CHINESE GEOGRAPHICAL SCIENCE
Volume 7, Number 3, pp. 251 – 258, 1997
Science Press, Beijing, China

WATER ENVIRONMENT AND SUSTAINABLE DEVELOPMENT ALONG THE BELT OF XINJIANG SECTION OF THE NEW EURASIAN CONTINENTAL BRIDGE

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(Received 6 January 1997)

ABSTRACT: The opening of the new Eusasian Continental Bridge not only brings about great opportunities for development of Xinjiang, but also plays a major role in reducing the gap between the western and eastern parts of China. In general, Xinjiang section of the new Eusasian Continental Bridge goes ahead along the oasis belt of northern slope of the Tianshan Mountains with advanced economy and concentrated populattion. The main factor to determine the fate of oasis is water. There are relatively more rivers in Xinjiang section of the Eurasian Continental Bridge. But as far as the region is concerned, if we take Ürümqi as the boundary, river runoff of the western section accounts for 90%, the eastern section just occupies 10%, so surface runoff is highly concentrated in the west. In this paper, river water environment and ground water environment are evaluated emphatical. On the whole, the status of water environment of seven rivers being evaluated is gradually improved and ground water quality of main cities along the bridge is good. In the future, carrying out sustainable development strategy and doing well in compositive prevention and cure should be long-term guidelines so as to ensure the normal running of the new Eurasian Continental Bridge and economic development along the continental bridge.

KEY WORDS: water environment, sustainable development, Xinjiang, new Eurasian Continental Bridge

The important guiding principle that ensures the sustainable development of China is "The 21st Century's Agenda of China"(Office, 1994). The sustainable development in the areas along the new Eurasian Continental Bridge (section in Xinjiang) belongs to one of the prior items of "the agenda". The opening of the new Eurasian Continental Bridge not only brings about great opportunities for development of Xinjiang, but also plays a major role in reducing the gap between the western and eastern parts of China. Furthermore, it can trigger future sustainable development in those areas. Xinjiang section of the new Eurasian Continental Bridge runs

through oasis belt, and the main factor that determines the fate of oasis is water. Rivers in Xinjiang section of the new Eurasian Continental Bridge are relatively plentiful. Most of them originates from the northern foot of the Tianshan Mountains, and abundant ground water is formed when those rivers flow out of the mountain outlets. This kind of surface water and ground water that derives from the same origin breeds numerous oases in this area. Those oases give important support to the continental bridge. This article evaluates and analyzes the water environment quality of some important water bodies in the areas along the continental bridge and sums up its characteristics. In addition, it discusses the relationship between the protection of water environment and sustainable development in the belt along the continental bridge.

I. OUTLINE OF THE BELT ALONG XINJIANG SECTION OF THE NEW EURASIAN CONTINENTAL BRIDGE

After the new Eurasian Continental Bridge enters Xinjiang, it crosses Hami and Turpan Basin, then passes through the Tianshan Mountains by Daban City and goes westowards along the northern foot of the Tianshan Mountains until it reaches Alataw Pass(Fig. 1). The completion of the North Xinjiang railway from Ürümqi to Alataw Pass means that the new Eurasian Continental Bridge is joined up. On the whole, the railway in Xinjiang extends along the areas of Turpan – Hami Basin and alluvial and diluvial plains of the northern foot of the western Tianshan Mountains. The northern slope of the western Tianshan Mountains is temperate continental climate, has high evaporation, low precipitation and very changeable temperature.

