Chinese experience in water-saving irrigation

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Outline

- The importance of irrigation in China
- Water-saving irrigation in the past twenty years
- Effect from water-saving irrigation practices
- Outlook for irrigation
The importance of irrigation in China

- China is the most populous country in the world. (1.3958 billion in 2018)
- We need to feed ourselves and we did.
The importance of irrigation in China

- Irrigation contributes to the **food security of China**.
- Irrigation is totally required for stable output.
- Irrigation generally increase the yield by 1-2 times in China

Permanent irrigation (P<400 mm)

Unstable irrigation (400<P<1000 mm)

Supplement irrigation (P>1000mm)
The importance of irrigation in China

- Irrigation contributes to the **food security** of China.
  - China has the most irrigated lands in the world (65.87 million ha in 2018).
  - Irrigated land (about 50% of the total) produce 75% cereals and 90% cash crops.
  - 7% world arable land feed 20% world population.

![Irrigation area chart](chart.png)

Source: ICID 2018
The importance of irrigation in China

- **Irrigation contributes to the social development.**
  - Irrigated agriculture employ 27% labors in 2018 and ensure the rapid development is rural development
  - Irrigation projects provide 1/7 industrial and domestic water supply, covering 50% urban population.
The importance of irrigation in China

- Irrigation contributes to the social development.
  - The development in irrigation is one important measure for poverty-relief.

China promises to end poverty by 2020

1% in 2018

Poverty standard:

2018: Family's per capita net income < 3535 CNY Yuan
The importance of irrigation in China

- Irrigation play an important role in eco-environment protection.
- Oasis irrigation in arid areas greatly improves the living environment conditions for organism (plant, animals and human).
The importance of irrigation in China

- Irrigation play an important role in eco-environment protection.
  - The fertilizer consumption application rate is 3.7 times as the world average level.
  - The utilization application efficiency is less than 30%, half of the world average level.

![Fertilizer consumption (kilograms per hectare of arable land)](image1)

![2015 Overall Groundwater Quality](image2)

![Groundwater Quality Deterioration 2012-2016](image3)

Source: The World Bank, 2013
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The importance of irrigation in China

- Irrigation play an important role in eco-environment protection.
- Suitable irrigation and drainage management can help reduce agricultural pollution.
The importance of irrigation in China

- Irrigation plays an very important role in the Water security of China.
Water-saving irrigation in the past twenty years

- Political and policy support: building a water saving society.
  - Protecting and saving water is the basic national policy, 1983.
  - Promote water-saving irrigation as a revolutionary measure, The Third Plenary Session of the 15th CPC Central Committee, 1998
  - Building a water saving society, the 10th Five-Year Plan for Economic and Social Development of the People's Republic of, 2000
  - Water saving is focused in the No. 1 central document since 2004
  - Applying the Strictest Water Resources Management system, “three red line”, the No. 1 central document, 2011
Water-saving irrigation in the past twenty years

● Political and policy support: building a water saving society.

✓ “Applying the Strictest Water Resources Management system, “three red line”, the No. 1 central document, 2011

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<th>Table 1. Future water planning targets</th>
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<td>Targets</td>
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<td>Red line for total water use</td>
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<td>Total water consumption must not exceed</td>
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<td>Red line for water use efficiency</td>
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<tr>
<td>Industries will reduce their water use per US$1,600 (CNY10,000) of industrial added value</td>
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<tr>
<td>Irrigation efficiency must exceed</td>
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<td>Red line for controlling pollution</td>
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<td>The number of water function zones complying with the water quality standard will be more than</td>
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<td>All sources of drinking water will meet set standards for both rural and urban areas</td>
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<td>All water function zones will comply with water quality standards</td>
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Water-saving irrigation in the past twenty years

- Law
  - Water Law of the Peoples Republic of China
  - Agricultural Law of the Peoples Republic of China
  - Law of the PRC on the Popularization of Agricultural Technology

The people's governments at all levels shall implement water-saving irrigation methods and water-saving technologies, take necessary anti-leakage measures for agricultural water storage and water transfer projects, and improve agricultural water use efficiency.
Water-saving irrigation in the past twenty years

Investment

Investments in irrigation have been growing steadily and rapidly from the 6th Five-Year Plan period (1981–1985) to the now. The investment during the 12th Five-Year Plan (2011–2015) is about 200 times as that during the 6th Five Year Plan (1981-1985).

It is required that the local government should invest 10% of the land transfer fee in irrigation projects.
Water-saving irrigation in the past twenty years

Central government financed water-saving plans for irrigation

- Water-saving and Efficiency-increasing Demonstration project (1996-2008)
  - 1230 demonstration plot with a total area of 0.27 million ha
- Rehabilitation of large & middle-scale irrigation schemes with the objectives of increasing irrigation efficiency and productivity (1998-2020)
  - 434 large-scale irrigation (Irrigated Area > 3 million mu, or 20000 hm²)
  - 2157 middle-scale irrigation (Irrigated Area 667～20000 hm²)
  - 30 million ha effectively irrigated area is covered.
- National plan to increase production capacity of 100 million ton project (2009-2020)
  - Arable land ≈ 66.7 million ha
- Water saving irrigation in mountainous and pastoral area project (2011-2020)
- High efficient water-saving irrigation project (2012-2020)
Northeast: save irrigation water and increase grain product

North: Save irrigation water and reduce groundwater withdraw

South: Save irrigation water and reduce drainage

Northwest: Save irrigation water and increase Improve efficiency
Water-saving irrigation in the past twenty years

