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Construction and Management of Water Conservancy Projects in China

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Main content

1. **History** of China's water infrastructure construction
2. **Current Status** of China's water projects
3. **Major achievements** in China's water project construction
4. **Experiences and understandings gained** from China's water projects

1. History of China's water infrastructure construction (5 stages)

Stage 1: The early days of new China (1949-1956)

When the PRC was newly founded, most rivers in the country were barely managed and there was no decent water conservancy facility. Floods were raging everywhere, and the rate of water utilization was terribly low. The top priority was to resume production, and the most important water projects were the flood control systems.

- We carried out large-scale Huaihe River conservancy project.
- We built flood diversion gates on the Jingjiang River and the lower reach of Han River.
- We reclaimed lands around Dongting Lake, Poyang Lake, and in the Pearl River Delta region.



Jingjiang flood diversion gate on the Yangtze River



Du Jiatai flood diversion gate on the Han River

1. History of China's water infrastructure construction

Stage 2: Large-scale agricultural development (1957-1976)

Confronted with frequent natural disasters, we had to solve the problem of food security. So we launched large-scale public water conservancy campaigns, which largely increased agricultural production.

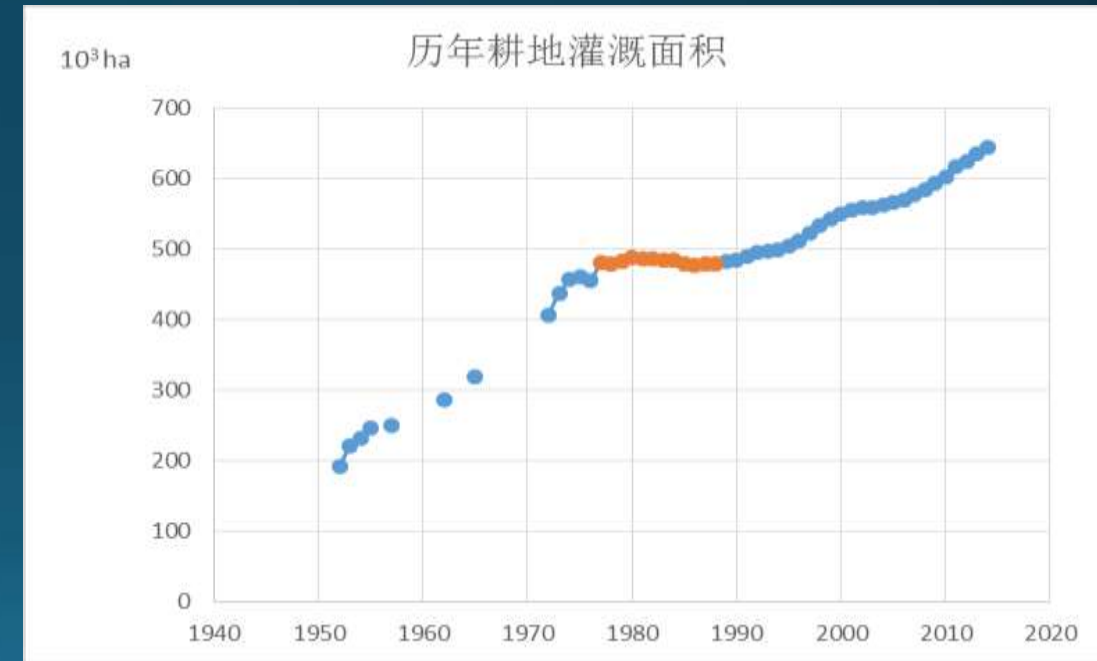
- Reservoirs were constructed in large scale.
- We set up irrigation areas and launched water conservancy projects for farming.



1. History of China's water infrastructure construction

Stage 3: From reform and opening up to the late 1980s (1977-1989)

This is a critical stage for opening up and economic reform. The focus of government work is economic development, and the focus of water management is “intensify the management and economic benefits”. During this stage, input for water projects declined, areas for irrigation remained unchanged for 10 years, and the number of water project hit rock bottom. The conflict between poor water infrastructure and rapid economic growth became more salient.



Changes of irrigation area (from 1950s)

1. History of China's water infrastructure construction

Stage 4: Recovery of water projects (1990-1997)

During this stage we were confronted with even more floods and droughts. People began to realize the importance of water conservancy construction, so we carried out more water projects and stepped up to manage our rivers.

- We launched a series of important water conservancy projects like the Three Gorges Dam and the Xiaolangdi Dam.
- We carried out several water diversion projects like “Directing Water from the Yellow River to Hebei” and “Directing Water from the Datong River to the Qinwangchuan basin.”
- We made great progress in managing the Huaihe River and Taihu Lake.
- Significant progress was also made in urban/rural water supply, drinking water for man/animal, hydropower in rural areas, and conservation of water and soil.