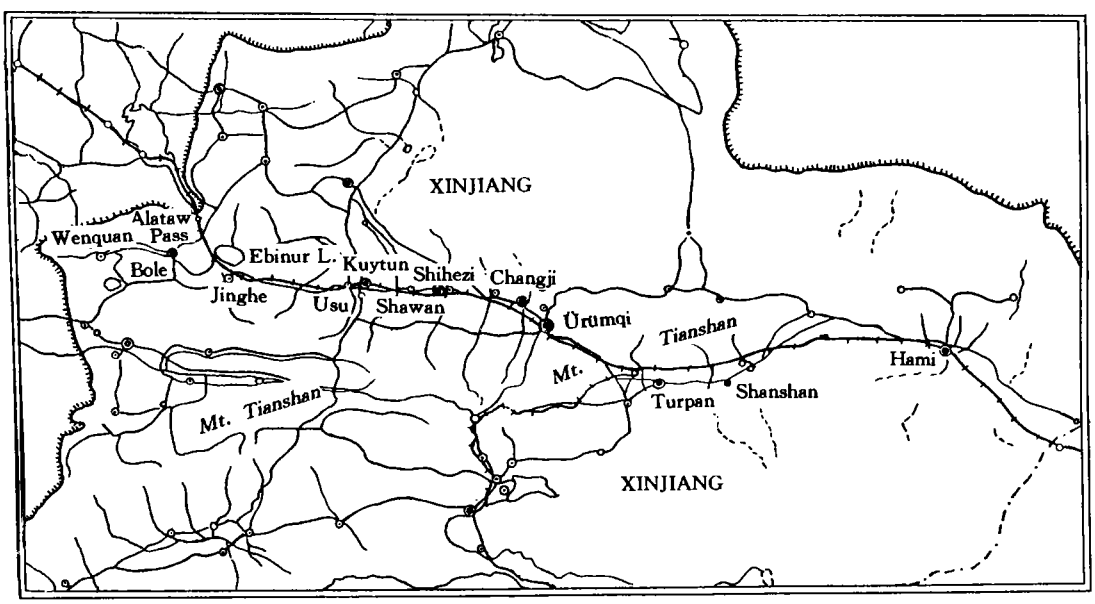

Fig. 1 Scheme of Xinjiang section of the new Eurasian Continental Bridge

Turpan – Hami Basin is temperate arid climate, it has low precipitation and frequent

gale.

The whole area along Xinjiang section of the new Eurasian Continental Bridge is rich in light and heat resources. Frostless period in this region is about 180 days, which meets the needs of the crops growth. The belt along the continental bridge is the areas with flourishing economy, dense population and complete industrial kinds, it lays a certain foundation for further economic development. Land resources in this area is concentrated, meanwhile, the land that can be utilized almost occupies half of the land resources, and has a long cultivated history. It is an important farming area of Xinjiang. This area also has flourishing animal husbandry, and the proportion of grassland that can be used is high. The quality of forage grass is good and its yield is high, moreover, water, light, heat and wind energy in this area are quite abundant. There is a large reserve of oil and coal. Turpan－Hami Basin and Kuitun region have plenty of oil and natural gas, and coal almost scatters over the whole area along the continental bridge. The energy source in this region is mainly coal. Over half of Xinjiang's industry concentrates in this region. From east to west, the main cities along the railway line are Hami, Turpan, Ürümqi, Changji, Shihezi, Kuytun and Bole. The total population of those cities almost account for over one third of the total population of Xinjiang.

II. WATER RESOURCES ALONG XINJIANG SECTION OF THE NEW EURASIAN CONTINENTAL BRIDGE AND THEIR CHARACTERISTICS

There are more than 200 rivers in the region along the continental bridge, among which there are 14 rivers with annual runoff more than 1×10^8 m^3. Most of them are located in the west of Ürümqi. The main rivers are the Ürümqi River, Santun River, Hutubi River, Manas River, Kuytun River, Bortala River and so on (Table 1). Most of them originate from the Tianshan Mountains, and forms an interior centripetal water system towards the north of Junggar Basin. Precipitation in this region is relatively less and water resources are poor except mountain areas. Meanwhile, because of the continuous development of agriculture and industry, the degree of utilization of surface water is relatively high, but utilization rate of ground water is relatively low, there still has certain potentialities of development. In general, agriculture water was the main in the past. The annual variation of precipitation in the areas along the northern foot of the Tianshan Mountains is quite big, and its distribution is uneven. However, abundant ice and snow resources in mountains areas give river sources an important supply and adjustment effect. The supply of river runoff is mostly from precipitation, glacier and snow cover. Surface runoff derived from mountain areas increases with the rise of temperature, so the runoff from May to September occupies about 80 percent of annual runoff. As far as the region is concerned, both precipitation and river runoff in the areas along Xinjiang section of the northern foot of the Tianshan Mountains are high in the west and low in the east. For example, if we take Ürümqi City as the boundary, the lengths of the mountains in the northern slope of the Tianshan Mountains to the west and east of Ürümqi are basically equal, but river

