# The Main Problems of the Water Ecological Environment and Protective Countermeasures in the River Basin of the Altay Region, Xinjiang

Authors: Yan, Qin, Aldyarhan, Kayrat, Zhe, Zhang, Peng, Liu, Hao, Liu, et al.

Source: Journal of Resources and Ecology, 14(2) : 383-390

Published By: Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences

URL: https://doi.org/10.5814/j.issn.1674-764x.2023.02.016

J. Resour. Ecol. 2023 14(2): 383-390
DOI: 10.5814/j.issn.1674-764x.2023.02.016
www.jorae.cn

# The Main Problems of the Water Ecological Environment and Protective Countermeasures in the River Basin of the Altay Region, Xinjiang

QIN Yan[1], KAYRAT Aldyarhan[2], ZHANG Zhe[1,*], LIU Peng[1], LIU Hao[1], LI Yuchen[1]

1. Chinese Research Academy of Environmental Sciences, Beijing 100012, China;
2. Landscape Forest Field Lake Grass Ecological Protection and Restoration Project, Pilot Project Headquarters, Office of the Irtysh River Basin in Xinjiang, Altay, Xinjiang 836599, China

**Abstract:** This study systematically sorted out the situation of the water ecological environment in the river basins of the Altay region, and analyzed the main problems that exist concerning water environmental quality, water ecology, water resources, and other aspects. The Altay region has three major river systems: the Irtysh River, the Ulungur River and the rivers of Jimunai County. The water environmental quality of major rivers in the region remained stable, and the total amount of water resources in the Altay region is at the forefront of Xinjiang. However, insufficient ecological flow in the Altay basin, serious water ecological damage and water environmental risks are still prominent. Based on the main problems which were identified and the distribution of the river system, the Altay region would be divided into four areas: the Irtysh River Basin, the Ulungur River Basin, the river basins of Jimunai County, and the desert control unit in the south, and the four areas was divided into eleven water ecological environment control units. In order to provide scientific and technological support for the improvement of the water ecological environmental quality of the river basins in the Altay region, general ideas and countermeasures are put forward for protecting the water ecological environment of the river basin from the three aspects of enhancing water pollution prevention and control, strengthening the protection of water resources, and reinforcing water ecological protection and restoration.

**Key words:** Altay region; water ecological environment; control units; key tasks

## 1 Introduction

Prior to the 13th Five-Year Plan period, China had successively formulated and implemented five phases of key river basin plans (Wang, 2020). The key river basin plans implemented during this period focused on improving water environmental quality and improving the physical and chemical indicators of water quality. Zhao et al. (2018) pointed out that accelerating the adjustment of water functional zones, revising water quality objectives by classification, and implementing precise treatments based on the targeted management of river water quality were the main work directions in Hebei Province during the 13th Five-Year Plan period. The current research on ecological environmental protection in river basins carried out by Chinese scholars also focuses on the improvement of water quality. Li (2021) systematically analyzed the evolutionary trend of water quality in the Yellow River Basin, the different characteristics of water quality in the trunk and tributaries of the Yellow River, and the social and economic factors causing those differences. Xiao et al. (2021) studied the characteristics of the spatiotemporal variations in the pollution load in the Tuojiang River Basin and estimated the pollution loads of total phosphorus (TP), total nitrogen (TN), ammonia nitrogen ($NH_3$-N) and chemical oxygen demand (COD) in the Tuojiang River Basin using the emission coefficient method. Wang (2020) evaluated the impact of "Five Water Treat-

**Received:** 2021-11-08 **Accepted:** 2022-03-15
**Foundation:** The National Natural Science Foundation of China (41701601, 41871196); The Scientific Research Project in Altay Region, Xinjiang Uygur Autonomous Region of China (2019-529).
**First author:** QIN Yan, E-mail: 1085402303@qq.com
***Corresponding author:** ZHANG Zhe, E-mail: zhangzhe@craes.org.cn

**Citation:** QIN Yan, Kayrat Aldyarhan, ZHANG Zhe, et al. 2023. The Main Problems of the Water Ecological Environment and Protective Countermeasures in the River Basin of the Altay Region, Xinjiang. *Journal of Resources and Ecology*, 14(2): 383–390.

ment" measures on the reduction of the water pollution load in the Yiwu River Basin.

In recent years, Chinese President Xi Jinping has repeatedly stressed the need to adhere to the goals of ecosystem protection and restoration. In the field of water ecology and environmental protection, it is necessary to implement strategies for the protection and restoration of water ecology and strengthen the protection of water resources on the basis of continuous improvements in water quality. In December 2019, the Ministry of Ecology and Environment issued the Technical Outline of the 14th Five-Year Plan period for Water Ecological and Environmental Protection in Key Basins (hereafter referred to as "the Outline"), which clearly proposed highlighting the overall planning of water resources, water ecology and the water environment, and achieving the goal of "there is both river and water, there is both fish and grass, and harmony between humanity and water" (Ma et al., 2020).

