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“One Lake & Four Rivers” in Hunan Province
—— Past, Present and Future

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The general introduction of “One Lake & Four Rivers”

Dongting lake — past and present

“Four Rivers” — past and present

The future of “One Lake & Four Rivers”
The general introduction of “One Lake & Four Rivers”

“One Lake & Four Rivers”: Dongting Lake, Xiang River, Zi River, Yuan River and Li River.

The geographical position:
N 27°39’-29°51’ and E 111°19’-113°34’.

The basin area:
204,800 km² in Hunan province

Fig.1. Water system map of Hunan province
Dongting lake is the second largest fresh water lake in China.

**Water area**: 710-2,700 km².

**EDL National Natural Reserve**: the first green list of the International Union for Conservation of Nature

**WDL National Natural Reserve**: internationally important wetlands

**SDL Natural Reserve**: internationally important wetlands

Fig.2. Dongting Lake basin
Prominent ecological function

The largest inland wetland reserve in Asia;
The world's 200 biodiversity hotspots identified by World Wildlife Fund;
National key biodiversity reserve and world freshwater fish quality species resource gene bank.

Dongting Lake is responsible for ecological security, water security and national food security in the Yangtze River Basin.
Good economic fundamentals

Dongting lake district is an **important agricultural production base** in China and has formed pillar industries such as food processing, petrochemical, paper making and light textile.

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Profound cultural background

With 55 state-level tourist attractions, **7 state-level nature reserves** and **7 state-level famous historical** and cultural cities and towns.
Evolution of water area of Dongting Lake (19th century—20th century)

Fig. 7. Variation diagram of Dongting lake water area from 1825 to 1995

Area (km²)

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<td>Area</td>
<td>6270</td>
<td>5400</td>
<td>4500</td>
<td>3600</td>
<td>2700</td>
<td>1800</td>
<td>1200</td>
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Fig. 8. Water area change of Dongting lake from 1852 to 1934

Dongting lake decreased from 6270 km² in 1825 to 2625 km² in 1995.

The lake is divided into three parts: East, South and West Dongting lake.

China’s largest freshwater lake, has been replaced by Poyang lake.

Fig. 9. Reclaiming farmland from lakes
Evolution of water area of Dongting Lake 20th century - 21th century

Fig. 10. Chart of main water area of Dongting Lake in 1996-2013

Fig. 11. Variation diagram of Dongting lake water area from 1996 to 2015

In 1998, implemented the project of “Returning farmland to lake" in time.

But between 1996~2013 years, the water area of the main lakes in Dongting Lake overall showed a shrinking trend.

Fig.12. Land cover change in the East Dongting lake during 1995–2015

The area of Water & Mudflat & Grass

The area of Reed, Forest & Total vegetation

The natural wetland

The artificial wetland
After the late 1990s: the water level fell unsteadily.
Since the operation of the Three Gorges Reservoir in 2003: the water level has been declining continuously. In 2006 and 2009, a rare historical drought has occurred, which has caused a series of ecological and environmental problems.
The main ecological and environmental problems in Dongting lake

Fig. 15. The flood disaster

Fig. 16. The drought

Fig. 17. The east voles

Fig. 18. The schistosomiasis
Fig. 19. Endangered species

Fig. 20. Alien species invasion

Fig. 21. Habitat destruction of birds

From 1991 to 2015: TN and TP fluctuated, deteriorated as a whole.

Pollution types have changed from industrial pollution in the past to diversified pollution (industrial, agricultural, living, etc.).

Fig. 22. TN and TP evolutions of the Dongting lake (1991-2015)

The concentration of Chla did not change much, from 0.99 to 5.39 mg/m³.

The number of phytoplankton increased significantly, increased from $16.95 \times 10^3$ to $3320.25 \times 10^3$ /L.

Fig.23. Chla and Phytoplankton evolutions of the Dongting lake(1991-2015)
From 2008 to 2010, East Dongting lake was *mild eutrophicated*. West Dongting lake and South Dongting lake were *moderately rich in nutrition*. 
The change of ecological management policy in Dongting Lake

- **1800-1950s**: Sediment silting, reclamation of land around the lake
- **1998**: The project of “Returning farmland to lake”
- **2002**: “General Planning Report of Dongting Lake 4350 Project in Hunan Province”
- **2005**: Comprehensively renovate the paper mill in the Dongting Lake basin
- **2006**: Hunan wetland protection regulations
- **2008**: “Regulations for Water Conservancy Management in Dongting Lake Area of Hunan Province”
- **2009**: “Recent Implementation Plan of Dongting Lake Governance”, the total investment amounts to 12.8 billion RMB