runoff of the west section accounts for 90 percent, but the east section just occupies 10 percent. Surface runoff concentrates highly in the west. So the rivers discussed in this article are mainly the rivers located to the west of Ürümqi(Editorial, 1991). Under mountain outlets, because of loose Quternary strata that are apt at storing groundwater, the rivers originating from mountain regions seep into ground gradually except utilization of human beings. Therefore, abundant groundwater resources are formed. Groundwater and surface water transform and complement each other, forming a favorable characteristic in the utilization of water resources.

Table 1 Hydrological characteristics of main rivers

River	River length(km)	Annual average discharge(m^3/s)	Annual runoff($\times 10^8\ m^3$)	Remarks
Urümqi	150	7.25	2.36	flows into Qingeda Lake
Toutun	130	7.00	2.35	flows into Qingeda Lake
Santun	180	10.40	3.49	disappears in desert
Manas	190	40.60	12.80	flows into Manas Lake
Jingou	83	10.20	3.21	
Taxi	49	7.16	2.29	
Kuytun	80	20.00	6.36	flows into Ebinur Lake
Sikeshu	61	9.14	2.89	flows into Ebinur Lake
Jinghe	80	14.70	4.61	flows into Ebinur Lake
Bortala	184	15.10	4.78	flows into Ebinur Lake

The key factor that determines natural water quality of rivers in the arid area is dry climate. Rare rain leads to weak surface leaching, and strong evaporation in plain areas causes the concentration of river water and the rise of mineralization degree. The mineralization degree of some rivers in the northern slope of the Tianshan Mountains discussed in this paper usually varies from 100 − 200 mg/L in the upper reaches to 200 − 300mg/L in the lower reaches. In Turpan Basin, the mineralization degree of rivers originating from Bogda Mountain is less than 200 mg/L. Most water seeps into the ground under mountain outlets, when it spills out in the northern foot of Huoyanshan, its mineralization degree reached to 200 − 500 mg/L, at centre of the basin, it reached to 1 − 3 g/L. The distribution of hardness is similar to that of the mineralization degree, it is also low in mountain regions but high in basins. The total hardness of rivers in the northern slope of the Tianshan Mountains is usually between 5 and 10.

III. EVALUATION AND ANALYSIS OF WATER ENVIRONMENT IN THE AREAS ALONG XINJIANG SECTION OF THE NEW EURASIAN CONTINENTAL BRIDGE

1. Evaluation

This paper chooses typical rivers of main cities along the continental bridge and the ground water of those cities to evaluate its environmental quality. Because the railway from the west of Bole to Hami is basically located in the zone of latitude of 43° − 45°N, the section of rivers mon-

itored is in this zone. From east to west, we choose Guxiang River in Hami (near 43° 08′ N), Meiyaogou River in Turpan (near 43°11′N), Ürümqi River in Ürümqi (near 43°55′N), Kuytun River in Kuytun (near 44°02′N), Manas River in Shihezi (near 44°11′N), Bortala River in Bole (near 44°52′N). The section of rivers monitored is basically around the railway line, and they have good representativeness. In the evaluation of water quality, the surface water adopts the three-grade criterion of "China Surface Water Quality Standard" (GB3838 - 88); the ground water adopts "the Hygiene Criterion of the Life Drinking Water" (GB5749 - 85). The evaluation factors are pH, total hardness, COD, BOD_5, ammonia nitrogen, sub-nitrous nitrogen, Nitrous Nitrogen, volatile phenol, cyanide, arsonium, mercury, hexavalent chromium, lead, cadmium, fluorine and so on. They are added or omitted in different water bodies. The evaluation adopts the method of comprehensive polluted indexes commonly used in many areas, and in this way, P——the annual average value of comprehensive polluted index is used to present the status of water environment quality. The higher the value of P is, the worse the water environment quality will be. To illuminate the process of its evolution, we take the seven years (1982 - 1988) before we started to set up the north Xinjiang railway as former period, take the four years (1989 - 1992) during which the railway was being built and joined up as latter period, we compare their average value of comprehensive polluted index over years——P, and we can see the evolution and evaluation of water environment quality of all main rivers from Table 2(Hao, 1991) and ground water environment quality of all main cities along the continental bridge from Table 3.