The Altay region is not only an important water source area and strategic reserve area of water resources in northern Xinjiang, but also a critical area for maintaining the water tower in northern Xinjiang and the "life river" in Xinjiang (Liu et al., 2021a). The water ecological environment of the river basin in the Altay region has been continuously improved. However, insufficient ecological flow in the river basin, poor local water environmental quality, and the destruction of water ecology are still prominent problems. Taking the solutions of water ecological environmental problems in the Altay region as the starting point, this paper advances the overall planning of water resource management, water pollution treatment and water ecological protection in different regions, and puts forward the countermeasures for the management of the river basin ecological environment in different regions in order to provide a reference for the decision-making regarding water ecological environmental protection in the Altay region.

## 2 Overview of the river basin in the Altay region

### 2.1 Main rivers and lakes in the Altay region

The Altay region has three major river systems: the Irtysh River, the Ulungur River and the rivers of Jimunai County. There are 272 rivers in the whole Altay region, 56 of which are larger rivers. The total annual runoff of these rivers is $12.3\times10^9$ m$^3$ (Liu et al., 2021a). The Irtysh River is the second largest river in Xinjiang. Its main stream is 546 km and its drainage area is about $97.2\times10^3$ km$^2$. The annual average runoff accounts for 91.5% of the total surface runoff in the Altay region, which is one-seventh of the total river runoff in Xinjiang (Wang et al., 2021a). The total length of the Ulungur River is 821 km from the source of Daqing River to Jili Lake, with a drainage area of $43\times10^3$ km$^2$ (Li et al., 2020). Jimunai Mountain Stream originates from the Musi Island glaciers, with a drainage area of 8000 km$^2$ and an average annual runoff of about $90\times10^6$ m$^3$ (Song et al., 2020).

The area of wetland in the Altay region is $190.5\times10^3$ ha, of which the lake wetland area is $116.5\times10^3$ ha. There are 21 lakes in the region with a water area greater than 1 km$^2$, among which Ulungur Lake and Kanas Lake are the most important lakes. Ulungur Lake is the tail of the Ulungur River and the second largest inland lake in Xinjiang. It is a typical faulted lake in the plains and basins of the inland arid area of Northwest China. It is composed of Ulungur Lake (also known as Brentuo Sea, Great Lake) and Jili Lake (also known as Khaole Lake, Small Lake) (Tian et al., 2021). Kanas Lake is the deepest ice-eroded and ice-stained alpine valley lake known in China, with an area of 5000 ha. Large areas of peat swamp are distributed in the valleys and depressions, high mountains and depressions, lakesides and riversides in the Kanas National Nature Reserve (Li et al., 2021).

### 2.2 Water environmental quality of the basin

During the 13th Five-Year Plan period, the water environmental quality of major rivers in the region remained stable. Irtysh River and Ulungur River have Class II water quality, and the water quality status is "excellent". The water quality levels of the Burqin River, Haba River, Kayerts River and other rivers meet Class II water quality standards. The water quality of Kanas Lake showed a trend of overall improvement, with the water quality improving from Class II to Class I, and the overall water quality status was "excellent". Ulungur Lake has had water quality below Class V for a long time, and it is severely polluted. The main over-standard factors of Ulungur Lake are fluoride, sulfate, chloride, and chemical oxygen demand (Ji, 2018).

### 2.3 Water ecology of the basin

The ecosystem structure of the Altay region is dominated by bare land and grassland. The areas of grassland ecosystem and ecological land (forest land, grassland, wetland, and water body) in the Irtysh River Basin account for 40.43% and 59.47% of the total area, respectively. Cultivated land in the Irtysh River Basin accounts for about 53% of the total cultivated land in the Altay region. The Altay region is a key area for cold-water fish development in Xinjiang. There are 24 species of indigenous fish in the Irtysh River, six of which are included in the list of key protected aquatic wildlife in the autonomous region. The results of an ecological health assessment of the key river basins in the Altay region show that the ecological health of the Irtysh River Basin tributaries are relatively good, and the ecological health of the main stream areas of the Irtysh River and the Kelan River are normal. The ecological health status of the middle and lower reaches of the Ulungur River Basin and the Ulungur Lake are poor.

