

Groundwater Sustainable Development in China

中国地下水可持续开发利用

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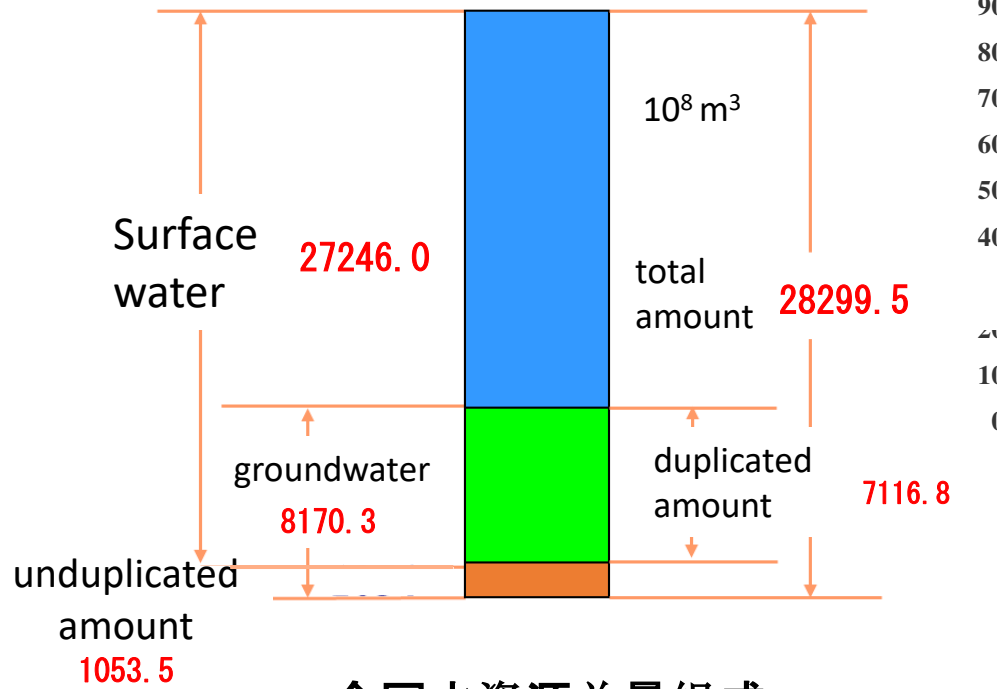
水利部水利水电规划设计总院

September 2023, Beijing

1. Groundwater Resources in China

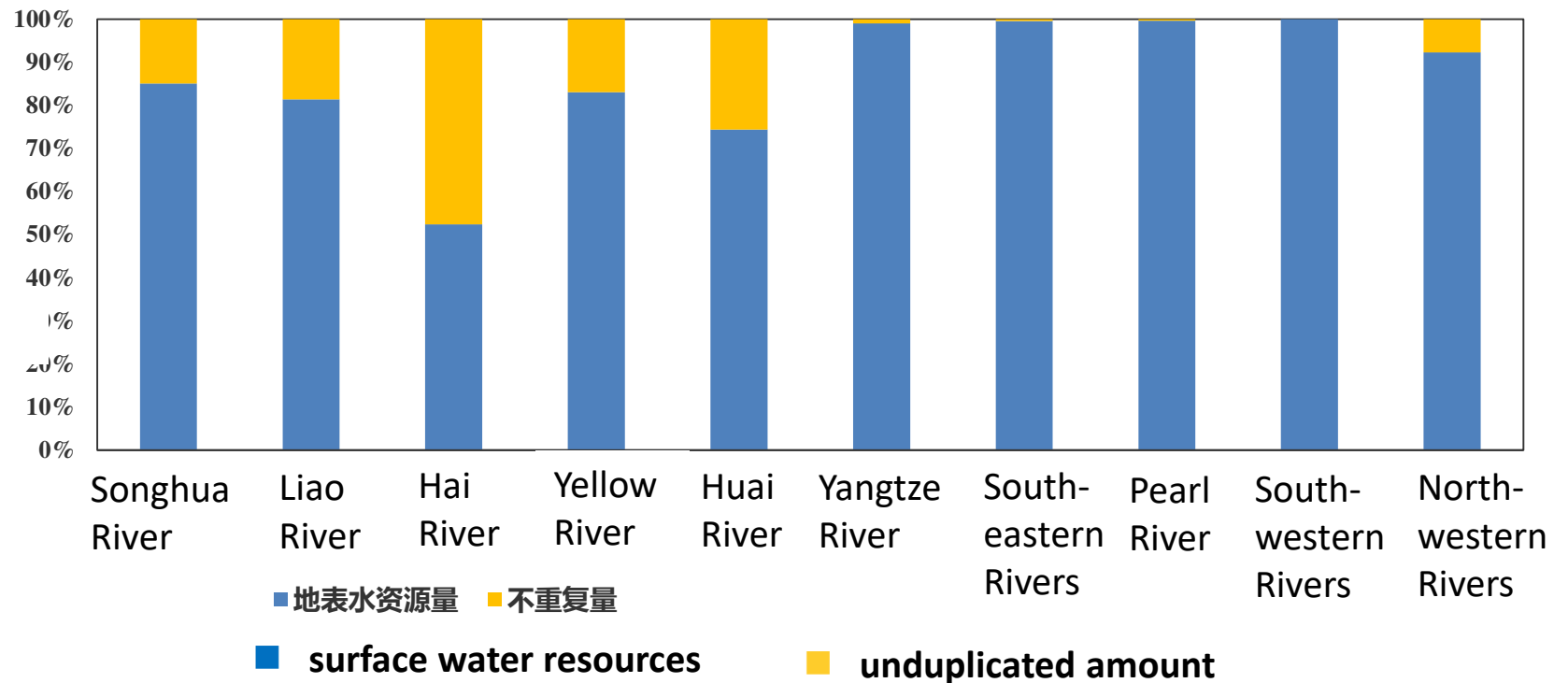
Amount

□ National total: the amount of groundwater resources is about 820 billion m³/a, accounts for 30% of the total water resources. 全国地下水资源量为8200亿m³, 占水资源总量的30%。



