Drain-off of the Yellow River and the comprehensive control of the Yellow River Watershed

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1. The Yellow River is a special river

1.1 Be famous for easily choked, breached and moved.

The Yellow River is a river with heavy flood in China. Since the Qin Dynasty, the river course from Hua Yuan Kou changed constantly; it flickered between Tian Jing city and Bing Hai County, Jiang Shu Province. Before the year of 1194, it flowed into Bo Hai and 1194-1855 into Huang Hai. After the year of 1855, it flowed into BoHai again. During the 2540 years from 602 B.C to 1938 A.D, it breached 1,590 times, changed its course 26 times extensively and changed its course special extensively 9 times. The frequent change of its course brought great suffering to the people living in two banks.

1.2 Frequent drought

Drought is frequent in the watershed of the Yellow River. During the 268 years of Qing Dynasty, drought happened 201 times. In 1929, heavy drought happened in thousands of miles, with 34,000,000 people suffering from drought. It sustained for 5 years and involved in several provinces, such as Shaan, Gan, Jing.In the heavy drought of 1995-1997, people and domestic animals in many places of Loess Plateau had no drinking water, thus the government had to transport water to maintain lives of local people.

The Yellow River valley is the most suitable place to live in history, which can be proved by the ancient metropolises, such as Chang'an, Luo Yang, and Kai Feng.The deterioration of eco-environment began in Qing and Han Dynasty, prevailed in middle-Tang and prevailed further in dynasty of Ming and Qin. Forest and grassland lost and the Loess Plateau was eroded greatly. Silt from the Yellow River inundated Yu Lin, Tong Wan and so on. At present, ratio of forest cover on Loess Plateau is less than 1/2 that of the whole country, less than 1% in the most serious place. The eco-environment is very fragile and hardly rehabilitated if it is deteriorated.

1.3 Water amount is decided by upper-middle reaches and silt is decided by middle reaches

Water from the area upper Lan Zhou accounts for 58%, silt accounts for 9%. From He Kou town to Tong Guan, the watershed covers 310,000 km^2, water from this area is 18,700,000,000 m^3, accounts for 33% of the runoff, while silt accounts for 90%, with 800,000,000 tons of sand deposited in lower reaches per year. Average silt content is 3 $kg/m^3 \cdot a$ in Lan Zhou course and 6 $kg/m^3 \cdot a$ in Bao Tou course. Silt content is increased greatly when the river flows through Loess Plateau, with 145 $kg/m^3 \cdot a$ in Yong Ding river and 30 kg/m^3 in confluence site. It is 161 kg/m^3 in the confluence of Luo He, Jing He and Wei He. It is 35 kg/m^3 when the river flows out Shaan'xi, with a maximum of 580 kg/m^3. It is 38 kg/m^3, with a maximum of 911 kg/m^3 in SanMenxia.

1.4 Naturally Deficient Water Resources

Total amount of water resources is 280,000,000 m^3 in China, and 80 percent of it distributes in the south

area beyond ChangJiang River. The amount of water resources is only 2,400m^3 per person. Water resources in Yellow River watershed only account for 2.7%, and the amount per person is only 742 m^3, which is 1/4 of native level. Since 1970s, the rainfall decreased in the upper and middle of Yellow River, and in 1980s it decreased by 5% and in 1990s by 13%. Thus water from upper reaches and middle reaches decreased 1,600,000,000 m^3 and 6,700,000,000 m^3 respectively. Runoff decreased by 19% in 1990s. In 1995~1997 period, with drought in whole watershed serious drain-off was happened. But in 1927~1931 period, Block Channel was not happened with runoff decreased by 34%.

2 Drain-off of the Yellow River

Before 1960s, efficiency of water resource was low. Drain-off happened seven times during 1972~1980, with the average duration of 9 days per year. The average duration was 11 days in 1980s. Since 1991, Drain-off happened every year, and duration became longer and longer, with 122 days in 1995, 136 days in 1996, 226 days in 1997, and 133 days in 1998 which was a plentiful rainfall year. Extent of drain-off became more and more, with 742km in 1995. The date of drain-off became earlier and the most serious happened in February. The degree of drain-off was aggravated and it also happened in flood seasons. Drain-off happened 13 times in 1997.