### 2.4 Water resources of the basin

The total amount of water resources in the Altay region is at the forefront of Xinjiang. In 2016, the total amount of water

resources in the Altay region was $15.18\times10^9$ $m^3$. The average water volume per unit area of $1.285\times10^5$ $m^3$ $km^{-2}$ is higher than that of Xinjiang, at $6.65\times10^4$ $m^3$ $km^{-2}$. The Altay region is a water-rich area; however, the water resources are still relatively scarce compared with the national level of $3.43\times10^5$ $m^3$ $km^{-2}$ (He, 2017). Altay City, Beitun Town, and Fuhai County are connected by a dividing line, and the Altay region can be divided into two parts of equal area, east and west. The runoff of the rivers in the east is about $5.367\times10^9$ $m^3$, and the runoff of the rivers in the west is about $6.997\times10^9$ $m^3$. There is more water in the west than in the east, with less water in the south than in the north. The Jimunai area in the southwest has the least amount of water, with its runoff accounting for only 1.04% of the runoff in the Altay region.

## 3 Main ecological and environmental problems of the basin

The water ecological environment of the basin has been improving continuously. The concentration of fluoride and chemical oxygen demand, which have been the main over-standard factors at the national control section of Ulungur Lake, have been reduced. The water quality levels of the centralized drinking water sources in the Altay region have remained stable, and the water quality compliance rate of the centralized drinking water sources was maintained at 100%. However, insufficient ecological flow in the Altay basin, serious water ecological damage and water environmental risks are still prominent. 1) The overall water quality class and water quality status have remained unchanged. In 2019, the water quality of Ulungur Lake was still below Class V, with a "severely polluted" water quality status (Gao et al., 2020a; Gao et al., 2020b). 2) The Altay region is one of Xinjiang's water-rich areas, and it is responsible for supplying water to Karamay and Urumqi. The implementation of water diversion projects, an increase in industrial and agricultural development projects and inadequate engineering measures have led to inefficient water use and an obvious shortage of regional ecological water consumption. In some areas, some rivers have dried up, desertification appeared in valley forest areas, the desertification area increased, and the downstream wetland area decreased (Jiang et al., 2019). 3) The ecological risks of the river basin are becoming more and more prominent. The fish spawning grounds in the Irtysh River are becoming degraded and declining due to a significant change in the river level (Liu et al., 2021a; Liu et al., 2021b). According to the statistics, the reproduction of some indigenous fishes and rare species living in the Irtysh river and the Ulungur river basins has been severely affected, and some individual fish species are close to extinction (Sang, 2020; Yu, 2020). In addition, excessive interception, deforestation and overgrazing have led to the rapid decline and reduction of the water conservation functions of bottom land forest.

## 4 The general idea of water ecological environmental protection

Protection efforts would be focused on the prominent problems in the key basins of the Altay region related to their water resources, water environment and water ecology. They should be problem-oriented to establish the spatial management and control system of the river basin, according to the general idea of developing countermeasures in accordance with the actual situations of the different regions. The systematic nature, integrity and synergy of regional water environmental governance would be taken as guidelines for systematically designing targeted and differentiated mission measures and governance strategies.

### 4.1 Dividing the basin into different control units

Based on the distribution of the river basin and the main ecological and environmental problems faced by different regions, the Altay region would be divided into four areas: the Irtysh River Basin, the Ulungur River Basin, the river basins of Jimunai County, and the desert control unit in the south. The Irtysh River and the Ulungur River have been further refined. Specifically, the Irtysh River Basin was divided into the six control units of Kelan River, Beitun Bridge, Fuyun Bridge, Burqin River, Haba River, and Berezek River. The Ulungur River Basin was divided into the three control units of Dingshan Section, Fuhai Section and Ulungur Lake. Guided by the main ecological and environmental issues of the different control units and combined with water environmental quality, ecosystem characteristics and pollutant emissions, differentiated key tasks and engineering projects can be formulated (Table 1).

Table 1 The division of basin control units in the Altay region

| Serial number | Main area | Control unit |
|---|---|---|
| 1 | Irtysh River Basin | Fuyun Bridge |
| 2 | | Beitun Bridge |
| 3 | | Cran River |
| 4 | | Burqin River |
| 5 | | Haba River |
| 6 | | Berezek River |
| 7 | Ulungur River Basin | The river basin above the Dingshan section |
| 8 | | The river basin below the Dingshan section |
| 9 | | Ulungur Lake |
| 10 | The river basin of Jimunai County | – |
| 11 | The Southern Desert | – |

### 4.2 Technical route

(1) Data collection and field investigation. The data for key river basins in the Altay region would be collated and analyzed. The experiences and effects of water ecological environment protection during the 13th Five-Year Plan period would be summarized. The aquatic ecological envi-

ronments of the key river basins would be sorted out and field surveys would be carried out based on the data.

