

Study on River's Ecological Restoration and Water supply in the Dongliao River basin

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- Overview of the basin
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1. Excessive development of water resources

In history even 62% of the Surface water was consumed by the demands for life, industry and agriculture with a low efficiency. Water shortage and conflict in water demands lead to excessive development of water resources.

2. Ecological water cannot be guaranteed

Due to the increasing water consumption, drought and incorrect scheduling schemes of the reservoir, the river could be dried up even cut off from time to time since the 1980s.

3. Water pollution

The water quality has deteriorated significantly in recent years. Dongliao River was in the Comprehensive water environment control plan for key river basins in the "Fourteenth Five-Year Plan".

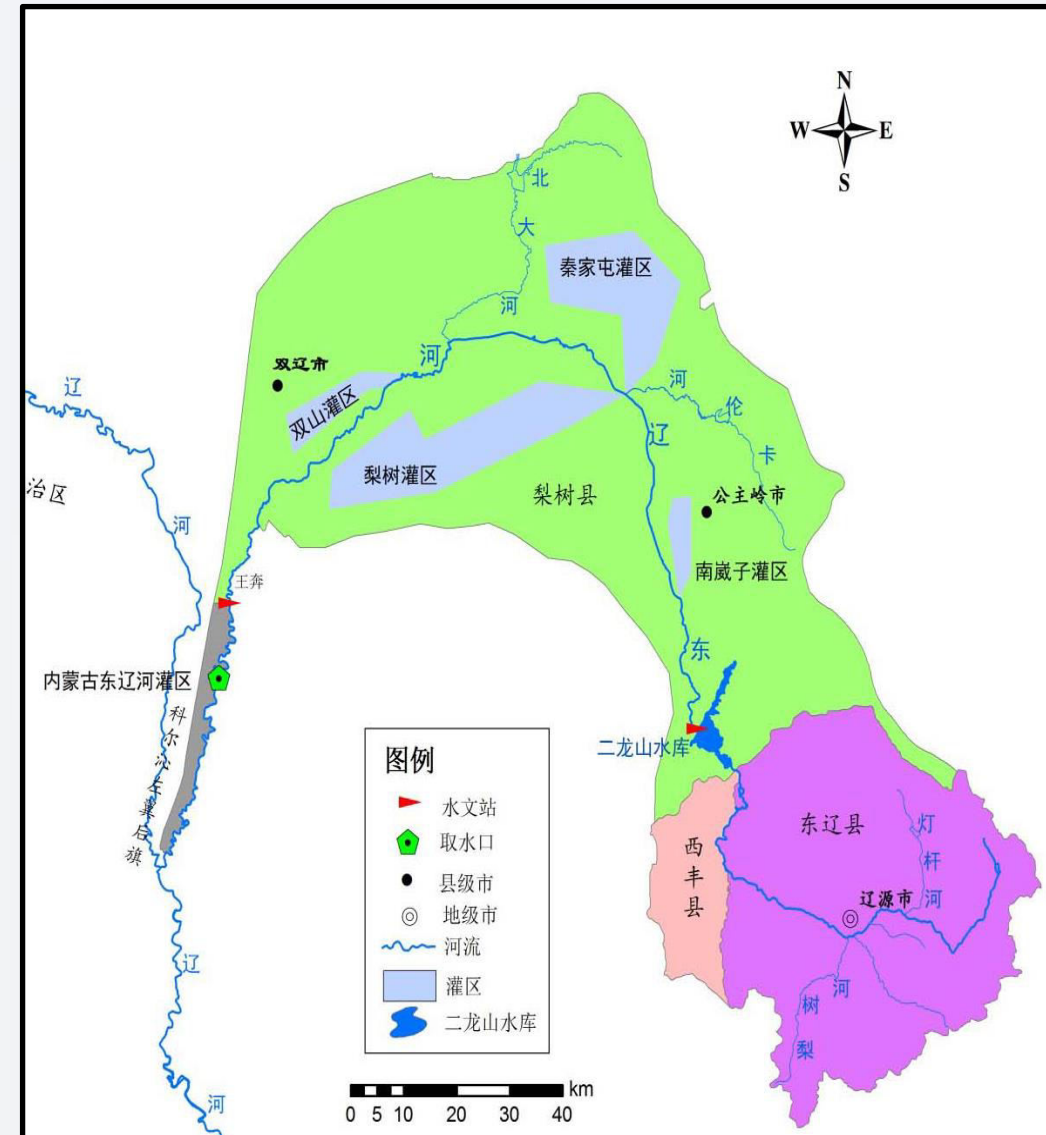


Figure 2 dispatching project and water resource zoning map

1. For the basin: Water Quantity Allocation Scheme

Red line of the total water use, the ecological flow in the river, the discharge water volume of the cross-section.