1. History of China's water infrastructure construction

Stage 5: Great development for water conservancy (1998-2015)

After the floods in the Yangtze River, the Nenjiang River, and the Songhua River in 1998, the Chinese government put more investment in water conservancy projects, the amount of which increased from 30 billion to 200 billion yuan, signaling rapid growth in water conservancy.

- The Three Gorges Dam, the Xiaolnagdi Dam, and the Linhuaigang flood control system were built and put into use.
- Management of great rivers and their branches was improved on a large scale.
- Large irrigation areas were equipped with supporting facilities. Water-saving upgrade was in full swing.
- The East Route and the first phrase of the Middle Route of the South-to-North Water Transfer Project were completed and put into use.
- The idea of water management changed radically: People began to use modern, sustainable ways, instead of traditional ones, to manage water resources.

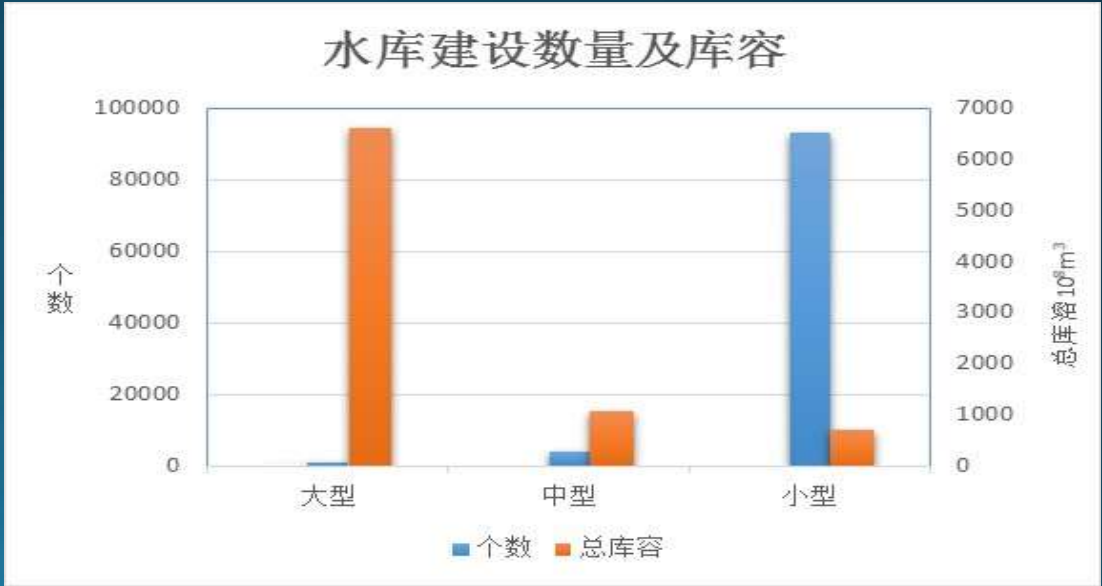


Investment on water conservancy (from 2000)

2. Current status of China's water projects

2.1 Reservoir

| | Unit | Large | Middle | Small | Total |
|------------------------|--------------------------------|-------|--------|-------|-------|
| Number | - | 697 | 3799 | 93239 | 97735 |
| Number% | % | 0.7 | 3.9 | 95.4 | 100 |
| Total storage capacity | 10 ⁸ m ³ | 6617 | 1075 | 702 | 8394 |
| Storage capacity% | % | 78.8 | 12.8 | 8.4 | 100 |



The number of reservoirs and total storage capacity

2. Current status of China's water projects

2.2 River Dike

The total length of dikes in China is 284,400 km,

188,700 km of which meets the flood control standard.

The total length of level 1 and level 2 dikes reaches 30,400 km.

Area of protected farm land is 42.79 million ha.

Population protected is 586 million.



2. Current status of China's water projects

2.3 Sluice Project

Number of sluice projects

| Total | Large | Middle | Small |
|-------|-------|--------|-------|
| 98686 | 875 | 6360 | 91451 |

| Flood diversion gate | Check gate | Drainage gate | Diversion gate | Tidal gate |
|----------------------|------------|---------------|----------------|------------|
| 7993 | 56157 | 17581 | 11124 | 5831 |



2. Current status of China's water projects

2.4 Irrigation and Waterlogging Control

We have 7709 irrigation zones, each taking up more than 10,000 *mu* (666 ha), with a total coverage of 30.26 million ha.

We have 456 irrigation zones, each taking up more than 300,000 *mu* (20,000 ha), with a total coverage of 11.25 million ha.



2. Current status of China's water projects

2.4 Irrigation and Waterlogging Control

- We have installed 4,584,000 electromechanical pumps. Each of them can pump 20m^3 of water or has an internal diameter of more than 20cm.
- We have installed 90,650 pump stations, each with pumping capacity of $1\text{ m}^3/\text{s}$ or installed power of more than 50kW.
- The total installed power of electromechanical equipment is 52.79 million kw and its total irrigation area is 42.49m ha.