(2) Analysis of water ecological environmental problems. The most prominent water ecological environmental problems of key river basins would be the focus. The water ecological environmental problems would be carefully sorted out and systematically analyzed to comprehensively understand the main problems and prominent contradictions of the ecosystem in the basin (Ma et al., 2020; Wang et al., 2021b).

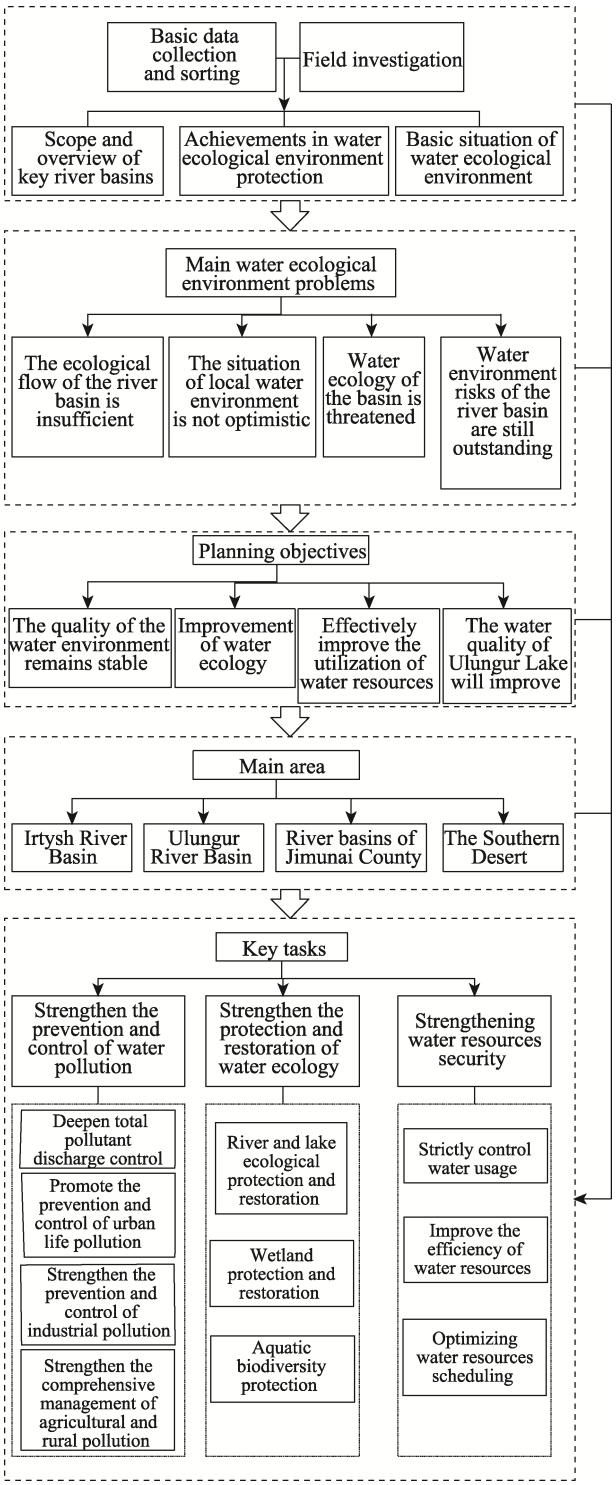


Fig. 1 Technical roadmap of water ecological environmental protection in the Altay region

(3) Determine the protection target. A medium and long-term target index system should be scientifically and reasonably formulated on the basis of the new situation and new requirements (Tian and Deng, 2021).

(4) Divide the basin into different control units. According to the prominent ecological environmental problems and the main ecological function orientations, the ecological environment protection space of the river basin would be divided into different regions.

(5) Clarify the key tasks and measures. According to the causes of the water ecological environmental problems and protection objectives in the basin, the key tasks and measures for ecological environmental protection in the basin would be put forward. At the same time, it would be necessary to also put forward the relevant safeguard measures, implement the main responsibilities, build a long-term mechanism and strengthen public supervision (He et al., 2019; Ma et al., 2020).

## 5 Countermeasures of water ecological environmental protection in the river basins

In order to adhere to the problem orientation and goal orientation, the prominent water ecological environmental problems of water resources, the water environment and water ecology in key river basins of the Altay region could be sorted out and analyzed. The solutions for the water ecological environmental problems could be taken as the starting point and according to the division of river basin control units, countermeasures could be proposed from three aspects: enhancing water pollution prevention and control, strengthening water resource protection, and intensifying water ecological protection and restoration.