2. Analysis

According to the above evaluation, the status of water environment quality along the continental bridge usually is relatively good. Most water environment of both rivers and ground water are not substantially polluted. On the one hand, the rivers among the seven rivers which have large discharge such as Ürümqi River, Bortala River, Manas River and so on have strong dilute ability, their water quality are lightly polluted formerly, on the other hand, environmental protection was done well in the areas along the continental bridge, in addition to the progress of Three-North Shelter Forest Engineering in recent years, strengthening disposal of waste water and solid waste which caused water environment quality of most rivers to become better. So water environment quality of the seven rivers are mostly improved. But what is worth noticing is, large and small mountainous streams which are located along the northern foot of the Tianshan Mountains are concentrated in the lowlying land of the basin from south to north, which forms a centripetal water system without ways of draining water away. The pollutants in every water system are difficult to be drained out of water system. So to forbid strictly pollutants to drain into the surface water body is the important measures to be taken.

According to Table 3, the quality of ground water in every city is usually good. For one thing, rapid economic development in Ürümqi area causes over-exploitation of ground water re

Table 2 Evaluation and evolution of water environment quality of the main rivers along Xinjiang section of the new Eurasian Continental Bridge

River	Status of environment quality				Evolution of water environment quality	Four main polluntants			
	1982 – 1988		1989 – 1992						
	Average value $\bar{p}$	Status	Average value $\bar{p}$	Status		1	2	3	4
Guxiang	0.84	fairly clean	0.58	clean	improved	Hg	$NG_3 - N$	COD	BOD_5
Meiyaogou	1.42	lightly polluted	1.35	lightly polluted	lightly improved	Hg	$NH_3 - N$	BOD_5	Cr^{6+}
Urumqi	0.81	fairly clcean	0.61	clean	improved	pH	BOD_5	ArOH	COD
Santun	0.99	lightly polluted	0.78	fairly clcean	improved	$NO_2 - N$	ArOH	$NH_3 - N$	Hg
Manas	0.88	fairly clean	0.76	fairly clcean	improved	Hg	PH	COD	Cr^{6+}
Kuytun	1.60	medium polluted	0.85	fairly clean	substantly improved	Hg	$NH_3 - N$	PH	COD
Bortala	0.50	clean	0.64	clean	lightly declined	PH	$NH_3 - N$	F	Total hardness

Table 3 Evaluation and evolution of groundwater environment of main cities and towns along Xinjiang section of the new Eurasian Continental Bridge

City	Status of groundwater environment quality				Evolution of groundwater environment quality	Four main polluntants			
	1982 – 1988		1989 – 1992						
	Average value $\bar{p}$	Status	Average value $\bar{p}$	Status		1	2	3	4
Hami	0.52	lightly polluted	0.50	lightly polluted	improved	Total hardness	Cr^{6+}	F	ArOH
Turpan			0.77	lightly polluted		Total hardness	Ar^{6+}	pH	Cyanide
Urumqi	0.98	fairly clcean	1.21	medium polluted	declined	Sulphate	Total hardness	ArOH	Cyanide
Changji	0.55	lightly polluted	0.45	clean	improved	ArOH	Total hardness	$NO_2 - N$	pH
Shihezi	0.38	clcan	0.42	clean		Sulphate	Total hardness	pH	Cr^{6+}
Kuytun	0.73	lihgtly poluted	0.39	clean	improved	pH	Total hardness	$NH_3 - N$	F
Bole					no data				

sources for insufficient water supply. The utilization rate of ground water has reached to 120 percent, and consequently, ground water level is decline rapidly and water quality become worse; for another, Ürümqi has a development history of several years, and ground water has been polluted for a long time, so the ground water quality of Ü rümqi city has a substantial decline.