2. Current status of China's water projects

2.4 Irrigation and Waterlogging Control

| Irrigation area | Total | Farmland irrigation | Forestland irrigation | Orchard irrigation | Pasture irrigation | Other irrigation |
|--------------------|-------|---------------------|-----------------------|--------------------|--------------------|------------------|
| 10 ⁴ ha | 7065 | 6454 | 223 | 238 | 109 | 42 |

| Water saving area | Total | Canal irrigation | Sprinkler irrigation | Micro irrigation | Pipe irrigation |
|--------------------|-------|------------------|----------------------|------------------|-----------------|
| 10 ⁴ ha | 2902 | 1290 | 316 | 468 | 827 |

| Waterlogging control area | Total | 3-5 years | 5-10 years | Over 10 years |
|---------------------------|-------|-----------|------------|---------------|
| 10 ⁴ ha | 2237 | 975 | 853 | 409 |



2. Current status of China's water projects

2.5 Trans-Basin Water Transfer

The Middle Route of the South-to-North Water Transfer Project: providing over 20 cities in Henan, Hebei, Tianjin, and Beijing with water from the Danjiangkou Reservoir on the Hanjiang River, a branch of the Yangtze River. **The length of the main canal is 1,432 km, transferring 800 m³/s of water. Planned average transferred water for a year is 14.5b m³.** In a normal dry year (75% guarantee of water), we can transfer about 11 billion m³ of water. In Dec. 2014 the first phrase of the project was completed and put into use.

The East Route of the South-to-North Water Transfer Project: providing Jiangsu, Anhui, Shandong, Hebei and Tianjin with water from Jiangdu hydraulic project, Yangzhou, Jiangsu province through 50 planned new pumps. **The length of the main canal is 1,156 km, transferring 14.33 billion m³ of water per year.** In 2013 the first phrase of the project was completed and put into use.



Map of the middle route



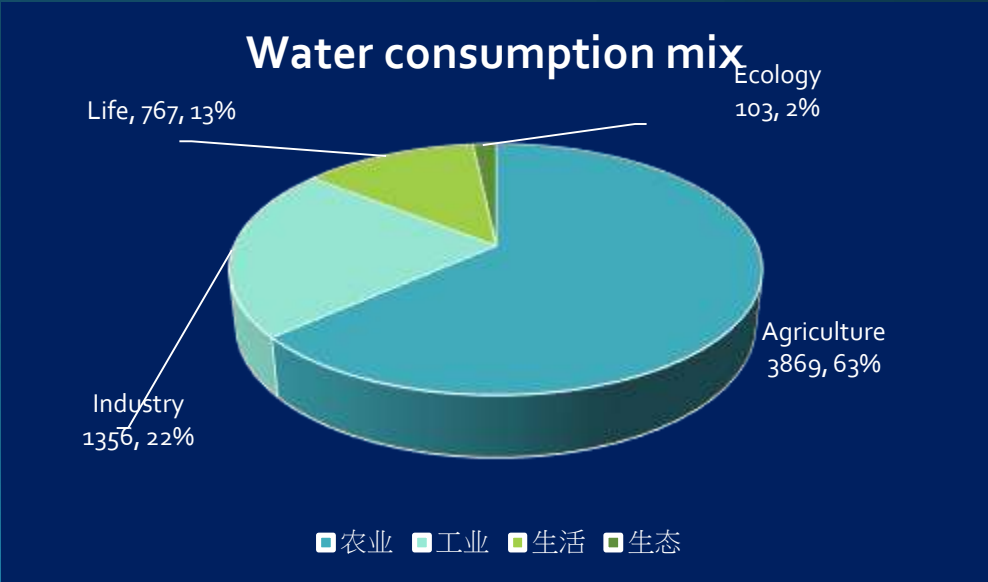
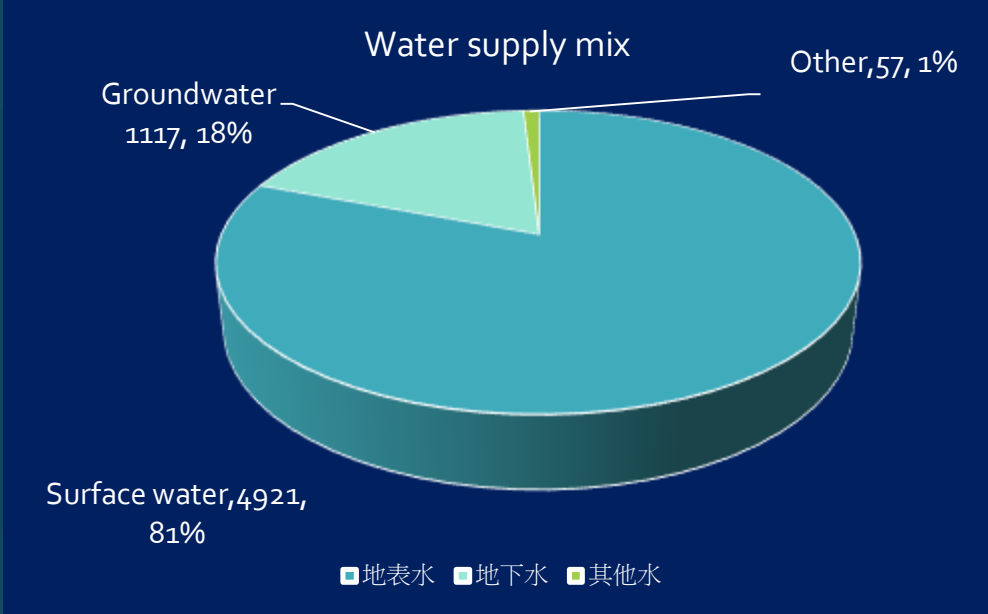
Map of the east route

