CHINESE GEOGRAPHICAL SCIENCE
Volume 6, Number 2, pp. 185－191, 1996
Science Press, Beijing, China

ECOLOGIC ENVIRONMENT OF TARIM RIVER AND ITS PROTECTIVE PROGRAMME

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(Manuscript was received in July 1994)

ABSTRACT: Situated in the arid area in the inland of the Central Asia, the reaches of the Tarim River possesses unique natural conditions. Being one of the most concentrated *Populus euphratica* distributing areas, it is a comparatively big ecosystem. Due to the human effect during the recent 30 years, especially the lack of overall planning of exploitation and utilization of water resources and poor awareness of ecologic protection, resources of the whole reaches and its ecologic environment is deteriorating, which rouses the attention from home and abroad. The programme being carried out is based on protecting the ecologic environment of the reaches of the Tarim River. The task is to protect ecologic environment, improve and restore the existing natural vegetation in order to prevent land desertification.
KEY WORDS: Tarim River, ecologic environment, environmental protection

I. INTRODUCTION

The Tarim River is a famous inland river in the world, located in the Tarim Basin, Xinjiang, covers an area of 198×10^3 km^2 and runs 2,200 km from the origin of the Yarkant River to Taitmar Lake. The Tarim River, as we call it, is the river from the confluence of the Aksu River, the Yarkant River and the Hotan River to Taitmar Lake. The mainstream of Tarim River runs 1,280 km long. In the early years, all bigger tributaries could join the Tarim River and drain into Lopnur Lake finally. Because of the influence of human activities, especially the development of the large-scale reclamation after 1958, today there is no water in other branches flowing into the Tarim River except the three rivers mentioned above. Besides water is cut off in the Daxihaizi Reservoir at the lower reaches, the extension of the Tarim River has been controlled(Fig. 1)[1].

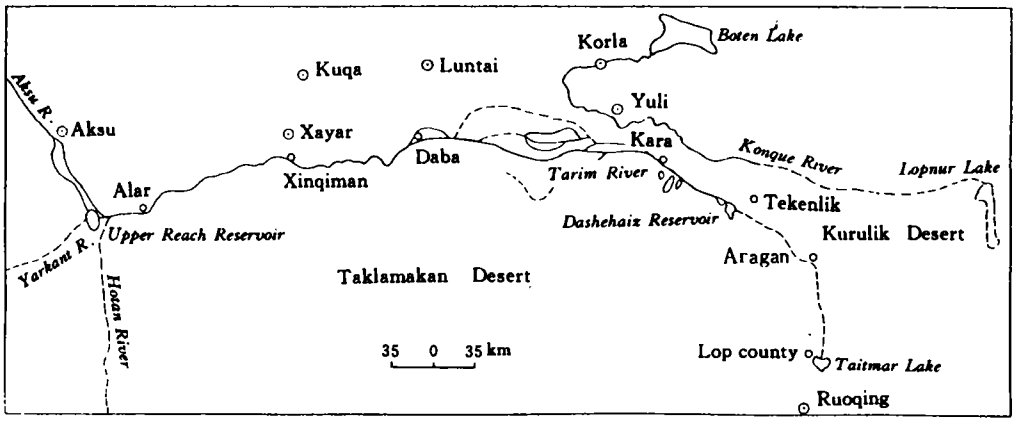

Fig. 1 Water system of the Tarim River

The Tarim River runs between the alluvial plain on the side of the Tianshan Mountains and the Taklimakan Desert and provides a natural defence to the attack of desert on the north side of the river. It plays an important role in keeping the ecologic environment of "The Green Corridor" at the lower reaches of the river in the desert. It serves both economic and strategic function. However, in the recent thirty years, there exist intricate contradictions between the upper and lower reaches for lack of overall plan on exploitation and utilization of the resources of the Tarim River and for lack of knowledge about the importance of keeping ecologic balance in the areas and the corridor passage so that the resources of the areas are becoming poorer and poorer and the ecologic environment is getting worse and worse. Therefore, we should make out plans and take immediate measures[2].

II. ECOLOGIC ENVIRONMENT

Because of its dryness no water is produced at the alluvial plain of the Tarim River. The flow of the Tarim River depends on the three branches at the upper reaches and is limited by exploitation and utilization of the upper sources. The surface flow of the whole valley is 196×10^8 m^3 but only 48.7×10^8 m^3 flows through the Alar Station, among which the Aksu River takes up 72.0%, the Hotan River 22.5% and the Yarkant River 5.5%[3], flooding water and return water from the irrigation field at the upper reaches feed the river. Between the flood and low water period there is a great disparity and concentration in the distribution of the annual runoff of the Tarim River. From this we draw a conclusion that the water diverted from the three rivers and the water discharged from the upper reaches decreased as the irrigation areas were

increasing[4].