全国水资源总量组成

Total national water resources composition



水资源一级区水资源总量组成

water resources composition in 1st level basin

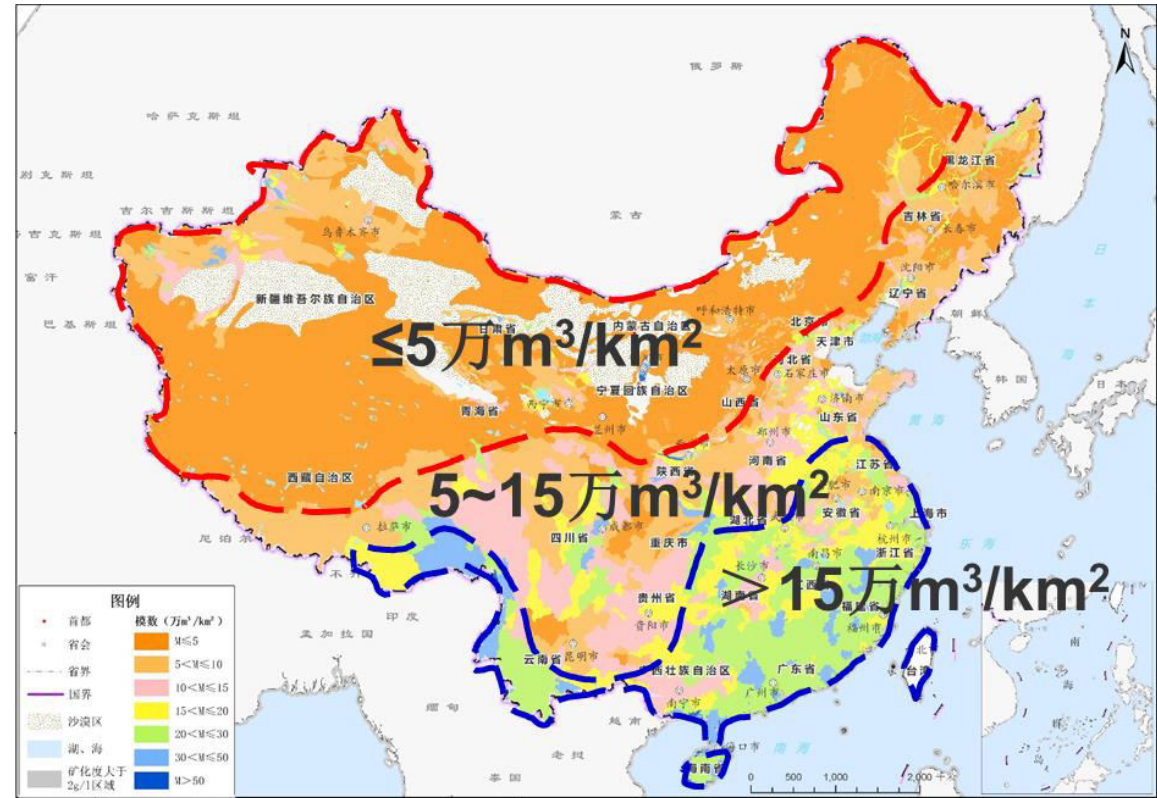
1. Groundwater Resources in China

Spatial distribution

■ The annual groundwater resources per unit area of China is $9.5 \times 10^4 \text{ m}^3/\text{km}^2$, which presents an increasing trend from west to east, from north to south.

- ✓ North China: $4.8 \times 10^4 \text{ m}^3/\text{km}^2$
- ✓ Northwestern Rivers: $3.0 \times 10^4 \text{ m}^3/\text{km}^2$
- ✓ South China: $16.8 \times 10^4 \text{ m}^3/\text{km}^2$

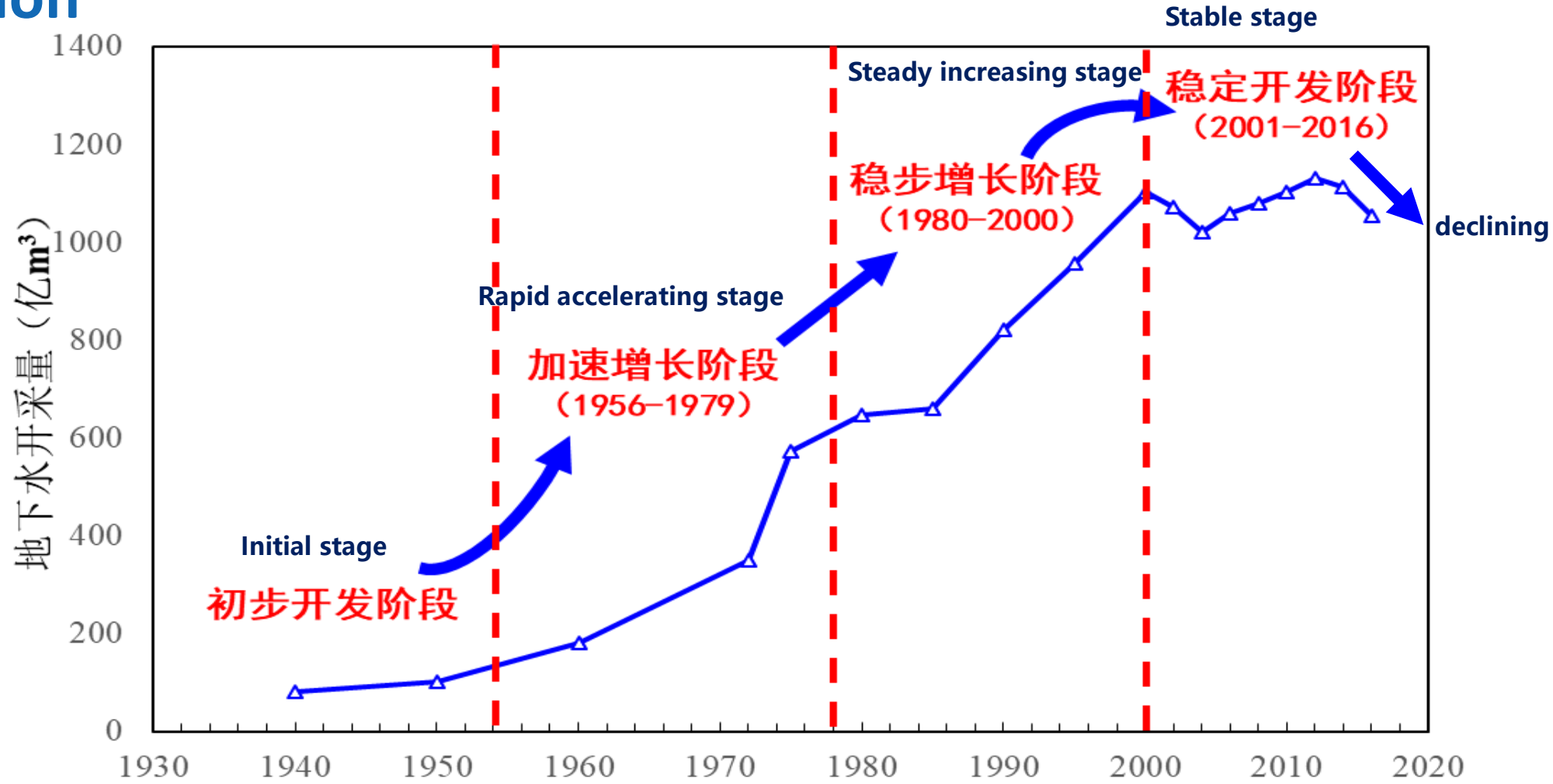
全国地下水资源量模数 $9.5 \text{ 万 m}^3/\text{km}^2$ ，总体呈从西向东、由北向南递增趋势。北方地区 $4.8 \text{ 万 m}^3/\text{km}^2$ ，其中西北诸河区 $3.0 \text{ 万 m}^3/\text{km}^2$ ；南方地区 $16.8 \text{ 万 m}^3/\text{km}^2$ 。