2. Current status of China's water projects

2.6 Water Supply and Water Consumption

| Water supply | Total | Surface water | Groundwater | Other water |
|------------------|-------|---------------|-------------|-------------|
| 10^8m^3 | 6095 | 4921 | 1117 | 57 |

| Water consumption | Total | Agriculture | Industry | Living | Ecological use |
|-------------------|-------|-------------|----------|--------|----------------|
| 10^8m^3 | 6095 | 3869 | 1356 | 767 | 103 |



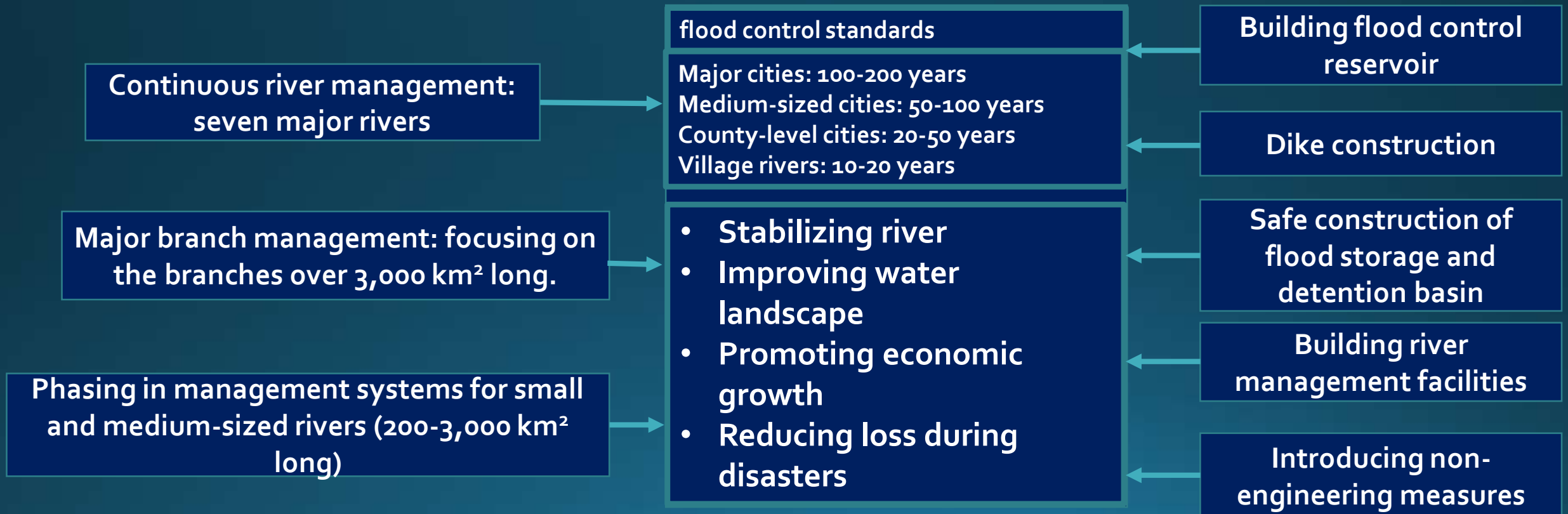
3. Major achievements in China's water project construction

3.1 The Establishment of China's Water Conservancy System

- Reservoir + Dike + Flood storage and detention basin + Early warning = Flood control system
- Storage + Diversion + Lifting + Trans-basin transfer = Water resource allocation system
- Water and soil conservation + Pollution control + Ecological remediation = water environment protection system
- Project control + Management control (total quantity control + Consumption control + Efficiency control) = Water saving system
- Management mechanism + Management system + Management capacity = Modern management system
- Law and regulation + Policy + Standard + Investment = Supporting guarantee system