The fundamental reason that leads to the pollution of water environment is that the areas along the railway line in Xinjiang have high density of population and developed industry and agriculture, meanwhile, the fact that surface water and ground water from the same source favours transformation and utilization, but also cause related pollution. Therefore, we must pay more attention to comprehensive protection in future. We should carry out overall analysis according to the change law of environmental quality, the influence of pollutants on ecosystem, environmental capacity, and all factors that affect environment, at the same time, we should make economical, reasonable, efficient plan to control pollution and establish technological system of comprehensive protection on the basis of environmental monitoring and evaluation of environmental quality. We must unite proportion, layouts, management, protection of environment; enviromental disposal and human health and ecological balance; environmental disposal and economical factors; environmental protection and development of production closely(Xie, 1994). Furthermore, we must take measures related with laws, administration, economy, and engineering technology to resolve environmental problems. To maintain regular running of the continental bridge, we should do our best to improve environmental protection consciousness of the public, and strengthen protection of water sources areas and oasis eco-environment.

IV. PROTECTION OF WATER ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

The core of the China's 21st century environment strategy is the transformation from exterior environment to interior environment, that is, the transformation from the strategy, policy and management mode that environment and economy, environment and society, environment and resources not be considered together to the management mode of sustainable development that combine environment protection with development closely. From now to the 21st century, the pressure of China's environmental protection will be caused by growth of population, development of industry and agriculture, and urbanization(Liu, 1994), it is especially applicable in Xinjiang. The opening of the new Eurasian Continental Bridge brings about great opportunities for Xinjiang's economic development, but our future development must be on the basis of overall scientific proof and summary of past experience and lessons. Xinjiang, especially in the areas along the railway line in Xinjiang should be as follows. (1)The key factor that guarantees the sustainable development of the continental bridge and the areas along it is water environment. The areas along the railway line are the most developed economic belt of Xinjiang. However, many environmental problems have been caused in the course of the past economic development. For instance, occupation of ecological water leads to deterioration of eco-

environment, drainage of pollutants pollution of water quality has caused and so on. In additi on, the shortage of water resources has become the controlling factor of development of Ürümqi region and some other regions. So we must sum up past experience and lessons, work out a correct sustainable development strategy and industrial policy, do well in planning of river basin, and guarantee ecological water of oasis. The opening of the continental bridge bring about economic development of the areas along the railway line, but, consequently water demands of every city increase, meanwhile, there are potentially all kinds of factors that cause pollution of water environment. So the work we must do at present is to do well in comprehensive protection in order to ensure sustainable development in the Nine-Five Plan period and in the future. (2) Water conservancy facilities in the areas along the railway line is relatively perfect, and utilization rate of water resources is relatively high, but potentiality of water carrying capacity is limited, especialy in Ürümqi region. Therefore, we must pay equal attention to broadening sources and reducing expenditure. We must save water in development of agriculture and animal husbandry, at the same time, we should save water in industry and mining industry. Establishment of saving-water society in arid areas should be launched first in the areas along the continental bridge. (3) Two water bodies with most serious pollution in the areas along the continental bridge are Shuimo River in Ürümqi City and Jiahezi Reservoir near Shihezi City. They are being harnessing at present. Relative concentration of industry and agriculture in the areas along the continental bridge threatens water bodies greatly. We should protect water environment and water resources in agreement with laws under condition of the legal system being strengthened. (4) Alataw Pass located in Bortala region is the door that the new Eurasian Continental Bridge enters and goes out of China, it is also a famous wind gap. In recent years declining trend of Ebinur Lake in this region is distinctive. Uncovered silt at the bottom of the lake level increase the weather of sand storm and dust under the affection of wind. This will endanger directly the railway. So we should pay more attention to protection of Ebinur lake and the areas around it, and strengthen environmental protection of the door of our country.

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