Groundwater resources per unit area
(average of 2001-2016, unit: $10^4 \text{ m}^3/\text{km}^2$)
2001~2016 年多年平均地下水资源量模数分区图

1. Groundwater Resources in China

Utilization



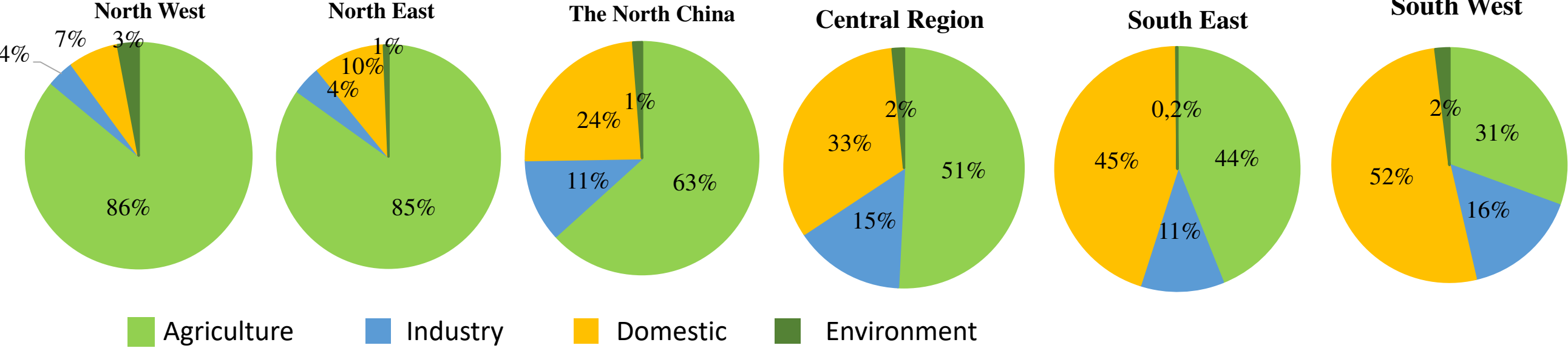
我国地下水开发利用进程示意图

Changing trend of groundwater exploitation in China

1. Groundwater Resources in China

Utilization

The annual groundwater use amount is about 80 billion m³, and 70% is for agriculture.



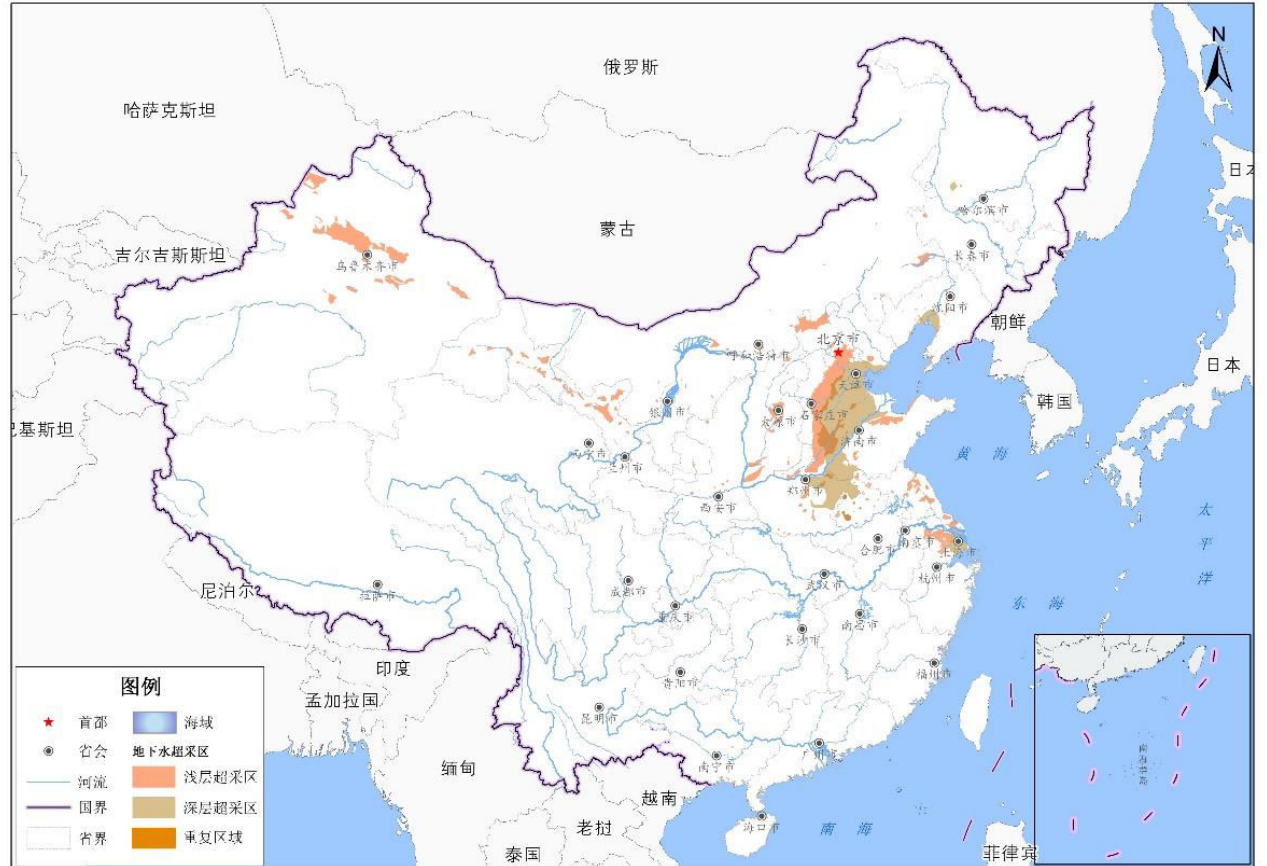
Percentage of groundwater used for different sectors in various regions