3. Major achievements in China's water project construction

3.2 Enhanced Capacity for River Flood Control



3. Major achievements in China's water project construction

3.3 Higher capacity for regulating and control of water resources

- Building storage reservoir
- Building supporting facilities in large irrigation areas and upgrading water-saving systems
- Launching trans-basin/trans region water transfer projects
- Securing water supply in urban area
- Securing drinking water in rural area
- Building a water-saving society



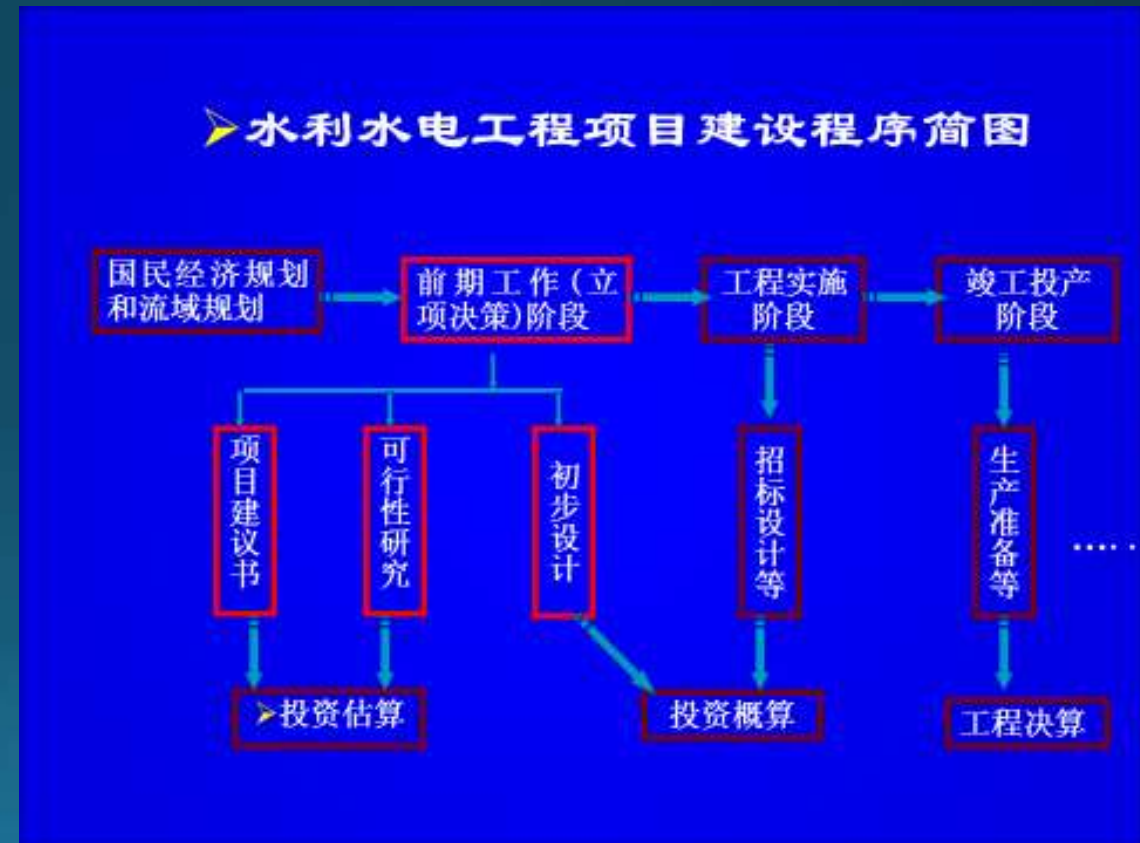
- Water security
- Food security
- Ecological security

3. Major achievements in China's water project construction

3.4 Higher level of management in water project construction

1. Effective implementation of basic construction process

- Basic process for implementing a water project includes four stages: decision-making, design, construction, and operation.
- Preliminary work for water conservancy project generally consists of 3 stages:
 - Project proposal
 - Feasibility study
 - Preliminary design

