Post evaluation on project rehabilitation and reconstruction of large scale irrigation districts in China

Han Zhenzhong, Prof. Dr.-Ing
China irrigation and Drainage Development Center (CIDDC)

Outline

1. Current situation of irrigation districts and large scale irrigation districts rehabilitation in China
2. Work procedure of post evaluation on large scale irrigation districts rehabilitation and reconstruction project
3. Method and content of post evaluation
4. Composing post evaluation report
5. Post evaluation case

1. Current situation of irrigation districts and large scale irrigation districts rehabilitation in China

1.1 Current situation of irrigation districts

Irrigation districts:
Irrigation districts with area more than 666.7 hm² in China: 7806
Irrigation area: 33.06 million hm², 49.9% of the total irrigation area in China.

Irrigation canals:
The total length of the irrigation canals: 1.01 million km
The length of lining canals: 299 thousand km, 29.7% of the total length.

1.2 Current situation of large scale irrigation district

Irrigation district with area more than 20000 hm²: 458
The total area of these irrigation districts: 17.7 million hm², 26.6% of the irrigation area in the country.
The irrigation water use: 110.9 billion m³, 33% of the total irrigation water use in the country.

Quantity proportion of different scale irrigation districts
Acreage proportion of different scale irrigation districts
Engineering facilities

The total length of the irrigation canals (flow≥0.2m³/s): 519.5 thousand km.  
The total length of the canals more than 1.0m³/s: 147.2 thousand km  
The length of lining canals (flow ≥ 1.0m³/s): 60.9 thousand km, 41.2% of the total length.

Ecological environment in large-scale irrigation districts

Relatively good. But, there are ecological problems such as source pollution, soil salinization, groundwater overexploitation, natural vegetation and soil degradation in these areas.

Problems

Low: the standard of engineering facilities, the informatization level of management, the efficiency and efficiency of irrigation
Weak: the irrigation service and management  
Not compatible with: Agricultural modernization, Construction of water-saving society and ecological civilization

Water management

Making water use plan according to needs of user, supplying water according to plan and contract
Making irrigation water use, water price, water fee in public.
The water price for irrigation: 1.6 to 80 USD per 1000m³, which is less than a half of the cost of water supply.
There are 12.1 thousand WUAs in the large scale irrigation district, and it charges 5.93 million hm² irrigated area, 31.83% of the total irrigated area in large scale irrigation districts.
Irrigation efficiency: The average irrigation efficiency of the large scale irrigation districts is 49.2% in China by the end of 2016.

1.3 Rehabilitation and Reconstruction of large-scale irrigation districts

The project of rehabilitation and reconstruction of large scale irrigation districts was started in 1998. It will be totally completed till the year of 2020.

Tasks: Improvement and reconstruction of the aging and disrepair irrigation engineering facilities, and seepage prevention lining for the serious leakage channel, management reform.

Objectives: to improve the efficiency of the irrigation water and the degree of water supply guarantee.

Project Progress: By the end of 2016, investment of 17.36 billion USD for rehabilitation and and reconstruction, 77.5% of the planned cost. Among the investment, 11.12 billion USD by the central government, and 6.24 billion USD by the locale government and irrigation districts.
1.3 Rehabilitation and Reconstruction of large-scale irrigation districts

Up to now, there are 210 large scale irrigation districts that have been completed the planned investment. In order to evaluate the implementation and benefit of the project, the post evaluation has been taken after the project is completed and operated for more than 2 years.

In post evaluation, the comparison will be made between expected effects in project plan and the actual effects achieved after the project completed, experiences and lessons are summarized, and countermeasures and suggestions is put forward.

“Regulations for post evaluation of water conservancy construction projects (Trial)”, “Specifications on report preparation for post evaluation of water conservancy project”, the both are the basis for the post evaluation of projects irrigation districts construction and rehabilitation.

Specific work steps for post evaluation:

(1) Select assessment agency. Selecting qualified professional and technical units to undertake the post evaluation, and sign contract.
(2) Determine the evaluation method and standard.
(3) Make out work plan.
(4) Self evaluation of irrigation districts. According to the post evaluation requirements, the irrigation area management department filled the post evaluation data questionnaire; made analysis and summary on project construction, project benefit, management reform, etc.; and compiled a self-assessment report.
2. Post evaluation work procedure of project irrigation district rehabilitation

(5) Expert technical training.
(6) Field survey and assessment. Evaluation expert group make field investigation and evaluation, according the discussion, the beneficiary survey, the monitoring data collection and analysis, and the field investigation to complete the field assessment.
(7) Data review, comprehensive analysis and evaluation.
(8) Compile post evaluation report.
(9) Submit the post evaluation results to the management department.
◆ Feedback the result to the management organization of the irrigation district, put forward problems and suggestions for improvement.
◆ Submit a summary evaluation report to the MWR, put forward some suggestions and proposals.