1. Groundwater Resources in China

Overexploitation

■ According to the outcome of groundwater over-exploitation evaluation conducted in 2012-2014, the total over-exploitation area of China reached 287,000 km², 21 provinces involved, 95% in Northern China. Over-pump annual amount is over 15 billion m³ per year.

■ 2012年~2014年超采区评价：全国超采区面积28.7万km²，涉及21个省级行政区。全国地下水年超采量158亿m³。



全国地下水超采区分布图

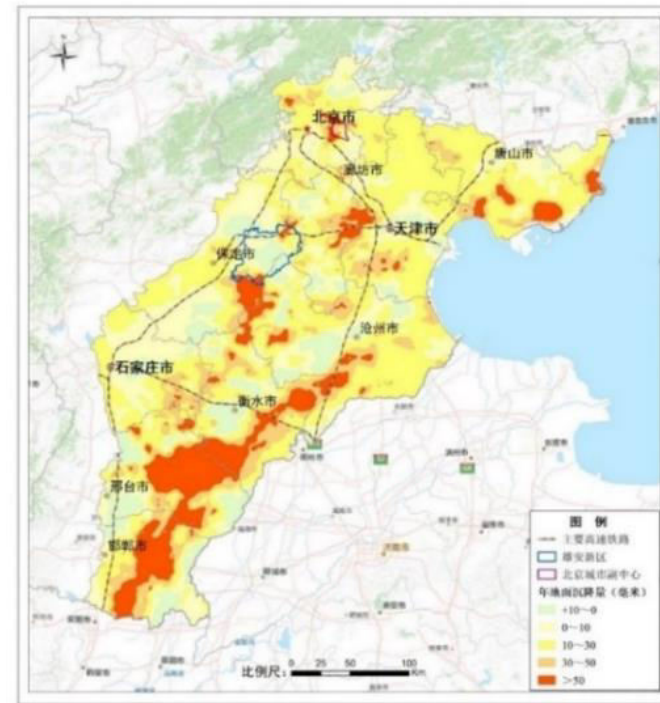
Over-exploitation area distribution in China
(orange: shallow aquifer; light brown: deep confined aquifer; dark brown: overlapping area)

1. Groundwater Resources in China

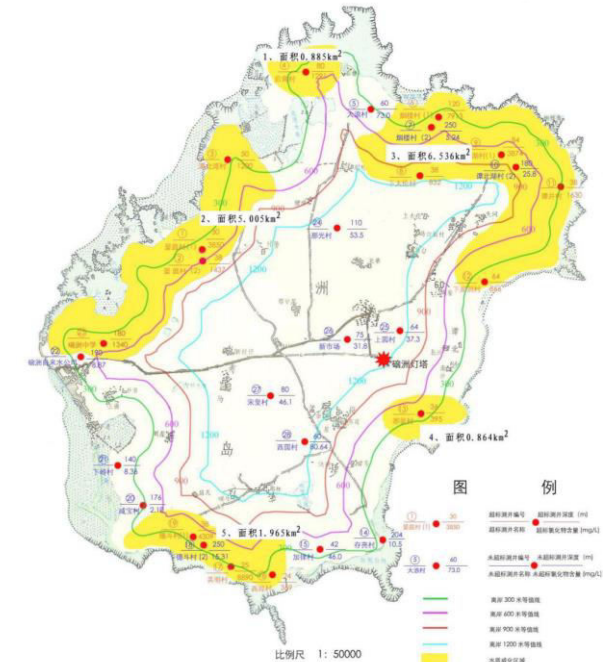
Overexploitation

Ecological and environmental problems caused by groundwater overexploitation.

- 地面沉降 land subsidence
- 海（咸）水入侵 Seawater intrusion
- 河湖萎缩 river lake shrinkage
- 泉水衰竭 spring depletion
- 河道断流 river dry-off

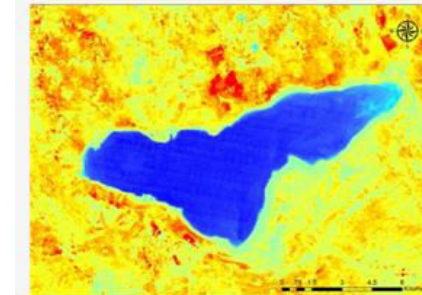


京津冀平原2019年地面沉降分布
Land subsidence in North China
Plain 2019

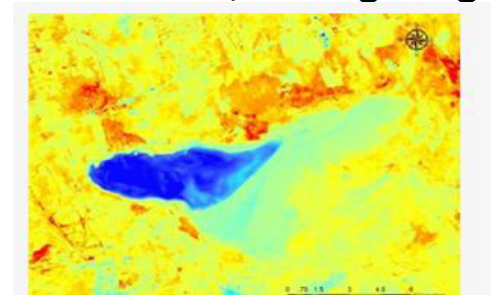


硃洲岛浅层地下水水质咸化区域
the seawater intrusion area in
Naozhou Island, Guangdong Province

黄旗
海湖
面萎
缩
Huangqihai
Lake (Inner
Mongolia)
shrinkage



1987年9月
September, 1987



2014年8月
August, 2014

2.Approaches

- ✓ National groundwater investigation and evaluation 开展全国水资源调查评价
- ✓ National groundwater utilization and protection plan 《全国地下水利用与保护规划》
- ✓ Comprehensive groundwater over-exploitation control 实施地下水超采综合治理
- ✓ Legislation: Groundwater Management Regulation 出台《地下水管理条例》
- ✓ “double control” of groundwater pumping rate and water table 地下水双控

2.1 Investigation and assessment

China has carried out three rounds of national water resources investigation and evaluation. The quantity, quality and utilization of China's water resources, water pollution and water ecological conditions and their spatial and temporal evolution patterns over the past 60 years have been figured out.