### 5.1 Strengthen the prevention and control of water pollution

The shortcomings of water environmental quality in the key basins of the Altay region still exist. Ulungur Lake is one of the key basins in the Altay region. Over the years, the Altay region has continued to regulate and protect the Lake, although its water environment quality has not significantly changed thus far. In view of the water quality problem of Ulungur Lake, efforts should be undertaken to implement serious protection of the ecological environment of Ulungur Lake. In addition, comprehensive measures such as control the source of pollution, pollution interception, ecological restoration and sediment dredging should be adopted to effectively improve the water quality standards in the region (Gao et al., 2020a).

#### 5.1.1 Strengthen control of total pollutant discharge

(1) Strengthen and clarify the pollution receiving capaci-

ty in accordance with management requirements. Pollution management should be strictly implemented and there should be no approval for the building of new sewage outlets into rivers other than the urban centralized domestic sewage treatment facilities.

(2) Strictly implement the pollutant discharge permit system. The "double reduction" of pollutant increase and storage should be carried out to full execution.

(3) Ensure that all parties fulfill their responsibilities for ecological protection. It will be necessary to clarify the pollutant discharge control measures and environmental management requirements.

#### 5.1.2 Promote the prevention and treatment of urban household pollution

(1) Strengthen the construction and transformation of urban sewage treatment facilities. Speed up the second-phase expansion of the sewage treatment plant and sewage reuse project in Altay City, and accelerate the construction of sewage treatment plant projects and sewage reuse system projects in all counties.

(2) Strengthen the supervision of the inflow and outflow of sewage treatment plants. Fully implement the permit system for sewage discharge into the drainage pipe network, and encourage and support the reform of sewage treatment charges and the sewage industrialization system.

(3) Comprehensively strengthen the construction of the supporting pipeline network. Promote the construction of new-type community sewage collection systems in towns and villages, and accelerate the construction of sewage collection, treatment and supporting pipeline networks in major scenic spots.

#### 5.1.3 Strengthen the prevention and treatment of industrial pollution

The construction of centralized water pollution control facilities in industrial parks such as Jimunai County Border Economic Cooperation Zone, Heilongjiang-Fuyun Industrial Park, Qinghe County Industrial Park, Altay Fuhai Industrial Park, and others should be accelerated. The building of all newly-built enterprises that emit pollutants must be arranged in corresponding industrial parks. Industrial wastewater in the industrial parks must be pretreated to meet the requirements for centralized treatment before it can be discharged into the centralized sewage treatment facility.

#### 5.1.4 Strengthen the comprehensive control of agricultural and rural pollution

Strengthen the comprehensive management of agricultural and rural pollution in the Altay region.

(1) In order to rationally plan the distribution of livestock and poultry breeding, the areas where it would be forbidden and restricted should be scientifically delineated. At the same time, it is necessary to vigorously develop ecological animal husbandry and publicize a technical model for the comprehensive utilization of livestock and poultry manure according to local conditions in order to promote the transformation and upgrading of animal husbandry.

(2) Control agricultural non-point source pollution. Establish a scientific fertilization management system and a technical system, and carry out the green prevention and control of crop diseases and insect pests. Focusing on Altay City, Qinghe County and Jimunai County, demonstration parks for integrated pest management and green prevention and control should be built.

(3) Construct ecological ditches, sewage purification ponds, surface runoff storage tanks and other facilities in the large and medium-sized irrigation areas that are in sensitive areas, such as the Irtysh River and Wulungu River Basin, in order to purify farmland drainage and surface runoff and achieve comprehensive utilization.

(4) Promote healthy aquaculture and strengthen the standardized transformation of aquaculture ponds around Wulungu Lake in Fuhai County.

### 5.2 Strengthen water resources protection

Due to the implementation of projects in the Altay region to supply water to other regions, the overall water efficiency of the region is not high, resulting in water shortage in the Altay region. The regional water shortage has led to an obvious shortage of ecological water supply. Parts of the rivers have dried up, the area of desertification and desertification in the valley forest area have increased, and the area of downstream wetlands has shrunk. The above-mentioned problems could be solved by improving the utilization rate of water resources in the Altay region, rationally distributing production water and ecological water, and improving the quality of industrial and agricultural development.

#### 5.2.1 Strictly control the consumption of water resources

Strictly control the water consumption in the Altay region. The supervision and management of water intake permits should be comprehensively strengthened. The management of planned water use, metered water use, and quota water use should be continuously promoted. It is necessary to promote the clean-up and standardization of agricultural water and groundwater extraction permits. The distribution of river water should be accelerated to implement the control indicators for the total amount of water use in the river basins and major water sources.

#### 5.2.2 Improve the utilization efficiency of water resources

Improve water resource use efficiency in the Altay region.