3. Post evaluation method and content

3.1 The principle of post evaluation

◆ Equity. The evaluation staff must abide by the principle of seeking truth from facts and fairness and impartiality, so as to ensure the correctness of the evaluation process and conclusions.
◆ Objectivity. The basic data and supporting materials of the evaluation should be based on the actual data after the project is completed and the results have been achieved after the project is operated for more than 2 years, so as to ensure the objective authenticity of the evaluation.
◆ Scientificity. Using scientific and reasonable analytical methods to ensure the scientific of post evaluation. In the post evaluation, the evaluation criteria should be consistent with the calculated statement, and the actual data and the planned data should be comparable. Meanwhile, the emphasis should be emphasized so as to make the post evaluation work more pertinent.

3.2 Evaluation method

In the post evaluation it mainly adopts the investigation and analysis method and the contrast analysis method.
◆ The investigation and analysis method.
◆ The contrast analysis method.

The data used for evaluation:
statistical yearbook, design document, completion report, typical investigation and monitoring data, the base data before project implementation is the data in planning base year (1998) , and the data after project implementation is the data in the year of evaluation doing.

3.3 Evaluation content

The post evaluation content includes Project implementation process evaluation, management and reform evaluation, benefit evaluation, impact assessment, project objectives realization and sustainability evaluation, etc.

<table>
<thead>
<tr>
<th>NO.</th>
<th>Evaluation Category</th>
<th>Evaluation content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Project implementation process</td>
<td>The preliminary work of the project, the management of the project construction, the completion of the planned investment, the completion of the construction task, the evaluation of engineering technology, etc.</td>
</tr>
<tr>
<td>2.</td>
<td>Management and reform of irrigation districts</td>
<td>Number of professional staffs, fund for operation and maintenance, water price and water use, participatory management, water metering, information management, etc.</td>
</tr>
<tr>
<td>3.</td>
<td>Project benefit</td>
<td>Economic benefit, social benefit, improvement of local economy, income increase, farmers' benefit, etc.</td>
</tr>
<tr>
<td>4.</td>
<td>Project impact</td>
<td>Social impact, environmental impact, etc.</td>
</tr>
<tr>
<td>5.</td>
<td>Objectives realization and sustainability</td>
<td>Project objectives realization, stability of irrigation area, sustainability of engineering operation and maintenance, continuity of policy support by government, etc.</td>
</tr>
</tbody>
</table>
3.3 Evaluation content

3.3.1 Evaluation of project implementation process

3.3.1.1 Preliminary work

(1) Whether the approval of the feasibility report and the implementation plans comply with the regulations of management and other relevant regulations.

(2) Compare the planning and implementation documents, if change, make explanations on the change and adjustment of project.

Evaluation indicator:
The conformity of implemented content and approved content:
\((\text{Investment change / approved investment}) \times 100\%\).

3.3.1.2 Construction management

The evaluation includes:
The regularized construction management and capital management; special audit and audit conclusions, any violation of discipline and rectification situation; the reasonableness of design changes; quality control management in the process of project implementation, project acceptance management, etc..

Evaluating indicators:
◆ The conformity degree of project management and management requirements:
\(\frac{\text{Quantity of standard management projects}}{\text{Quantity of total projects}} \times 100\%\)

◆ Standardization of capital management:
\(\left(1 - \frac{\text{Quantity of illegal and disciplinary projects found in the audit}}{\text{Quantity of total projects}}\right) \times 100\%\)

3.3.1.3 Investment on backbone engineering

Evaluation includes: Investment capital of the planned, approved and actual completed, paid-in investment and timeliness at central and local level, etc..

Evaluating indicators:
◆ the percentage of actual completed investment to approved investment on backbone engineering:
\(\frac{\text{actual completed investment}}{\text{approved investment}} \times 100\%\)

◆ Proportion of paid-in counterpart funds:
\(\frac{\text{the actual paid-in investment at local level}}{\text{the planned investment at local level}} \times 100\%\)

3.3.1.4 Completion of the construction tasks

To explain the completion degree of the construction tasks, and the reason should be given if there are changes. The impact on completion of the planned construction tasks due to improvement of construction standards and the price rising should be analyzed.