目前我国已经开展了三轮全国水资源调查评价，摸清了我国水资源数量、质量、开发利用状况、水污染状况和水生态状况及其60年来时空演变规律。

2.1 Investigation and assessment

- Calculate the amount of groundwater resources 计算地下水资源量：

Recharge: recharge from precipitation/ rivers and lakes/ irrigation 各项补给量

Discharge: by pumping/ to rivers and lakes/ evaporation 各项排泄量

Annual renewable amount. 年度可更新量

- Calculate sustainable yield for each and each county. 计算地下水可开采量
- Evaluate exploitation and identify overdraft zones 超采状况评价

2.2 National Planning

- In 2017, the Ministry of Water Resources and the former Ministry of Land and Resources jointly issued **the National Groundwater Utilization and Protection Plan**. The Plan analyzed the situation and problems facing groundwater in China, and proposed groundwater development and utilization and protection objectives and general layout, groundwater development and utilization total control scheme, comprehensive management of groundwater over-exploitation and measures for groundwater water conservation and protection.
- 2017年，水利部和原国土资源部联合印发《全国地下水利用与保护规划》，分析了我国地下水面临的形势与存在的问题，提出了地下水开发利用与保护目标和总体布局、地下水开发利用总量控制方案、地下水超采综合治理和地下水水源涵养与保护对策措施等。

2.3 Groundwater Over-exploitation Control

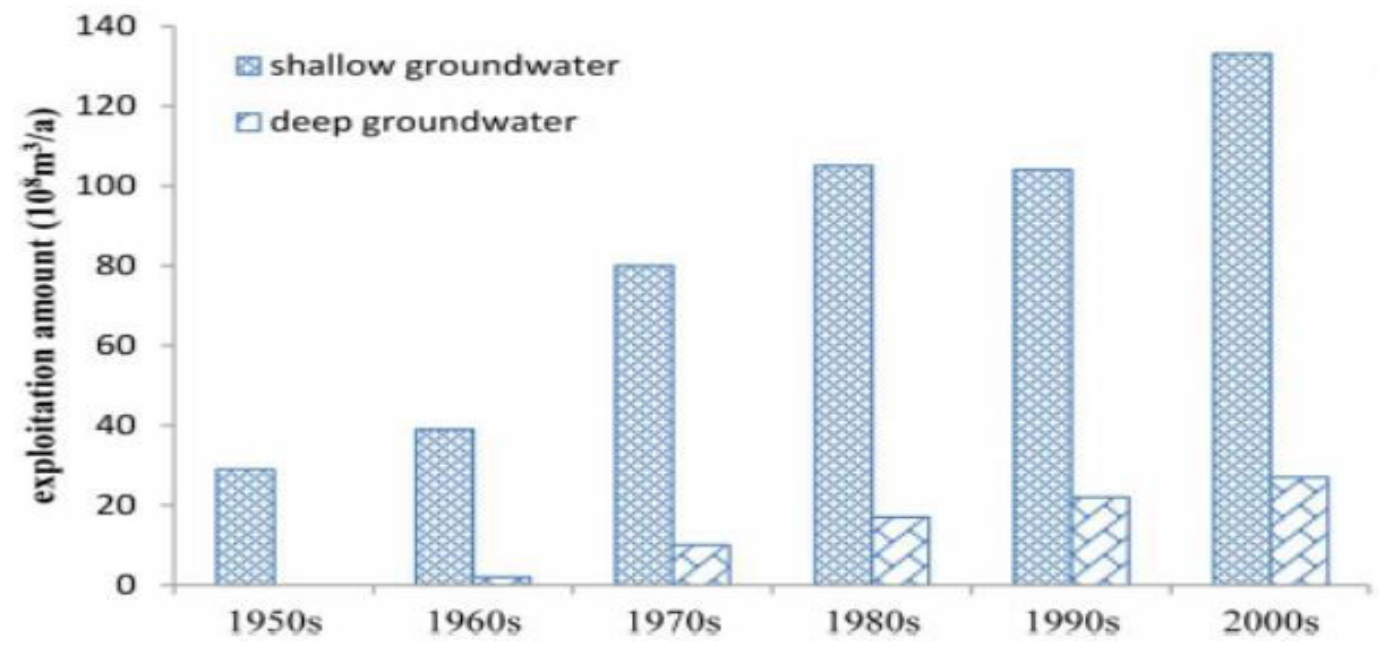
□ The North China Plain

4% of the national water resources amount supports:

- 25% population
- 27% GDP
- 25% irrigation area and food production



Location of the North China Plain



Change in groundwater exploitation amount of Hebei from the 1950s to 2000s.

2.3 Groundwater Over-exploitation Control

□ The North China Plain

- ✓ Enhance Water-saving: irrigation/industrial/domestic 加强节水
- ✓ Groundwater supply replacement: Yangze River (SNWTP)/ Yellow /local reservoir/reclaimed water 水源置换
- ✓ Crop structure adjustment and industrial layout optimization
调整种植结构、优化产业结构
- ✓ Artificial recharge through rivers and lakes 河湖地下水回补