Table 1 the total water use

province	In prediction	
	Distribution of water	water consumption
Jilin	4.3	3.38
Liaoning	0.11	0.07
Inner Mongolia	0.28	0.25
amount to	4.69	3.7

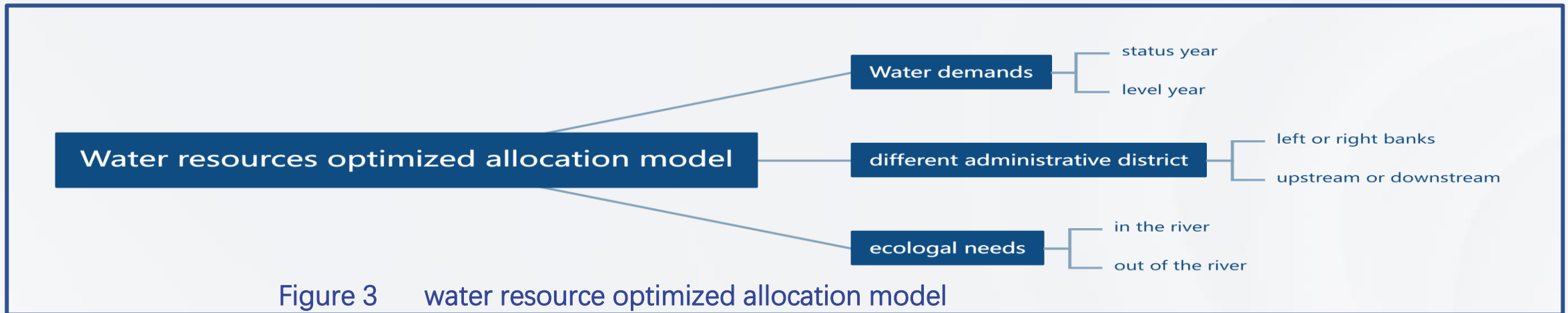


Figure 3 water resource optimized allocation model

Table 2 the ecological flow in the river

control section	Non-flood period(April to May, October to November) (P=90%, m ³ /s)	Flood period(June to September) (P=90%, m ³ /s)	Freezing period(a hundred million m ³)
Erlongshan Reservoir	2.88	4.45	0.77
Wang Ben	4.98	7.45	1.31

Table 3 the discharge water volume of the cross-section

control section	Inprediction
ErlongshanReservoir	3.21
WangBen	4.1
Watershed outlet	3.85