Evaluating indicators:
Completion rate of canals, or Completion rate of drainage ditches:
\(\frac{\text{the completion length of canals/drainage ditches}}{\text{the approved length of canals/drainage ditches}} \times 100\%\)

Completion rate of structures for rehabilitation and reconstruction:
\(\frac{\text{Completion rate of the completed structures}}{\text{Quantity of the approved structures for rehabilitation and reconstruction}} \times 100\%\)
3.3 Evaluation content

3.3.1 Evaluation of project implementation process

3.3.1.5 The Application of advanced technology
The effect and application of new technology, new materials, new construction processes and new equipment (“four new”), such as the application of the “four new” in construction of water source engineering, canal seepage prevention, building type, drainage engineering, water measurement and information management.

3.3.1.6 Rehabilitation of field engineering
the actual completion of investment in field engineering, the situation of field engineering rehabilitation at the same time should be evaluated.

3.3.2 Irrigation district management and reform evaluation

3.3.2.1 Operation & maintenance of irrigation districts
Evaluation includes: the number of professional staffs in the irrigation districts, the approved content and time of the reform scheme, the number of current staffs for management, approved operation and maintenance funds, the paid-in funds, and so on.
Evaluating indicators:
- the proportion of the number of current staffs to the approved number of staffs in irrigation districts;
- the rate of paid-in funds on operation & maintenance:
  \[
  \text{paid-in funds on operation & maintenance} \times 100\% 
  \]

3.3.2.2 Water price and water fee
The evaluation includes: the approved irrigation water supply cost and water price, the charge form of water fee (According to the cubic meter or according to the irrigation area), the collection rate of water fee, etc..
Evaluating indicators:
- the percentage of water price to water supply cost:
  \[
  \frac{\text{approved water price}}{\text{approved water supply cost}} \times 100\% 
  \]
- the collection rate of water fee:
  \[
  \frac{\text{actual collected water fee}}{\text{receivable water fee}} \times 100\% 
  \]

3.3.2.3 Water User’s Participation Management
To evaluate the situation of WUAs or farmers’ water users participation in irrigation management, the mechanism of participation in management, funding guarantees, the number of WUAs, and the irrigation area managed by WUAs.
Evaluation indicator:
- Increase rate of irrigation area managed by Farmer’s water use cooperative organization, such as WUAs and so on:
  \[
  \frac{\text{irrigation area managed by WUAs after project implementation} - \text{the one before}}{\text{the total irrigation area of irrigation districts}} \times 100\% 
  \]

3. Post evaluation method and content
3.3 Evaluation content

3.3.2 Irrigation District Management and Reform Evaluation
3.3.2.4 Water Measurements
To evaluate water measurement methods, the amount of water measurement facilities and its applications.

Evaluation indicator:
◆ The improvement extent of water measurement, that means, (the number of water measurement at lateral canals and higher level canals after project implementation – the one before)/ the total number water outlets at lateral canals and higher level canals) *100%

3. Post evaluation method and content

3.3 Evaluation content

3.3.3 Project Benefit Evaluation
3.3.3.1 Water Saving
The actual Water efficiency of canal system, water efficiency of irrigation, water saving capacity after project completed should be compared with the expected benefits of the approval plans to illustrate the extent of realization of water saving benefits.

Evaluation indicators:
◆ The decline percentage of average water consumption per hm² (the average water consumption per hm² before – the one after project completed)/ the average water consumption per hm² before ) *100%
◆ The realization extent of water saving benefits Water saving capacity after project completed/the expected water saving capacity of approval plans * 100%

3.3.3.2 Increase of grain yield and farmer income
To analyze the new developed and improved irrigation area in irrigation district before and after project completed, the grain yield change, the total grain output and net farmer’s incomes per capita.