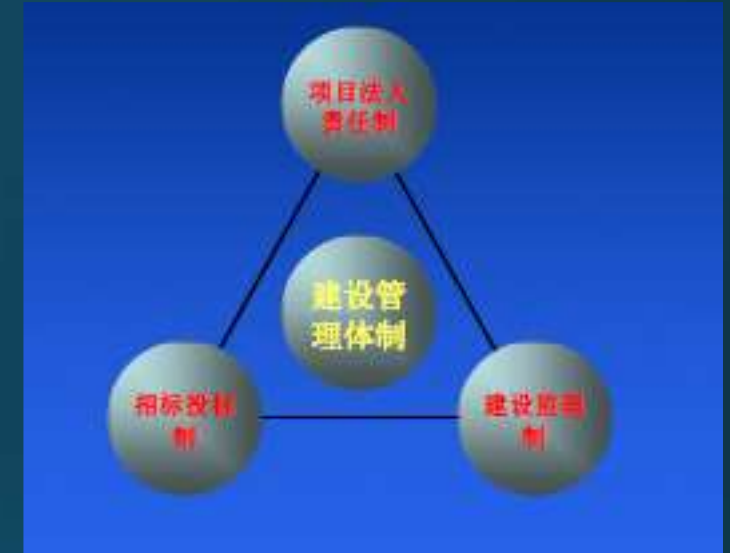


3. Major achievements in China's water project construction

3.4 Higher level of management in water project construction

2. Implementation of “Three Systems”

- **Legal person accountability system:** the project legal person is held accountable for planning, fund-raising, construction, operation, contractual payment, and maintaining asset value.
- **Tendering and bidding System:** the project legal person should arrange project design, construction, and supervision through public tendering and bidding.
- **Construction supervision system:** effective supervision should be introduced to ensure high quality and investment returns.

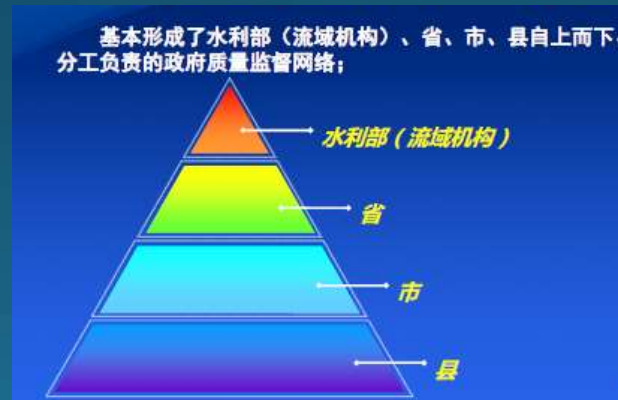
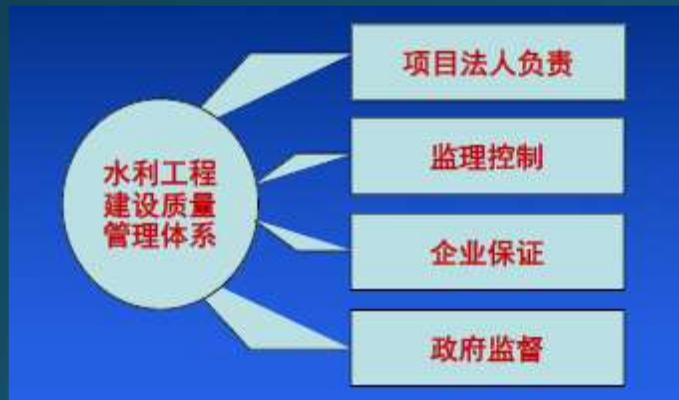


3. Major achievements in China's water project construction

3.4 Higher level of management in water project construction

3. Effective quality and safety supervision

- A quality management system is set up, combining legal person accountability, supervision, control, construction credibility as well as government regulation.
- A production management system for production safety is set up involving government regulation, owner accountability, business credit, and mass participation.
- A quality assessment system with supervision and a government and legal person acceptance system are set up.
- A new system is set up to ensure safety measures and main project will be designed, implemented, and put into operation all at the same time.



3. Major achievements in China's water project construction

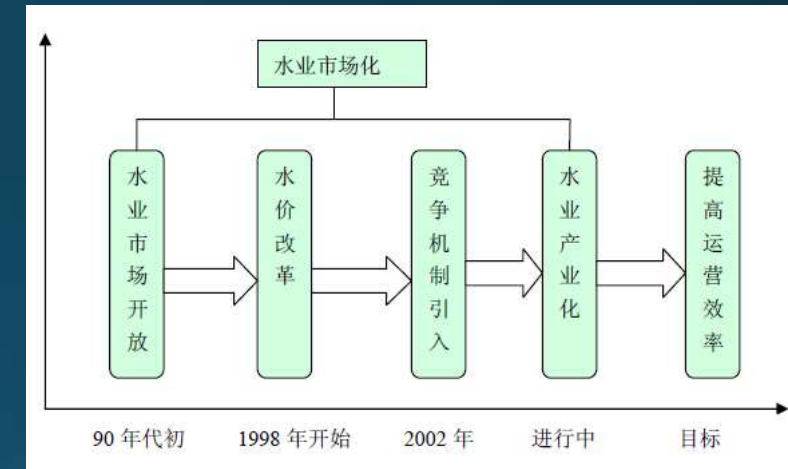
3.5 Significant results are achieved in the management of water conservancy project

1. Full implementation of water management system reform

- Management systems are more organized, state-own water management bodies are more streamlined, and everything is classified and determined.
- Expenditures of public managers and maintenance fee of public project are both clarified.
- Managers and maintenance staff are separated. Some managers are laid off to ensure effective management results.