2. For the reservoirs and water transfer projects: dispatching rules

3. For the ecological water demand: ecological flow guarantee scheme.

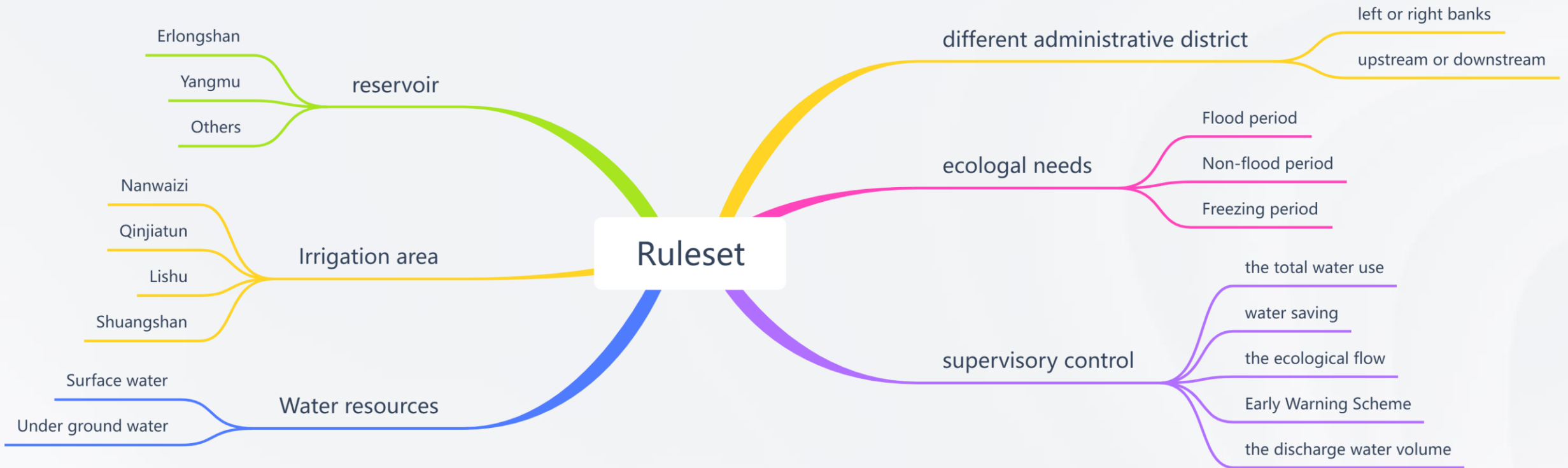


Figure 4 dispatching ruleset

4. For the implementation: Annual scheduling plan

- (1) Water resource scheduling and management mechanism.
- (2) Different responsibilities and scheduling authorities of basin management institution, provinces, cities, and counties.
- (3) Water use plan management, dynamic adjustment management, control section monitoring management, process supervision and inspection.
- (4) Annual scheduling, monthly correction and ten-day rolling adjustment.
- (5) Execute scheduling plan every October, summarize after the scheduling period ends.

1. The ecological flow was nearly 100% guaranteed during 2021~2022 scheduling period in contrast to the lowest rate 20% in the freezing period during 1980~2016.
2. The water resource management measures has been applied to the Dongliao River Basin since the winter of 2018. From 2019 to 2022, inferior V water bodies have been eliminated, the effect of water quality improvement has been significant.

Table 4 Degree of ecological base flow guarantee of the control section from 2021 to 2022

Control section		In 2021			In 2022								
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep
Erlongshan Reservoir	objective (m ³ /s)	1.45	1.45	1.45	1.45	1.45	1.45	2.88	2.88	4.45	4.45	4.45	1.45
	reality(Guarantee rate of%)	100	100	100	100	100	100	93.3	100	100	100	100	/
Wang Ben	objective (m ³ /s)	3.53	3.53	1.45	1.45	1.45	1.45	4.98	4.98	7.45	7.45	7.45	4.45
	reality(Guarantee rate of%)	100	100	100	100	100	100	94	100	100	100	100	/

Note: The implementation of the ecological base flow target is evaluated from October 2021 to August 2022.

Table 5 Water quality status of the state-controlled monitoring section of Liaohe River Basin, Jilin Province

year	I~III	IV	V	inferior class V
2017	11.10%	11.10%	22.20%	55.60%
2018	11.10%	33.30%	11.10%	44.50%
2019	—	33.30%	50.00%	16.70%
2020	50%	50%		
2021	75%	16.70%	8.30%	
2022	83.30%	8.30%	8.30%	

- 1. Water shortage, Water demands conflict, Water pollution were the common problems in the Northern China. Study on River's Ecological Restoration and Water supply was a method to taking all factors into consideration, including water demands in and out of river, water demands between urban and rural areas, water demands for life, industry and agriculture, and provided a way to continuously improve water environment quality.**
- 2. Water environment, water resources and water ecology were an organic whole in our research, but we made water resource as the principal line. Our study was divided into four hierarchy during implementation phase.**
- 3. The study played an important role in Rigid constraint of water resource, and made the promotion of efficient use of water resources, ensure the ascending of the water environment quality.**
- 4. The water ecology and water environment problems in the Dongliao River were caused by long-term comprehensive reasons. At present, through joint water resources dispatching and water ecological restoration, good results have been achieved in the Dongliao River, but problems of water shortage are still exists. Water diversion projects are still necessary.**