(1) Agriculture and animal husbandry are the main industries in the Altay region, so strengthening the water conservation in agriculture and animal husbandry is of great significance. The construction of high-standard farmland should be accelerated and the level of irrigation management should be continuously improved. It should be adapted to local conditions to achieve an efficient water-saving transformation, planting structure adjustment, etc. The comprehensive reform of water prices in agriculture and animal husbandry should be gradually promoted, and the

awareness of water conservation among farmers and herdsmen should be improved. The transfer of land should be accelerated and the development of large-scale and intensive water conservation should be promoted in agriculture and animal husbandry.

(2) Generate a list of the enterprises and products in the high water-consuming industries in the region, and the water intake quotas for high water-consuming industries in the region should be formulated.

(3) Support recycled water utilization facilities and build reclaimed water reuse facilities in Burqin County and Qinghe County, and increase the recycling rate of recycled water from sewage treatment plants. In addition, strengthen the recycling of industrial water and encourage the advanced treatment and reuse of wastewater from non-ferrous metal high water-consuming enterprises.

#### 5.2.3 Optimize the dispatch of water resources

The regulation of water resources in the Altay region should be optimized. On the basis of ecological flow, while ensuring the advancement before flood storage, the relationship between water resource utilization inside and outside the basin should be coordinated. In addition, the planning and management of water resource development should be further strengthened. It is necessary to enhance the control of the total amount of water withdrawal in the river basins and regions in order to realize the optimal allocation of water resources. Measures such as sluice and dam linkage and ecological water replenishment could be taken. By rationally arranging the amount and timing of water discharges from the sluices and dams, the basic ecological water requirements of the Ulungur River, Ulungur Lake and other rivers and lakes could be maintained. The ecological base flow in the dry season needs key protection. Under special circumstances, such as an imbalance in the hydrological relationship between the lake and the Jili Lake, and the flocculation of water and salt characteristics, an emergency dispatch plan should be formulated.

### 5.3 Strengthen the protection and restoration of water ecology

#### 5.3.1 Protect and restore the ecology of rivers and lakes

(1) Protect and restore the ecological spaces in rivers and lakes. Combined with the ecological protection red line in the Altay region, the overall arrangement is delineated, and the proposed water ecological space should be around the shoreline spaces of rivers, lakes and other water areas and the land wading ecological space for water conservation and soil conservation (Liu et al., 2019). Focusing on the hardening, channelization, and straightening of the river and lake shores, which will affect the health of the water ecosystem, the construction of riverside and lake vegetation buffer zones and the construction of ecological wetlands inside and outside the rivers and lakes should be carried out to improve the river landscape pattern. Restore the forests and grasses in river valleys.

(2) Implement the ecological submerged irrigation system and implement flood irrigation in the lower reaches of the Irtysh River. These steps would meet the environmental requirements for the growth of forests and grasses in the valley, the water supply requirements for wetlands and the environmental requirements for fish spawning and reproduction, and restore the ecological functions of the basin buffer zone. Strengthen data monitoring and scientifically evaluate the effect of flood irrigation.

#### 5.3.2 Protection and restoration of the wetland ecosystem

(1) Increase the protection of wetland resources. Focusing on wetland nature reserves such as Kanas, Burgen, Kekesu, and Keketuohai, increase investment in wetland protection and construction. Through the combination of spring flood water replenishment and cross-basin water replenishment, carry out the supplemental irrigation of water-deficient wetlands. Implement the transformation of the Ulungur River into the lake delta wetland park system protection project.

(2) Restore wetland aquatic plants, and artificially introduce and cultivate large submerged plants. Reduce the degree of oxidation in the water body, and implement projects such as reed lake ecological three-dimensional aquaculture, ecological planting experiments and wetland boundary ecological protection to improve the self-purification capacity of water bodies.

(3) Reduce human interference. Implement the wetland ecological migration project in the upper reaches of the Ulungur River in Qinghe County. Relocate the population of the river valley wetland and restore the river valley wetland area (Jiang et al., 2019).

(4) Restore the ecological shorelines of Ulungur Lake and other key lakes. Through a comprehensive clean-up of the shorelines, while implementing the simultaneous restoration of construction, conversion of farmland to wetland and return of grazing land to wetland, this will protect and restore the lakeside buffer zone and enhance the function of the coastline ecosystem.

#### 5.3.3 Protection of the aquatic biodiversity

(1) Protect and restore biological habitats. The restoration of habitat ecosystems and riverbed sediments should be carried out around the biological habitats of endangered and protected fish, such as spawning grounds and feeding grounds, as well as damaged important biological habitats to achieve diversity protection and restoration. In combination with the beaver and its habitat protection project, the protection of rare species would be strengthened.