Evaluation indicators:
◆ The increase rate of average grain yield per hm², that means, ((the average grain yield per hm² after project completed – the one before)/the average grain yield per hm² before) *100%
◆ The increase rate of net income per capita of farmer, that means, ((net farmer’s income of per capita after project completed – the one before)/net farmer’s income of per capita before) * 100%

3.3.4 Impact Assessment
Based on the actual situation of irrigation district, the impact of project constriction on social and environmental aspects is generally analyzed, includes some aspects as follows:
● The implementation status and effects of water and soil conservation, environmental projection
● Change of irrigation rotational period
● Reduction of irrigation labor intensity
● Reduction of water disputes
● Rural environment Improvement in irrigation district
3.3 Evaluation content

3.3.5 Objective realization and sustainability

3.3.5.1 Objective realization

The reached objectives after rehabilitation and reconstruction are compared with expected objectives of approved plan to analyze the objective realization. Compared and analyzed indicators are mainly as follows:
- New added and improved irrigation area
- Irrigation water saving capacity after project implementation
- Irrigation water efficiency
- Grain production increased per unit of irrigation area
- Total grain production increase in irrigation district

3.3.6 Comprehensive evaluation and conclusion

Finally, an integrated evaluation and overall conclusion can be made based on summary evaluation of the project implementation process, management and reform, project benefits, impact assessment and objective realization and sustainability and evaluation of other aspects of the project.

3.3.7 Lessons, problems and recommendations

The main learned lessons and experiences for reconstruction and rehabilitation of irrigation district, management and reform should be summed up, and suitable recommendations for irrigation district reconstruction and management in the future should be given.
In 2017, China irrigation and drainage center (CIDDC) was commissioned by MWR to carry out post-evaluation work on 28 irrigated districts which the planned investment had been completed by the end of 2015, and had been operated for more than 2 years.

The investment situation of 28 evaluated large-scale irrigation districts:

The total planned investment for rehabilitation and reconstruction was 1.5 billion USD, 23 irrigation districts with planned investment of 160 thousand to 80 million USD, 5 irrigation districts with planned investment of more than 80 million USD.

The total planned irrigation area of 28 irrigation districts are 1.64 million hm², 25 irrigation districts with irrigation area from 20 thousand hm² to 667 thousand hm², 3 irrigation districts with irrigation area of more than 667 thousand hm².

5.1 Evaluation work process

1. To make work plan for post evaluation of irrigation districts
2. To compile "Technical Guidelines for post-evaluation of large scale irrigation districts rehabilitation and reconstruction project"
3. To carry out self-evaluation work in every irrigation district, to complete the self-evaluation report
4. To carry out on-site investigation and data review work
5. To review self-assessment report in every irrigation district and to conduct a integrated assessment based on on-site investigation
6. To collect and analyze post-evaluation results of 28 irrigation districts, and to make overall evaluation
7. To complete summary post evaluation report, and to submit to MWR

5.2 Main results of post-evaluation

5.2.1 Project implementation process evaluation

- Completion of planned investment

28 irrigation districts have completed a total of 1.46 billion USD investment in rehabilitation and reconstruction project, accounting for 97.1% of the total planned investment. Among them, it has completed 1.10 billion USD investment from central government, and 360 thousand USD from local government and irrigation districts. However, a part of local parallel financing investment has not put in place and has not been implemented.

The percentage of planned tasks completion:

<table>
<thead>
<tr>
<th>Construction content</th>
<th>Head works (Units)</th>
<th>Structural (Units)</th>
<th>Irrigation canals (km)</th>
<th>Drainage ditches (km)</th>
<th>Works amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>The percentage of planned tasks completion</td>
<td>100.0%</td>
<td>98.1%</td>
<td>92.2%</td>
<td>104.1%</td>
<td>94.3%</td>
</tr>
</tbody>
</table>
Water use measurement facilities

There are 12,123 water measurement facilities in lateral canals and higher level canals in 28 irrigation districts, of which, the proportion of water measurement facilities to outlets in lateral canals and higher level canals in irrigation districts Zuncun (Shanxi), Santunhe (Xinjiang), and fuhai (Xinjiang) is relatively high and reaches over 80%.

<table>
<thead>
<tr>
<th>Projects</th>
<th>Flow measurement (Division)</th>
<th>Standard measurement (Division)</th>
<th>Buildings measurement (Division)</th>
<th>Trench measurement (Division)</th>
<th>Meter measurement (Division)</th>
<th>Other measurements (Division)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity</td>
<td>491</td>
<td>528</td>
<td>689</td>
<td>2677</td>
<td>643</td>
<td>896</td>
<td>12123</td>
</tr>
<tr>
<td>Percent (%)</td>
<td>4.1%</td>
<td>4.3%</td>
<td>56.9%</td>
<td>22.1%</td>
<td>5.3%</td>
<td>7.4%</td>
<td></td>
</tr>
</tbody>
</table>

5. Post Evaluation case

5.2 Main results of post-evaluation

5.2.1 Project implementation process evaluation

- Water use measurement facilities

In 26 irrigation districts, informatization construction have been carried out at a different level, it has completed a total investment of 27 million USD in informatization construction.