Because of the increasing in water consumption along the main stream, water amount of Kara Station decreased by 8.5×10^8 m^3 from the 1950s to the 1980s. Having dammed in the Daxihaizi Reservoir, its sluice gate has already become the end of the Tarim River today. This man-made factor has made the river courses in the lower reaches of the Tarim River in Yinsu and Aragan dried up for many years. It covers 147 km between Aragan and Lop villages and Taitmar Lake dried up in 1974 although there was about $4\times10^8-5\times10^8$ m^3 water emptied into the lake in the 1950s, the roads and bridges in Lop village were flocked up by windy dust (Table 1)[5].

Table 1 Water in sections of the Tarim River (10^8 m^3)

	Alar	Xinqiman	Daba	Kara
$\overline{W}_1$(1958—1967)	51.45	43.93	31.82	11.88
$\overline{W}_2$(1978—1987)	46.76	36.83	26.67	3.38
$\overline{W}_1-\overline{W}_2$(reduce)	4.69	7.1	5.15	8.50
Reduce(%)	9.12	16.16	16.18	71.55

Degree of mineralization of water is constantly increasing with the decreasing of the water quantity of the Tarim River. Changes in the water quality are also the comprehensive reflection of natural water for irrigation in the reclamation areas of the upper reaches. The large amount of rich mineral saline water and the drainage water of irrigation flow into the river course. The effect of evaporation and concentration of water which is stored in the wide and shallow reservoirs, and the variation of water quality generally tend to be worse yearly (Table 2).

Because of the surface water unbalance caused by man-made activities after large-scale reclamation, various changes have taken place in the hydrogeological conditions of the irrigation areas. The decline of groundwater level of

Table 2 Water quality in sections of the Tarim River (observed in April 1988)

	Alar	Xinqiman	Daba	The mouth of the Patarm River
Mineralization degree(g/L)	5.80	5.57	5.24	4.08

the Tarim River is more obvious, most of which fell from 3—5 m in the 1950s to 6—11 m now. With the decline of groundwater level, the degree of mineral-

ization of groundwater rises evidently. The composition of the soil in the Tarim River basin is simple. Most of soils belong to hydromorphic soil except eolian soil. The soil formation and its variation have close connection with water content in the district. The erosion of soil becomes serious due to light soil, damaged vegetation and drought and frequent wind. The leading of a large quantity of surface water into irrigation areas has raised groundwater level but groundwater outside the irrigated areas has dropped because of the reduction of surface runoff.

Desertification is getting serious with its enlarging area and great damage. The whole basin is in the process of land desertification. The Green Corridor in the lower reaches is the most seriously desertified district. The green defence facing the Kuruk Desert which was several hundreds of kilometers long has been disappering. Every year the Green Corridor is swallowed by desert at the speed of 3—5 m. A large area of permanent dunes is being developed into the blowing ones. The areas of the Corridor are getting smaller and smaller, on some sections on the south of Aragan, the Kuruk Desert and the Taklimakan Desert has been joined together. The desertification area in the lower reaches amounts to 3,903 km^2, which takes up 66.1% of the total area. According to the analysis data from aerial photography taken in 1958, 1978 and 1983, we could see that the area of forest in Aragan district was decreasing at the speed of 40% during the five years from 1978 to 1983. The area of fixed and semi-fixed dunes is shrinking and the area of moving sand dunes is increasing greatly[6].

The alluvial plain of the Tarim River belongs to typical desert vegetation. Because of too many branches, xeric, psammophytic and halophilic plants develop well. All these form the unique natural landscape of the arid areas. Among these vegetation the old and exuberant *Populus euphratica* is one of the important shelter belt in Xinjiang, and also one of the large ecosystems in the Tarim Basin and the major distribution of forests in the world. After reclamation, *Populus euphratica* have been experiencing great changes. In 1958, the area of *Populus euphratica* on at both banks of the Tarim River was 40×10^4 ha. However, there was only 17.5×10^4 ha in 1978. The decreasing rate was 56.9%. The lower reaches was the most seriously damaged area of the forest. During the twenty years from 1958 to 1978, the area was cut down to 69.6%. According to statistics, the natural vegetation in the Tarim River basin is 110.18×10^4 ha (excluding desert vegetation), among which there are 29.8×10^4 ha of *Populus euphratica*, 17.85×10^4 ha of bush, 62.52×10^4 ha of grass. The ratio among arbor, bush and grass is 1 to 0.6 to 2.1. Moreover, the area of desert vegetation is $121.34\times10^4\times10^4$ ha. The area of artificial oases only

takes up 7.37×10^4 ha (Table 3).