(2) Carry out reasonable multiplication and discharge. There is hope for strengthening the monitoring of germplasm resources and actively carrying out the breeding and release throughout the whole basin, mainly using local indigenous and economic fishes such as Altay duke, perch, and sticky perch (Yu, 2020).

(3) Establish protection zones for aquatic biological resources. One potential option is to establish a fish nature reserve in the section from Keketuohai Town to Fuyun County in Fuyun County on the upper reaches of the Irtysh River with high fish diversity.

(4) Improve the fishing moratorium and prohibition system. The ban on fishing in natural waters in the Altay region should be strictly implemented, and a specific work plan should be formulated for a comprehensive ban on fishing in the region.

## 6 Conclusions

Located in the hinterland of the Eurasian continent, the Altay region plays a significant role in the "Silk Road Economic Belt". It has a special strategic position in the pattern of China's opening up to the outside world. The Altay region is an important water source in northern Xinjiang. The numerous glaciers, rivers and lakes in the region provide an important guarantee for the production and living water which nourish the desert oasis in the river valley, and they also provide an important water source for Karamay City, Urumqi City and its surrounding areas. In the future, the Altay region can supply water to Hami and parts of southern Xinjiang. The Irtysh River Basin is one of the focus areas of cross-border water security and an important area related to China's ecological rights and interests.

The 14th Five-Year Plan period is the key period for achieving a victory in the battle for pollution prevention and control and for promoting the construction of beautiful China. Therefore, protection of the water ecological environment should be further promoted in the Altay region. In the basins, the Irtysh River, Ulungur River, Ulungur Lake and other lakes should be protected and improved. By comprehensively analyzing the current situation and existing problems of water resources, the water environment and water ecology, the main problems of the water ecological environment of the river basin in the Altay region, including insufficient ecological flow, poor local water environment quality, destruction of water ecology and water environment risks, are still prominent. Therefore, it is necessary to adhere to the problem-oriented and target-oriented approach to reasonably determine the objectives and assessment indicators of water ecological environmental protection; scientifically divide watershed protection and restoration control units; control the total amount of pollutants discharged, and strictly prevent and control urban domestic pollution, industrial pollution, agricultural and rural pollution; strictly control the use of water resources and improve the efficiency of water resources; and strengthen ecological protection and restoration of rivers and lakes, and earnestly carry out biodiversity protection. By improving the ecological compensation, river space management and control, pollution discharge permits and other institutional mechanisms a beautiful Altay region can be created with "there is both river and water, there is both fish and grass, and harmony between humanity and water".

## References


Gao F, He B, Yan Z, et al. 2020a. Analysis of the changes and driving force of the water area in the Ulungur Lake over the past 40 years. *Aqua*, 69(5): 500–510.

Gao F, Zou L, Sun X Y. 2020b. Analysis of the spatial characteristics of Ulungur Lake water quality based on improved comprehensive water quality index. *South-to-North Water Transfers and Water Science & Technology*, 18(1): 141–151. (in Chinese)

He B. 2017. Total evaluation and predictive analysis of water resources in Altay of Xinjiang. *Energy and Energy Conservation*, (10): 103–104. (in Chinese)

He Y J, Xiao Z H, Hu X Y. 2019. The impact of the implementation of the comprehensive planning of the Ecuadorian basin on the ecological environment and the countermeasures. *Environment and development*, 152(3): 191–192. (in Chinese)

Ji F F. 2018. Changes in water quality and analysis of underlying causes in Ulungur Lake. *Journal of Hydroecology*, 39(3): 61–66. (in Chinese)

Jiang X X, Huang J, Zhang Y, et al. 2019. Impact analysis of hydrological regime changes in Irtysh River Basin valley ecosystem and suggestions for ecological restoration. *China Rural Water and Hydropower*, (10): 16–20. (in Chinese)

Li X J, Jia P Y, Niu C Y, et al. 2020. Species diversity of freshwater fish and assessment on watershed health in the Irtysh River and Ulungur River basins in Xinjiang, China. *Biodiversity*, 28(4): 25–37. (in Chinese)

Li Y, Liu Y J, Zhang Q, et al. 2021. Research on ecological protection and restoration measures in Altay region based on the coupling perspective of the Mountains-Rivers-Forests-Farmlands-Lakes-Grasslands system. *Journal of Resources and Ecology*, 12(6): 791–800.

Li Y H. 2021. Study on water pollution control of mainstream and branches in the Yellow River Basin. *Economic Problems*, (5): 9–15. (in Chinese)

Liu H, Shu C, Zhou T T, et al. 2021b. Trade-off and synergy relationships of ecosystem services and driving force analysis based on land cover change in Altay Prefecture. *Journal of Resources and Ecology*, 12(6): 777–790.