2.3 Groundwater Over-exploitation Control

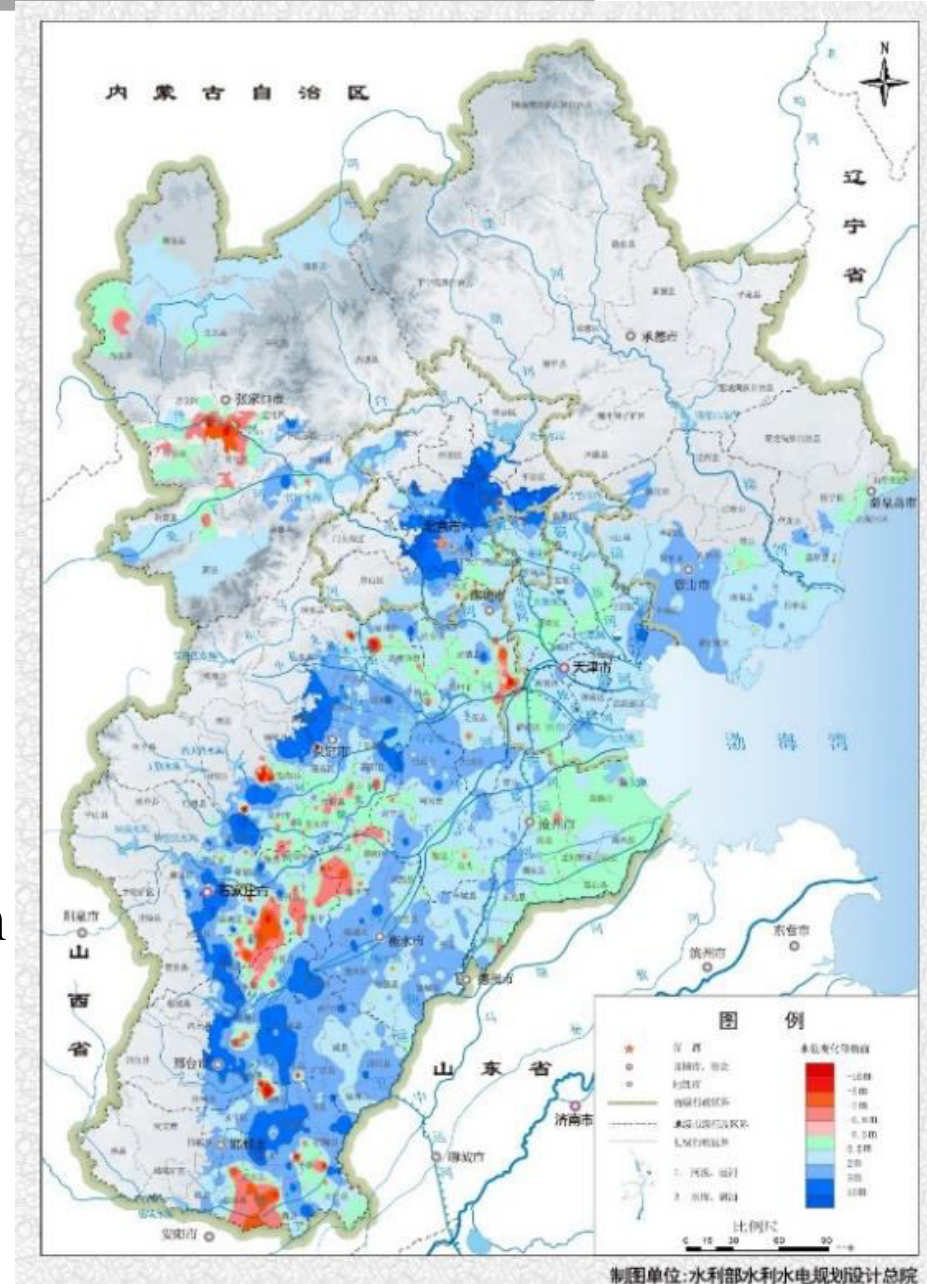
□ The North China Plain

The structure of water supply sources was further optimized, and the proportion of groundwater gradually decreased.



京津冀地下水供水量占比变化 ratio of groundwater to total water use in Beijing-Tianjin-Hebei region

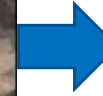
Groundwater table increases in some regions.



2.3 Groundwater Over-exploitation Control

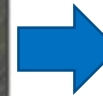
□ The North China Plain

The ecological environment of rivers and lakes has improved significantly.



滹沱河治理前后

Hutuo River before and after the control measures



永定河治理前后

Yongding River before and after the control measures

2.3 Groundwater Over-exploitation Control

Other key areas

10 other areas: 72 cities of 13 provinces.

10片区，涉及13个省级行政区，72个地市。

The plan issued by:

- ✓ Ministry of Water Resources
- ✓ Ministry of Finance
- ✓ National Development and Reform Commission
- ✓ Ministry of agriculture and rural affairs

水利部 财政部 国家发展改革委 农业农村部
文件

水资管[2023]58号

水利部 财政部 国家发展改革委 农业农村部
关于印发《“十四五”重点区域地下水超采
综合治理方案》的通知

各有关省(自治区)水利(水务)厅(局)、发展改革委、财政厅(局)、
农业农村厅(局)：

为深入贯彻落实习近平新时代中国特色社会主义思想，落实党



2.4 Legislation: Groundwater Management Regulation

Groundwater Management Regulation: A law at the national level dedicated to groundwater is issued in 2021.



- water saving and protection as priority
节约保护优先
- systematical governance and control
科学系统治理
- precise management and control
精准治理管控
- clear goals and liability
目标责任主体

2.4 Legislation: Groundwater Management Regulation

Groundwater Management Regulation: 8 chapters and 64 articles

OUTLINE

Chapter 1 General provisions 总则

Chapter 2 Investigation and planning 调查与规划

Chapter 3 Water saving and protection 节约与保护

Chapter 4 Groundwater over-exploitation control 超采治理

Chapter 5 Groundwater contamination prevention 污染防治

Chapter 6 Supervision and management 监督管理

Chapter 7 Liability 法律责任

Chapter 8 Attachments 附则

2.5 “double control” of pumping rate and water table

Determine control indicators for groundwater pumping rates and water levels as criterias for assessing the work groundwater management and protection of each province.

- Indicator of pumping rate : the pumping rate for each county in 2025 and 2030.