- Comprehensive water-saving measures
  - Engineering measures
  - Agronomic measures
  - Irrigation management measures
  - Economic and policy measures
Water-saving irrigation in the past twenty years

- Comprehensive water-saving measures
  - Improve the efficiency in conveyancing and allocating water

- Canal lining
- Canal lining
- Pipe
- Canal Control structure
Water-saving irrigation in the past twenty years

- Comprehensive water-saving measures
  - Improve the efficiency in field application

- Land leveling
- Film cover
- Improve surface irrigation efficiency
- Improve surface irrigation efficiency
Water-saving irrigation in the past twenty years

Comprehensive water-saving measures

✓ Improve the efficiency in field application

- Sprinkle irrigation
- Micro-sprinkle irrigation
- Drip irrigation
- Drip irrigation Under film
Water-saving irrigation in the past twenty years

- Comprehensive water-saving measures
  - Improve the efficiency agronomic measures

  - Sowing with partial irrigation
  - Conserve water by land covering
  - Coupling water and fertilizer application
  - Super absorbent polymer (SAP)
Water-saving irrigation in the past twenty years

- Comprehensive water-saving measures
  - Improve irrigation management

- Double control irrigation:
  - Water application rate
  - Total water consumption

- Smart Irrigation:
  - Soil/Water/Crop Sensing
  - Irrigation forecast
  - Precision irrigation

- Water saving irrigation scheme
Water-saving irrigation in the past twenty years

- Comprehensive water-saving measures
  - Optimizing irrigation water resource
Water-saving irrigation in the past twenty years

- Economic and social measures
  - Water user’s association (WUAs)

![Graph showing the increase in irrigated area managed by WUAs from 2010 to 2017, with a 35% irrigated area.]
Water-saving irrigation in the past twenty years

- **Economic and social measures**

  - **Water tariff reforms**: Water tariffs in China is below the price needed to recover the full financial cost of services, and much lower compared to other countries.
  
  2008, agricultural water tariff reform started
Water-saving irrigation in the past twenty years

- Economic and social measures
  - Water right exchange

    Started in 7 provinces in July, 2014
    Contents: water right identification and registration; water right exchange and related rules
    Dealer: inter-basin; upstream-downstream, regions; sectors; irrigators.

    China water exchange established in 2016 and 2.774 billion m³ water have been exchanged.
Water-saving irrigation in the past twenty years

Scientific and technic support:
✓ Irrigation experimental network

137 irrigation experimental stations have been built or rebuilt since 2003, providing standards for water saving
Water-saving irrigation in the past twenty years

Scientific and technic support:
✓ Irrigation experimental network
Water-saving irrigation in the past twenty years

Scientific and technic support
✓ A series of technical standard for water-saving irrigation engineering have been set to guide water-irrigation practices
Water-saving irrigation in the past twenty years

Scientific and technic support

- Systematic Research of irrigation water saving
Effects from Water Saving Irrigation

- Irrigated area increased from 55 million ha in 2000 to 68 million ha in 2018
- The ratio of water-saving irrigation area increased from 30% to 52%.
Effects from Water Saving Irrigation

- More efficient water saving technologies used
Effects from Water Saving Irrigation

- Unit yield: increased from 4261 kg/ha to 5621 kg/ha. (+32%)
- Total yield: increased from 462 to 658 million ton. (+42%)
- Total water use for agriculture slightly declined especially in recent years

![Graph showing changes in yield and water use from 2000 to 2018.](chart.png)
Effects from Water Saving Irrigation

Year 2000 → Year 2018

- Irrigation water use rate
  7185-5475 m³/ha -24%

- Irrigation water use efficiency
  0.43 → 0.554 +28%
  44 bn m³/yr water saved

- Irrigation water productivity
  0.86 → 1.25 kg/m³ +45%
The increases in agricultural productivity push the transformation of traditional agriculture to modern agriculture.

- The percentage of transferred land is higher than 35%.
Effects from Water Saving Irrigation

- Help to protect water-environment.

- Problems due to excessive irrigation are getting better, including soil salinity and water logging.
## Effects from Water Saving Irrigation

- Help to protect water-environment.

- Over-exploited groundwater is been slightly recharged.
Effects from Water Saving Irrigation

- Help to protect water-environment.
  - Saved water has been used by ecological restoration of dried/polluted water bodies.
Effects from Water Saving Irrigation

- Help to protect water-environment.

☑ The quality of surface water in the main rivers are getting better
Effects from Water Saving Irrigation

- Help to protect water-environment.
  - The farmer’s living environment is getting much cleaner and more beautiful
Outlook for irrigation

- Food security call for sustainable and more efficient irrigation.
- Water saving irrigation becomes more important as the task is more difficult.
- Nation water saving action plan was released in April 2019.

Prediction of national water demand

![Graph showing prediction of national water demand from 2000 to 2030.](image)

Figure 6. Indicators of water use efficiency for 2030

- Percentage of effective irrigated area (%): Present value 52.1, Target in the year 2030 57.5
- Water use efficiency of irrigated land (%): Present value 53, Target in the year 2030 60
- Water consumption for industrial added value per ten thousand CNY (m³): Present value 100, Target in the year 2030 40
Outlook for irrigation

- Environment

✓ Sound ecological environment is the most inclusive benefits to people's wellbeing.
✓ We want both golden, silver hill and clean water, green mountains as well.
✓ More consideration will be make when water saving is applied to irrigation.
-Outlook for irrigation

• Modernization

- Modernization of the State
- Urbanization
Thank you very much for your attention!