Table 3 The area of the main natural vegetation in the Tarim River basin (except desert vegetation)

Vegetation	Upper (10^4 ha)	Middle (10^4 ha)	Lower (10^4 ha)	The whole basin		
				Area (10^4 ha)	Percentage in area of natural vegetation (%)	Percentage in area of the whole basin (%)
Populus euphratica	10.48	15.31	4.01	29.80	27.05	6.00
bush	10.30	6.80	0.77	17.86	16.21	3.60
grass	21.85	31.07	9.60	62.52	56.74	12.58
altogether	42.63	53.18	14.38	110.18	100	22.18

III. PLANNING FOR PROTECTION

The ecological environment in the Tarim River is getting worse. Its changing environment has drawn attention of people both at home and abroad. To protect the present natural vegetation and improve it as well as to prevent land from desertification are the targets of the planning.

We should follow the principles when we carry out the planning for protection for protection. Firstly, the area of land should be set on the basis of water. The protected area should meet with water quantity in the area. Secondly, some areas should be protected and some given up. The area consuming surface water should be the protected area, on the contrary, we should pay little attention to the area that does not consume surface water. Thirdly, we should make overall plans and take all factors into consideration. The actual need for water quantity in river sources, main streams, branches and those upper, middle and lower reaches of the main streams should be connected with production and ecological environment. Fourthly, protection should be combined with utilization. Natural vegetation can be restored by means of man-made measures, and ecological environment can also be protected with correct use of water resources. In a word, not only ecological environment but also practical conditions should be considered in carrying out the planning[7].

There should be a limit to the decrease of the present protected vegetation. There are 1.92×10^4 km^2 vegetation altogether, making up 38.8% of the total area of the basin. They are made of 1.1×10^4 km^2 grass vegetation and 0.82×10^4 km^2 desert vegetation. On the basis of the above mentioned areas, 396.6 km^2 of vegetation on the lower reaches of the Green Corridor should be

restored. About 10 to 40 km river sections on both sides of the main streams of the Tarim River (including branches), and one kilometre on both sides of the Green Corridor should be included in the protected areas. Particular protection areas should be the sections in the lower part of the river. Every year we must convey enough water to guarantee the plenty of surface water here in order to slow down the process of desertification and prevent vegetation from deterioration.

According to concerned data and the present water quantity, we can calculate how much water quantity will be needed by arbors, bushes and grass in the basin at present and in future. *Poulus euphritica* need 6,000 m^3 and 6,750 m^3 of water per hectare at present and in future respectively, bushes, 3,750 m^3 and 4,500 m^3 and grass, 3,750m^3 and 4,500 m^3. Based on this, water quantity consumed by the protected ecological areas can evaluated. The total water quantity in present period should be 53×10^8 m^3 at least, and in the future there should be about 63×10^8 m^3(including the corridor in the lower reaches). However water quantity available now totals less than 50×10^8 m^3. So we should convey water from other districts. Conveying water from the Yanqi Basin is the best way because of its plentiful underground water and the serious salinization of soil.

Because the distance between the two places is short, we can get quick results with less investment. As a result, the environment in both areas will be improved. The conveying water quantity is 3.5×10^8 m^3 at present and will be 4.5×10^8 m^3 in the future. But water only from the Yanqi Basin can not meet the actural need in the future. We can solve the problem by exploring other water resources, for example, we can convey 6×10^8 m^3 to 7×10^8 m^3 of water from the Aksu River.

Conveying water alternatively by means of double channels should be made annually not only in the lower sections of the middle reaches but also in the middle sections of the lower reaches. It can enlarge the protected areas and can also carry surface water into the lower reaches of the Green Corridor. The method can also be used in the tributaries of the middle reaches. In the process of carrying out the water distribution, the ecological environment will be improved quickly[8].

Today, the Environment Planning Bureau of the United Nations and the World Bank have granted a loan to develop agriculture and protect the ecological environment in the Tarim River basin. We will have troubles in the process of carrying out the planning, for instance, we are in short of money. No matter what difficulty we will try our best to carry out the planning for the protection and improvement of the ecological environment of the Tarim River.

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