs. These projects involve in numerous aspects, influence broad areas, exist lots of beneficial groups, and face plenty of challenges in the process of programming, designing, constructing, and operating. Therefore, the institutional system construction of water diversion projects must be strengthened, including enhancing and perfecting water laws and regulations, formulating various administrative rules and economic levers, and promulgating sound water culture and water knowledge.

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