Liu H C, Fan J, Liu B Y, et al. 2021a. Practical exploration of ecological restoration and management of the Mountains-Rivers-Forests-Farmlands-Lakes-Grasslands system in the Irtysh River Basin in Altay, Xinjiang. *Journal of Resources and Ecology*, 12(6): 766–776.

Liu S D, Liu L, Zhang J J, et al. 2019. Study on ecological protection and restoration path of arid area based on improvement of ecosystem service capability: A case of the ecological protection and restoration pilot project area in Irtysh River Basin. *Acta Ecologica Sinica*, 39(23): 8998–9007. (in Chinese)

Ma L K, Xie Y C, Wen Y L, et al. 2020. Keynotes of making the 14th Five-Year Plan for water ecology and environment protection in key river basins. *China Environmental Management*, (4): 40–44. (in Chinese)

Sang C. 2020. Water quality evaluation of the Irtysh River in Xinjiang based on water quality index and biological integrity index (weekly clump algae and benthic animals). Diss., Wuhan, China: Huazhong Agricultural University. (in Chinese)

Song M Y, Li Z Q, Wang F T, et al. 2020. Hydrogen and oxygen isotopes and hydrochemical parameters of water samples from the Jimunai River Basin, Xinjiang. *Environmental Chemistry*, 39(7): 1809–1820. (in Chinese)

Tian J, Xiong J N, Zhang Y C, et al. 2021. Quantitative assessment of the

effects of climate change and human activities on grassland NPP in Altay Prefecture. *Journal of Resources and Ecology*, 12(6): 743–756.

Tian Z Q, Deng Y X. 2021. The pilot program of "14th Five-Year Plan" for water ecological environment protection and its enlightenment to the compilation of river basin planning. *China Environment*, (8): 33–34. (in Chinese)

Wang B X, Cheng W M, Lan S X. 2021a. Impact of land use changes on habitat quality in Altay region. *Journal of Resources and Ecology*, 12(6): 715–728.

Wang C, Yang F, Huang Z H, et al. 2021b. Study on the impact of the five water treatment action on water pollution load reduction in Yiwu River. *Chinese Journal of Environmental Engineering*, 15(4): 1157–1166. (in Chinese)

Wang J N. 2020. We will work out the Fourteenth Five-Year Plan for key river basins, which will be effective and effective in solving problems. *China Environment News*, 2020-04–27(003). (in Chinese)

Xiao Y T, Chen S, Fan M. 2021. Spatiotemporal variation of pollution load in Tuojiang River Basin. *Acta Scientiae Circumstantiae*, 41(4): 1–15. (in Chinese)

Yu X F. 2020. Current status and protection measures of fishery resources in Wulungu Lake. *Heilongjiang Fisheries*, 39(3): 8–9. (in Chinese)

Zhao S C, Chen X R, He X D. 2018. Suggestions on water pollution prevention and control during the 13th Five-Year Plan in Hebei Province. *Energy Conservation*, 37(6): 112–114. (in Chinese)

# 新疆阿勒泰地区流域水生态环境的主要问题与保护对策研究

秦　岩[1]，海拉提·阿力地阿尔汗[2]，张　哲[1]，刘　鹏[1]，刘　浩[1]，李毓琛[1]

1. 中国环境科学研究院，北京 100012；
2. 新疆额尔齐斯河流域山水林田湖草生态保护修复工程试点项目科技专家办，新疆阿勒泰 836599

**摘　要：**本文首先系统梳理了阿勒泰地区流域水生态环境状况，分析了阿勒泰地区水环境质量、水生态、水资源等方面存在的主要问题。阿勒泰地区主要有额尔齐斯河、乌伦古河和吉木乃县诸河三大河流水系。地区主要河流水环境质量总体保持稳定，水资源总量位于新疆前列，但还存在流域生态流量不足、水资源开发与保护矛盾未得到有效化解、水生态破坏问题仍然严重、水环境风险依然突出等问题。然后以问题为导向，结合流域水系分布，将阿勒泰地区划分为额尔齐斯河流域、乌伦古河流域、吉木乃县诸河流域和南部荒漠区共计 4 个区域，并将 4 个区域进一步划分为 11 个水生态环境控制单元。依据阿勒泰地区流域水生态环境现状和存在的问题，从加强水污染防治、强化水资源保障、加大水生态保护修复力度等层面，提出流域水生态环境保护的总体思路和对策建议，以期为改善阿勒泰地区流域水生态环境质量提供科技支撑。

**关键词：**阿勒泰地区；水生态环境；控制单元；重点任务