2.1 Serious Pollution and Wasted

Water in Yellow River was used mostly in agricultural irrigation and efficiency was low. Recycled efficiency of industry water was only 30%. Polluted length of Yellow River account for 71% of the whole watershed. Recycled efficiency of polluted water was under 21%.

2.2 The water demand was exceed supplied

Efficiency of Yellow River runoff has coming to 65%, now the area irrigated with Yellow River water increased to 7,400,000 ha from 800,000 ha in 1949. The resource of Yellow River couldn't satisfy the increasing water demand.

2.3 Exploit underground water excessively

The ground has subsided in large area because of the excessive exploitation underground. For example, the subsidence areas in Xi'an city in Taiyuan city were 1,000 km^2 and 216 km^2, with the max depth 1.5m and 1.8m, respectively.

3 Measure for preventing drain-off of the Yellow River

3.1 Adding sources

3.1.1 Moving water from south china to north china is the basic measure to prevent the Yellow River from draining off. The project has east、middle and west subprojects. The east and middle subprojects can only resolve the problem of water resource between need and supply in the lower reaches, while the west one can improve the eco-environment in upper and middle reaches with a lower economic benefit. Comparing with the east and middle subprojects, the west has higher benefit in economic、ecology and society aspects considering of eco-environment construction and comprehensive use of soil and light-heat resource in upper reaches. Thus it should prepare for the west subproject from now on and put it into practice in the early 21 century.

3.1.2 Constructing base to increase rainfall artificially in upper reaches of Yellow River. It can increase the amount of headwaters, and also improve eco-environment.

3.1.3 Using seawater to wash out the deposited silts. Seawater should be used adequately, such as in industrial and agricultural production and living after being desalted or in washing out the deposited silts.

3.2 Storing runoff

3.2.1 Blocking and storing runoff water. Ancient people had created water collecting technology for fighting drought, gathering and using rainfall in the Yellow River watershed. Runoff from slope, village and road was stored in water cellar, storage pond to supply water for human and animals. Measures of fish-scale pits, terraced fields were adopted to block slope runoff , recover vegetation, control water loss and soil erosion.

3.2.2 Blocking flood.

The Yellow River watershed is deficient in water resource, however a lot of flood runs into sea every year. Building reservoir in plat can store water for deficient rainfall year.

3.2.3 Cleaning polluted water and reusing it in the whole watershed.

3.3 Administration

Fluxion varied among seasons of the Yellow River obviously, that means, maximum is 2.5 times as much as minimum. So, a reasonable plan should be made to manage the water in different seasons of different rainfall year.

4 The control of the Yellow River watershed

Improve the environment of the Yellow River watershed and resolve the serious flood and drought. The construction of environment should be strengthened in upper and lower reaches of the Yellow River watershed. It lies in administrating the gully; controlling water loss and soil erosion, lessening the dangerous caused by the deposit of silt in lower reaches. At the same time, usage of the 10,000,000,000m^3 water to shed silt can be changed into the production of industry and agriculture.

4.1 Administering upper reaches of the Yellow River

The key of administer the upper reaches of the Yellow River lies in improving eco-environment.. Natural protected zone should be found by migration strategy in the area where environment can't meets human's need. Also, artificial rainfall area could be constructed to recover vegetation.

4.2 The administration of Loess plateau area

The administration of Loess plateau area began in 1930's and some experiences have been accumulated. In 1986, a comprehensive demonstration zone was founded in Chang Wu county, Shaan'Xi province,PRC. A measures concerning road, water, field, fruits and forest were practiced, thus the field yield was increased from 2,700kg/ha to 3,750 kg/ha, and forest and grass cover ratio was increased from 18% to 45% and soil erosion rate was below 800t/(ha·a) in the 10 years continuously.

4.3 Administering lower reaches of the Yellow River

Riverbed should be deepened in order to dredged up the silts in lower reaches of the Yellow River. Seawater runs into riverbed, thus lead to riverbed being cut significantly. The ability of transporting the silts should be strengthened in narrow-deep riverbed, and wide-shallow riverbed be changed. Silts should be dredged up and washed into sea in flood periods.