2. Stronger project operation management

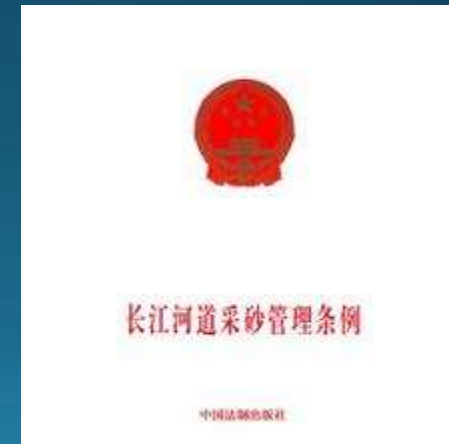
- Safe operation responsibility system is set up.
- Standardized and modernized management is introduced for water conservancy project.
- Reform of management system for small agricultural project is introduced.



3. Major achievements in China's water project construction

3.6 Stronger river and lake management to protect life in the water

1. Stronger river and lake management – saving water, preventing pollution, and connecting lakes and rivers
2. Stronger ecological distribution – ensuring necessary water in rivers and lakes for water circulation
3. Stronger management of sand excavation – setting up ban area, excavating area, and conservation area for proper exploitation
4. Stronger approval management for river-related project – promoting proper utilization of the riverbank



3. Major achievements in China's water project construction

3.7 Rapid development of water conservancy engineering technology – building a better system of technology standards

Table of water conservancy technology standards

| | Overall | | | | | | Construction | | | | | | | | | Management | | | | Total |
|---|---------|----------|-------------|---------|--------|------------|--------------|--------|--------|-----------------------|-------------------------------|-----------|------------|-------------|------------|------------|---------------------------|----------------------------|-------------|-------|
| | General | Planning | Information | Quality | Safety | Evaluation | General | Survey | Design | Testing and materials | Construction and installation | Equipment | Instrument | Supervision | Acceptance | General | Operation and maintenance | Monitoring and forecasting | Measurement | |
| A: Hydrology | 1 | 2 | 7 | 0 | 1 | 3 | 4 | 1 | 5 | 42 | 1 | 2 | 31 | 0 | 1 | 1 | 1 | 30 | 20 | 153 |
| B: Water resources | 1 | 11 | 3 | 0 | 0 | 29 | 6 | 1 | 7 | 1 | 0 | 2 | 0 | 0 | 0 | 4 | 3 | 8 | 1 | 77 |
| C: Flood and drought relief | 8 | 2 | 4 | 0 | 0 | 8 | 1 | 0 | 8 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 9 | 2 | 0 | 44 |
| D: Rural water conservancy | 0 | 3 | 1 | 0 | 0 | 2 | 11 | 0 | 3 | 2 | 0 | 4 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 29 |
| E: Water and soil conservation | 4 | 2 | 4 | 1 | 0 | 1 | 10 | 1 | 12 | 3 | 2 | 1 | 0 | 1 | 2 | 0 | 5 | 4 | 0 | 53 |
| F: Hydropower in rural area | 2 | 3 | 0 | 0 | 2 | 1 | 1 | 0 | 12 | 1 | 1 | 2 | 0 | 0 | 1 | 0 | 6 | 0 | 0 | 32 |
| G: Hydraulic structure | 8 | 4 | 5 | 5 | 9 | 5 | 13 | 21 | 42 | 25 | 27 | 4 | 29 | 1 | 8 | 0 | 12 | 10 | 47 | 275 |
| H: Electromechanical and metal structures | 0 | 0 | 0 | 7 | 1 | 0 | 5 | 0 | 16 | 7 | 6 | 18 | 0 | 1 | 4 | 0 | 7 | 1 | 0 | 73 |
| I: Migrant settlement | 1 | 3 | 1 | 0 | 0 | 1 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 12 |
| J: Others | 2 | 1 | 19 | 1 | 1 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 7 | 2 | 0 | 0 | 40 |
| Total | 27 | 31 | 44 | 14 | 14 | 52 | 53 | 24 | 111 | 81 | 38 | 34 | 60 | 3 | 19 | 12 | 46 | 57 | 68 | 788 |

By March 2016, 788 items are to be added. For standards, 475 are existing, 92 are being added, 90 are amended, and 131 are to be added.

3. Major achievements in China's water project construction

3.7 Rapid development of water conservancy engineering technology – technology standards are more globalized

- So far we have completed translation for 24 technology standards and 10 more are being translated. These standards are linked to dam building technology, small hydropower station construction, hydrology, sand exploitation, water and solid conservation, as well as other competitive technologies belonging to China.
- By now our translated standards are being applied in the planning, project design, and construction management in various river basins in Asia, Africa, and Latin America.

