Experiences and Results of Irrigation Modernization

A Case Study of Zhanghe Irrigation System in China

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Key Drivers of Irrigation Modernization

1. Legacy of poor design, degraded infrastructure and poor management and stagnation in the face of rapid transformations of agriculture and pressure on their water supply

2. More food to feed the increasing population, but it is not likely to have more water available for irrigation

3. More water saved from irrigation sectors and be transferred to non-agriculture water users

4. Irrigation must play more important role in China in the future, and there is a need for irrigation systems to improve their financial, environmental, technical and service performance to significantly increase control, reliability, equity and flexibility

Key Policies, Strategies & Projects

1. Irrigation development has become the top issue: 50 billion CNY from central government of China for irrigation development every year

2. High-level policy support to provide incentives for research, dissemination of new technologies in irrigation development, especially for the research of water saving irrigation (WSI) technology

3. The large and medium-sized schemes claim top priority for the state investment, and a series of planning for the rehabilitation and modernization of the existed irrigation systems

4. Improving irrigation water management (e.g. WUAs, water price, capacity buildings, institutional reform…….)
**Project Location**

The Zhanghe Irrigation System (ZIS) lies within the Zhanghe Irrigation District (ZID) located within the Yangyze River Basin 200 km west of Wuhan.

- Jingmen City, a new industrial city, is near by and growing rapidly.
- In addition ZIS supplies the growing demand for hydropower.

**Physical Context**

- The Zhanghe Irrigation District -5,550 sq.km. designed to irrigate 160,000 ha.
- Hilly terrain with clay-loam soils
- Annual rainfall of 900 mm but highly variable annually and seasonally.
- Zhanghe reservoir the main source of irrigation.
- There are over 80,000 small ponds developed mainly by farmers.
### Institutional setting

- Multi-tiered structure of irrigation organization – provincial authority, Zhanghe Irrigation Administration Bureau, canal management authority, village and farmer groups.
- Villages and townships contract for water from the main canal section.
- Ponds and reservoirs located within system allow farmers to obtain water on demand.
- Price of water for alternative uses established by province.

### Water allocation and transfer

- The transfer occurred over a period of more than four decades and as time progressed involved actions on the part of ZIS and on the part of farmers to promote water saving and transfer to non-agricultural uses with relatively small decline in rice production.
- There has been no direct compensation and water rights are vested in the state.
Water inflow and releases from the Zhanghe reservoir

Average water uses (Mm3 x 100)

<table>
<thead>
<tr>
<th>Period</th>
<th>Irrigation</th>
<th>Industrial</th>
<th>Municipal</th>
<th>Hydro-electric</th>
<th>Flood released</th>
<th>Expan- sion</th>
<th>Inflow</th>
<th>Rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966-78</td>
<td>6.0</td>
<td>0.17</td>
<td>0.00</td>
<td>0.25</td>
<td>0.15</td>
<td>1.24</td>
<td>6.94</td>
<td>952</td>
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<tr>
<td>1979-88</td>
<td>3.62</td>
<td>0.37</td>
<td>0.09</td>
<td>0.53</td>
<td>2.27</td>
<td>1.19</td>
<td>7.53</td>
<td>967</td>
</tr>
<tr>
<td>1989-01</td>
<td>2.21</td>
<td>0.48</td>
<td>0.16</td>
<td>2.76</td>
<td>1.98</td>
<td>1.22</td>
<td>8.82</td>
<td>945</td>
</tr>
<tr>
<td>2002-10</td>
<td>1.41</td>
<td>0.42</td>
<td>0.29</td>
<td>4.47</td>
<td>0.96</td>
<td>1.24</td>
<td>8.88</td>
<td>922</td>
</tr>
<tr>
<td>2011-13</td>
<td>1.33</td>
<td>0.41</td>
<td>0.37</td>
<td>1.81</td>
<td>0.01</td>
<td>1.05</td>
<td>5.25</td>
<td>767</td>
</tr>
</tbody>
</table>

Changes in rice irrigated area, planted area, production and yield in ZID

<table>
<thead>
<tr>
<th>Period</th>
<th>Rice irrigated area ha x 1000</th>
<th>Rice planted area ha x 1000</th>
<th>Rice production ton x 1000</th>
<th>Rice yield Ton ha^-1</th>
<th>Water supplied Mm3 x 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966-78</td>
<td>138</td>
<td>173</td>
<td>698</td>
<td>4.04</td>
<td>8.50</td>
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<tr>
<td>1979-88</td>
<td>134</td>
<td>149</td>
<td>1001</td>
<td>6.72</td>
<td>7.74</td>
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<tr>
<td>1989-01</td>
<td>112</td>
<td>118</td>
<td>934</td>
<td>7.98</td>
<td>3.96</td>
</tr>
<tr>
<td>2002-10</td>
<td>74</td>
<td>96</td>
<td>726</td>
<td>8.23</td>
<td>1.79</td>
</tr>
<tr>
<td>2011-15</td>
<td>74</td>
<td>88</td>
<td>883</td>
<td>10.0</td>
<td>2.06</td>
</tr>
</tbody>
</table>

Irrigation water from Zhanghe Reservoir and rice production in ZID (1966-2015)

Farmer Actions

- Adopting alternate wetting and drying (AWD)
- Expanding and improving farm ponds
- Reducing area in rice
- Shifting from two rices per year to one
- Increasing rice yields
Safe AWD-mature technology; reduces S&P

Field water depth (mm)

Typical Water Pond Medium

Storage capacity between 1,000 to 10,000 m³

Pond construction by time period in ZID

<table>
<thead>
<tr>
<th>Year of construction</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965-1990</td>
<td>30</td>
</tr>
<tr>
<td>1991-1999</td>
<td>35</td>
</tr>
<tr>
<td>2000-20015</td>
<td>35</td>
</tr>
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</table>
Zhanghe Irrigation System actions

- Reduced delivery to farmers
- Volumetric pricing
- Improved surface storage
- Reduced losses from delivery system
- WUAs

Government actions

- Fei gai shui (2002)
- Subsidy on hectares planted to grains (2006)

Conclusion and Discussion

- A combination of government and ZIS policies and farmer practices have resulted in a transfer of water from irrigation to non-irrigation uses with relatively little loss in farm production.

- To realize the importance of water saving/conservation in a region with a relative rich of water resources at early stages, and to develop and disseminate water saving irrigation technology.

- At system level, the potentials and ways to improve WUE and save water are much greater than that at farm level.

- Many irrigation systems in developing countries measured the inflow only, and did not know how much water flowing out the boundary, and the flow path/fate after leaving the systems.

- The success of ZIS does not mean that all experiences and practices applied in ZIS can be used easily and simply in other irrigation systems and same results will be achieved.
Thanks for your attention!