地下水取水总量控制指标

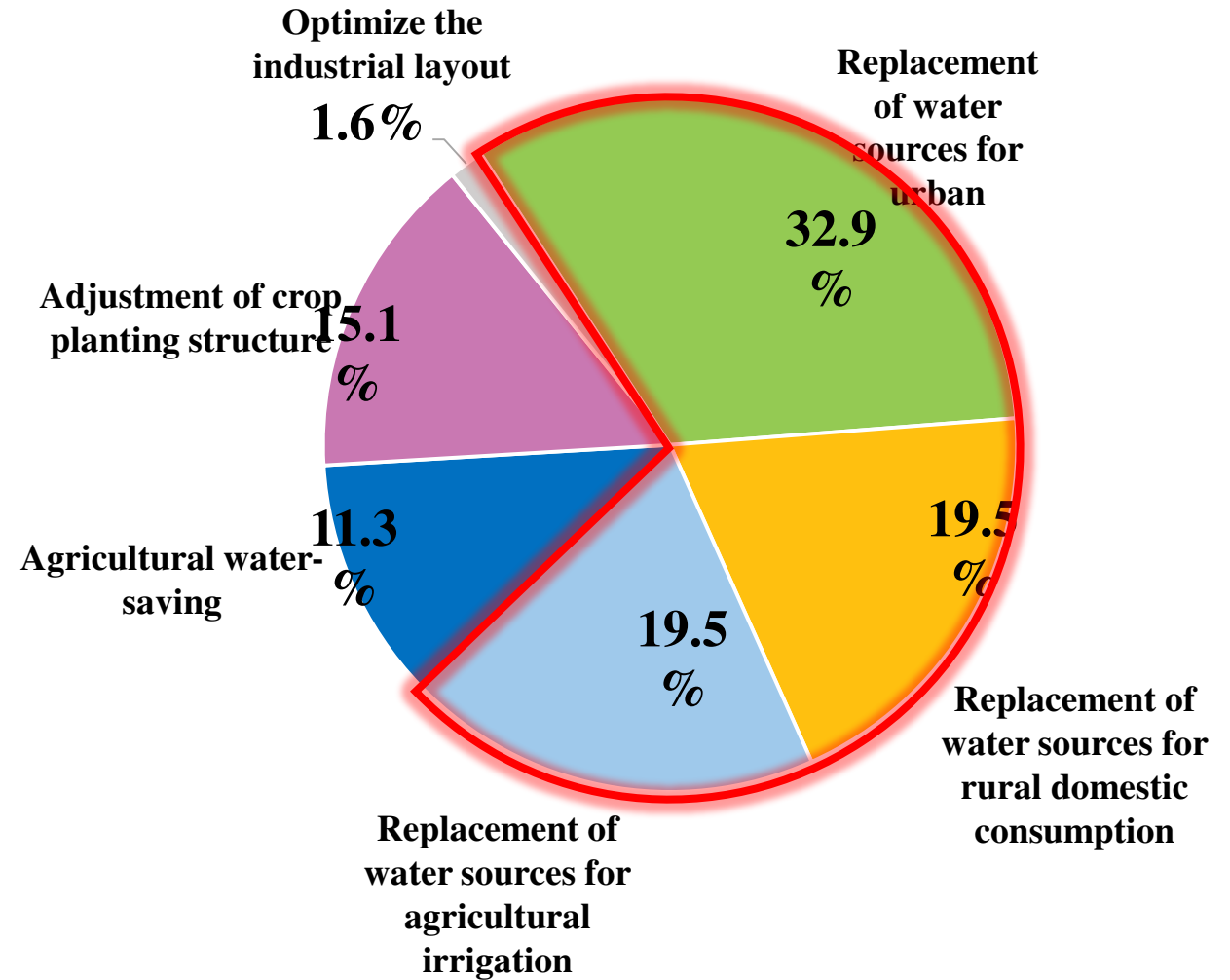
- Indicator of water table: groundwater level control indicators of different units in each county, and for key protection areas: major spring zones, ecologically fragile areas, seawater intrusion areas, salinization-prone areas, etc.

地下水水位控制指标

3. Challenges

Some measures may not be effective in the long term

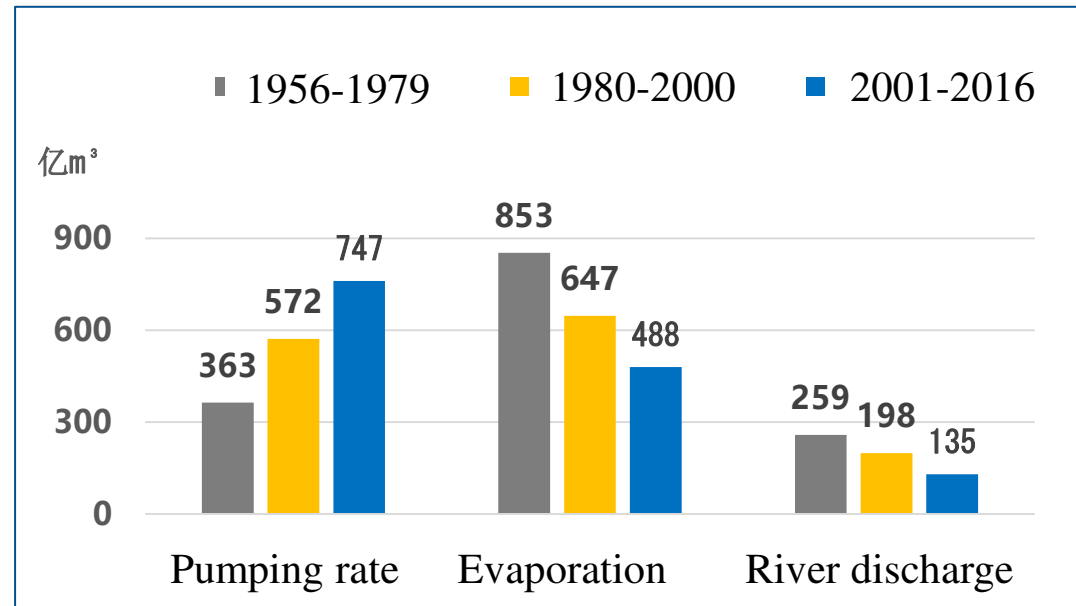
- 1. Most rely on surface water replacement
- 2. Crop structure adjustment needs subsidy