Standard for Design of Concrete Gravity Dam
Standard for Design of Concrete Arch Dam
Standard for Design of Rolled Earth-Rock Dam
Technical Specifications for Construction of Concrete Cutoff Wall in Water Conservancy and Hydropower Engineering

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Pakistan Suki Kinari hydropower station project
Malaysia BALEH hydropower station
Equatorial Guinea Giboulot hydropower station
Argentina Kirchner hydropower station project
Ecuador CCS hydropower station

...

3. Major achievements in China's water project construction

3.8 Water conservancy has become modernized with more innovation and new information

- We have achieved the historic transformation from simple copy to original innovation, bridging the gap between our technologies and those from the developed world.
- We have witnessed significant progress in theory and practice of distributing water resources, river ecological restoration technology, and other fundamental research.
- We have realized technological breakthrough in solving a series problems in the fields of water conservancy and hydropower project, changing China's international position.
- Information-gathering capacity and early warning for flood and drought have been improved.
- National flood control and drought relief command system, water conservancy e-government system, and water resource management and distribution system have been established and put into use, generating much benefits for the economy and the society.

4. Experience and understandings gained from China's water projects

4.1 Recognizing the effect of water conservancy and its supporting role in economic development

China is always confronted with floods and droughts, so water conservancy plays a pivotal role in national economy. It has been and will be a pressing strategic task in China's modernization. We should always be prepared to carry on.



4. Experience and understandings gained from China's water projects

4.2 Adopting a practical approach and advancing with the times to improve the water management concept in practice

We must understand China's situation and the water resources, explore principles, care for the people, balance man and nature, and save water for sustainable development through reform and innovation. Only in this way can we embrace modernization and put forward a water management concept that meets the demand of economic growth.



4. Experience and understandings gained from China's water projects

4.3 Respecting the superiority of China's water systems and developing water conservancy with Chinese characteristics

- With concerted efforts, a country can achieve great things – as launching major water projects
- Government, society and general public can work together – in construction and management
- Social forces can join together in harnessing water resources.



4. Experience and understandings gained from China's water projects

4.4 Putting the human first in developing water conservancy, with the focus of improving people's livelihood

Only by standing with the people, caring for their interests, and sharing the benefits of developing water projects can we gain their support and their engagement.



4. Experience and understandings gained from China's water projects

4.5 Following the laws of nature and maintaining the man/nature balance in managing water resources

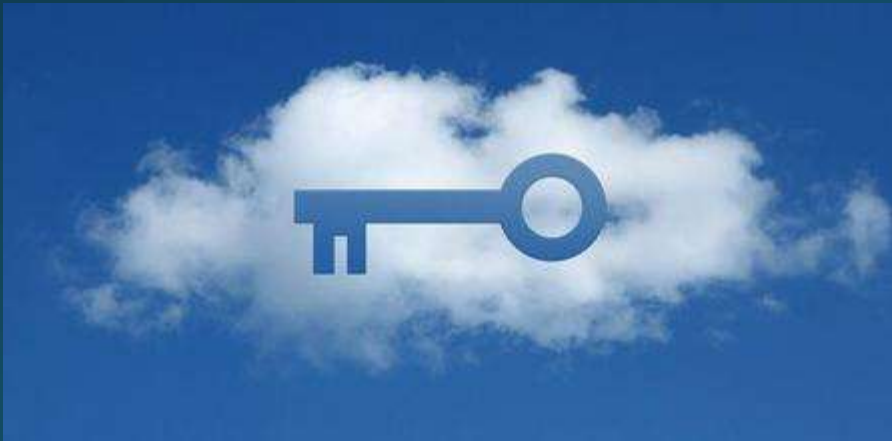
We need to respect the laws of nature, balance exploitation and protection of water resources, and achieve harmony between life, production and the ecosystem. Only by managing rivers and lakes properly can we better utilize water resources and promote sustainable development.



4. Experience and understandings gained from China's water projects

4.6 Building new water conservancy systems through reform and innovation

Reform and innovation is the force to drive traditional water conservancy toward sustainable development. Only by expanding water reform and promoting institutional innovation can we meet the ever changing demand of the times and keep going forward.



4. Experience and understandings gained from China's water projects

4.7 Managing water by law and promoting legalization of water conservancy

We need to manage water resources by law, promote legalization of water conservancy, and continuously improve administration and public services. Only in this way can we regulate water-related affairs and maintain sound and sustainable development of water conservancy.



4. Experience and understandings gained from China's water projects

4.8 Building a talent pool to guarantee the development of water conservancy

Only by focusing on training talents and building a strong team can we secure the intellectual support we need for water conservancy development.



Thank you