Under the concept of conquering nature

Under the concept of Harmony between Man and Nature
Water quality changes in Dongting lake in the past five years

No further deterioration than that in 2008-2010

In a state of medium to moderate eutrophication

Fig.28. The water quality of Dongting lake reaches the standard rate (2014-2018)

Fig.29. The outbreak of blue green algae in inner lake of dongting lake
Comprehensive treatment measures for water environment in Dongting lake

- Desilting
- Industrial pollution screening
- River chief system
- Populus deltoides cleaning
- Pollution control of livestock and poultry
- No purse-net breeding
- Treatment of living pollution
The change of ecological management policy in Dongting Lake

2014

"Planning of Dongting Lake eco economic zone"

2015

"Five Special Actions for Comprehensive Control of Water Environment in Dongting Lake"

"Implementation Plan of Special Action for Aquaculture Environment in Dongting Lake Region"

Guidelines for the treatment of black and odorous water bodies in cities

2017-2020


The ecological management of Dongting Lake becomes a national strategy
The characteristics of the change of ecological management policy in Dongting lake

A. Changes in the guiding ideology
   - Economic
   - Economic & Ecological
   - Ecological

B. Changes of content
   - Flood control, river regulation
   - Protection of lake health, biodiversity and wetlands

C. Change of means
   - Administrative
   - Administrative & Legal & Economic
   - Economic & Education
Xiang River

The largest river in Hunan province
The mother river of the Hunan people
A tributary of the Yangtze river
The total length is 948 km
The basin area is 9421 km².

The main source of water for industrial, residential and agricultural irrigation in Hunan province

Fig.30. Xiang River

Fig.31. Distribution of Water supply in different Watershed regions of Hunan Province in 2016
The most important economic belt in Hunan province.
The most densely populated region with the highest urbanization level and the most developed economic society and culture in Hunan province.

However, it also bears 60% of pollution in Hunan province, among which heavy metal pollution is the most serious.
Zi River

The Zi River is the third largest river in Hunan province.

- Total length: 661 km
- Catchment area: 28211 km²

The water quality of the Zi River reaches the standard rate.

Fig. 34. Zi River

Fig. 35. The water quality of Zi River reaches the standard rate

The Zi river is **third largest** river in Hunan province.

The total length is 661 km.

The catchment area is 28211 km².
Yuan River

The second largest river in Hunan province.

A tributary of the Yangtze river

The total length: 1053 km

The catchment area: 89833 km²

Rich in hydropower resources

Fig.36. Yuan River

Fig.37. The water quality of Yuan River reaches the standard rate
Li River

The smallest of the “Four Rivers”
The total length: 407 km
The catchment area: 16959 km²
The highest runoff modulus
Optimal water environment quality

Fig.38. Yuan River

Fig.39. The water quality of Li River reaches the standard rate
Review of water pollution in Xiang River

In the 1970s, known as “The green Xiang River”

From the late 1980s, **phenol, cyanide and heavy metal** pollution, mainly from **industrial pollution**.
Heavy metal pollution in Xiang River

Fig.42. Heavy metal pollution in Xiang River
This was a turning point, as the water quality of the Xiang river began to improve gradually.
Interim measures on ecological compensation for Xiangjiang River basin (water quality award and punishment)

Implementation plan for heavy metal pollution control in the Xiang river basin

Hunan Xiang River Protection and Management Regulations

The “Key Project No. 1” for the protection and management of Xiang River.

Implementation plan for the second "three-year action plan" for the protection and governance of Xiang river in Hunan province (2016-2018)

The management of the Xiang river basin has risen to the height of the national strategy

2011 2012 2013 2015 2016-2018
Water quality changes in Xiang River (1990-2017)

Fig.43. Water quality changes in Xiang River (1990-2017)
The future of “One Lake & Four Rivers”

- Flood Prevention and Mitigation Capacity Enhancement Project
- Black and smelly water treatment project
- Wetland ecological restoration project
- Ecological conservation belt construction project
- Heavy metal pollution control project in Xiang river basin
- Sewage treatment and upgrading project
- Breeding pollution control project
- Lake district dredging project
- River regulation and cleaning project
- Illegal Sand Mining Remediation Project
- Comprehensive improvement of human settlements

Protection of water supply and key areas
Thank You !