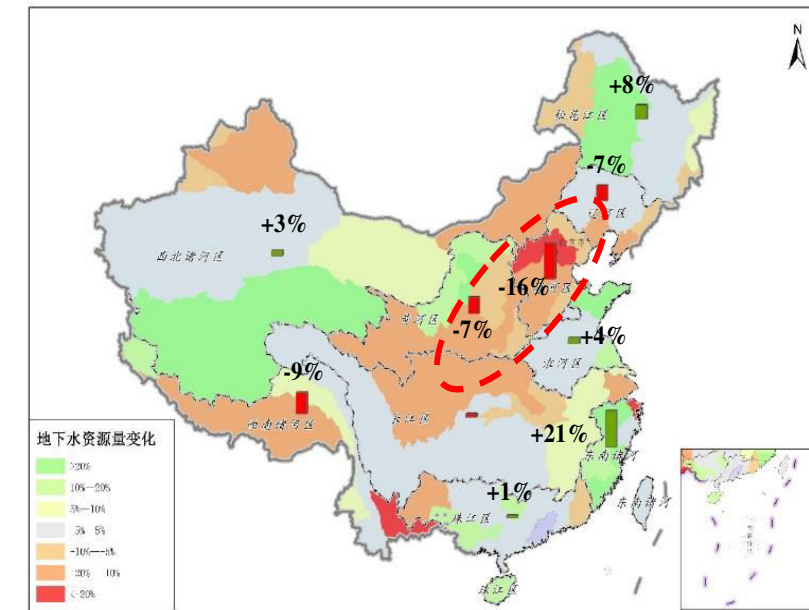
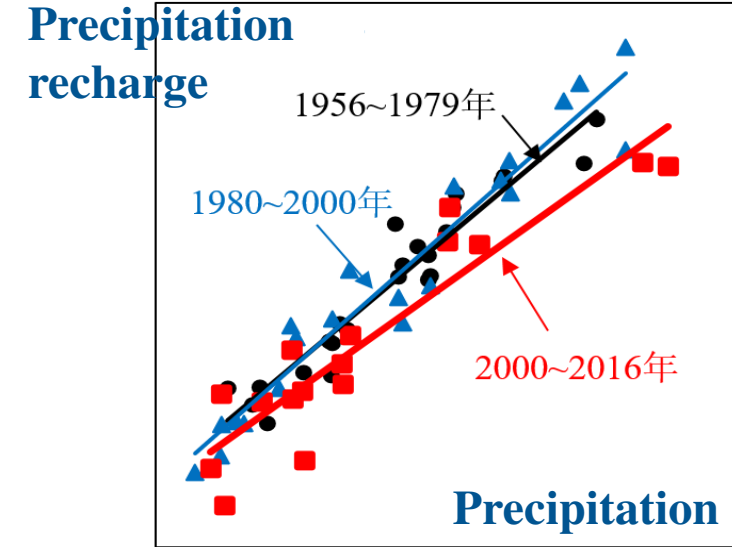
Challenges

□ Changing environment

- The groundwater resources decreases significantly in some areas.
- Groundwater pumping rate increases, evaporation, river discharge decreases.
- Uncertainty due to climate change.



Changes of discharge

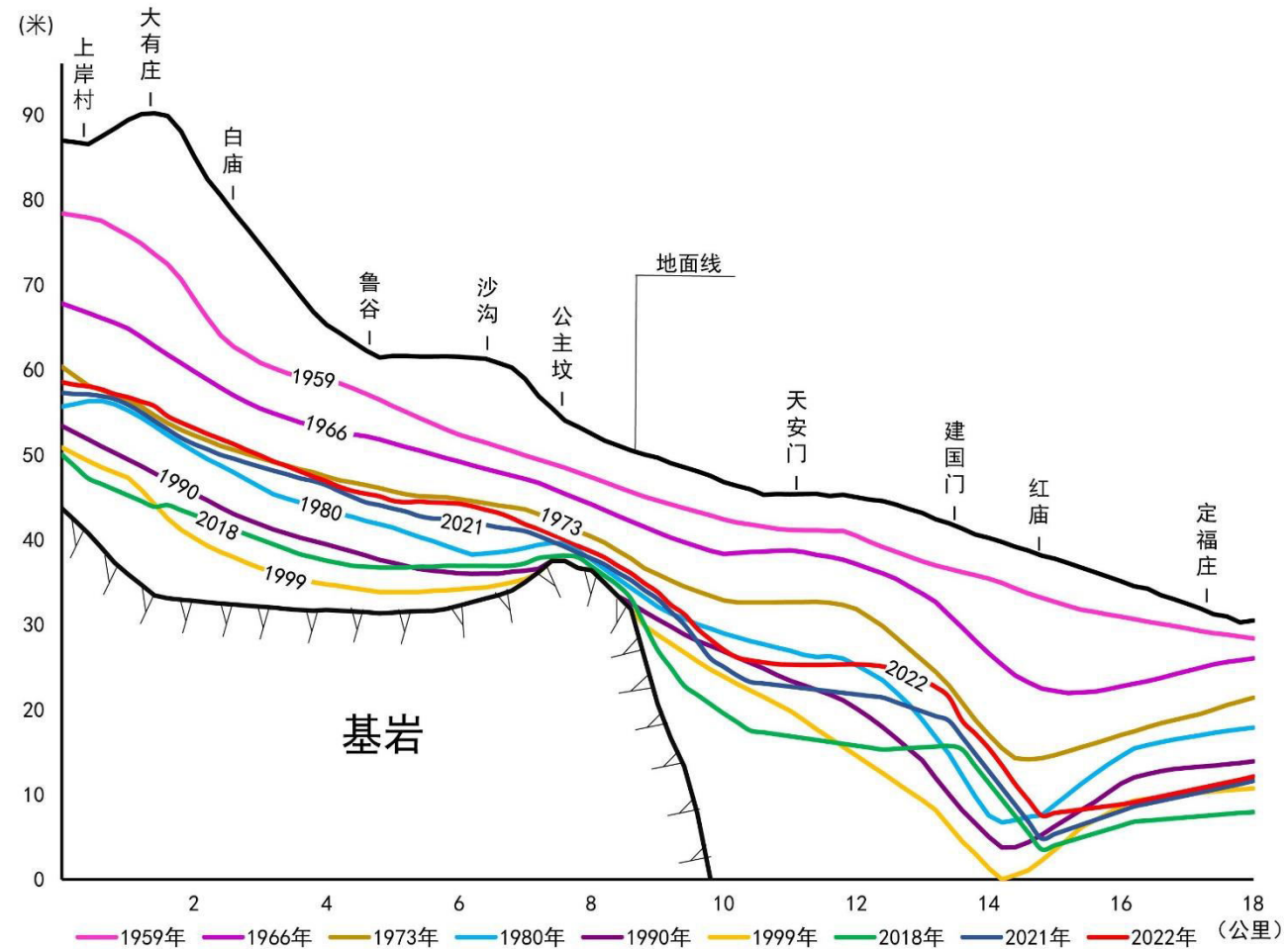


Changes of groundwater resources amount (2001-2016 VS 1956-1979年)

Challenges

□ About the “final goal”

What is the ideal situation of groundwater we want?



Challenges

□ About management

1. Difficult to know the accurate groundwater pumping amount.
2. Difficult to intervene farmers' behavior.
Crop production/water saving
3. Other perspectives:
unrenewable groundwater
discharge from mining
geothermal water
.....



More than 40 million pumping wells



Thanks!