- Management and reform evaluation

- Irrigation water price

The average water price is only 38.3% of the cost of water supply. Only 4 irrigation districts, their water price for agricultural irrigation has reached over 70% of the water supply cost, only one of 28 irrigation districts, its water price can cover the cost of water supply.

- Collection of irrigation water fees

There are 6 irrigation districts that collect irrigation water fee not from farmers, but from local finance fund, the rest of 22 irrigation districts collect irrigation water fee from farmers. The irrigation district should submit agricultural irrigation water fee 41.7 million USD in total, the actual collected water fee was only 30.6 million USD. The average collection rate of water fee is 73.2%.
Participatory irrigation management

1263 WUAs in 26 irrigation districts, maintain and operate irrigation area of 350 thousand hm², accounting for 20.7% of the total irrigated area of these irrigation districts. In 10 irrigation districts, the irrigation area managed by WUAs has reached more than 50% of its total irrigation area.

Post Evaluation case

5.2 Main results of post evaluation
5.2.2 management and reform evaluation

- Participatory irrigation management

5.2.4 objective realization evaluation

<table>
<thead>
<tr>
<th>Objectives realization of project</th>
<th>Value of Plan target</th>
<th>Reached value</th>
<th>Realization realization</th>
</tr>
</thead>
<tbody>
<tr>
<td>planned investment for main water works (million USD)</td>
<td>1505.7</td>
<td>1462.5</td>
<td>97.1%</td>
</tr>
<tr>
<td>planned investment for on-farm water works (million USD)</td>
<td>745.2</td>
<td>897.9</td>
<td>120.5%</td>
</tr>
<tr>
<td>New developed (restored) irrigation area (thousand hm²)</td>
<td>346.6</td>
<td>225.1</td>
<td>64.9%</td>
</tr>
<tr>
<td>Improved irrigation area (thousand hm²)</td>
<td>1102.2</td>
<td>1057.0</td>
<td>95.4%</td>
</tr>
<tr>
<td>New added water saving capacity (100 million m³)</td>
<td>23.7</td>
<td>18.9</td>
<td>79.4%</td>
</tr>
<tr>
<td>Irrigation water efficiency</td>
<td>56.8%</td>
<td>53.1%</td>
<td>71.6%</td>
</tr>
<tr>
<td>Grain yield (kg/hm²)</td>
<td>8206</td>
<td>8745</td>
<td>106.6%</td>
</tr>
<tr>
<td>New added grain yield (100 million kg)</td>
<td>39.2</td>
<td>30.8</td>
<td>78.6%</td>
</tr>
</tbody>
</table>

Average water efficiency of canal system and irrigation water efficiency in 28 irrigation districts has reached 61.6% and 53.1% respectively. The annual water saving capacity of 28 irrigation districts reaches 1.89 billion m³ water among them, 1.01 billion m³ water is used for expanding and improving irrigation area, 570 million m³ water for industrial and domestic living use, 310 million m³ water for ecological environment improvement.

5.2 Post-evaluation main results
5.2.3 project benefits evaluation

- New developed and improved irrigation area
  The irrigation area has increased from 1.3 million hm² (before project implementation) to 1.52 million hm² (after projects are completed), new developed irrigation area are 225 thousand hm². At the same time, the irrigation area of 1.05 million hm² is improved.

- Water saving
  The grain production per hm² increased from 6675 kg (before project implementation) to 8745 kg (after project is completed) in irrigation district, the grain yield per hm² increased by 2070 kg, and the new added grain production capacity of 28 irrigation districts has reached 2.64 billion kg.

- Agricultural output increase
  After project completed, the proportion of grain crops to cash crops in the 28 irrigation districts was adjusted from 7.4:2.6 in 1998 to 6.2:3.8 in 2016. The total agricultural output of the irrigation districts was increased from 11.23 billion USD to 28.23 billion USD, an increase of 151%.

- Farmer’s income increase
  After project completed, the annual net farmer’s income per capita in the irrigation districts was increased from 526 to 1666 USD, an increase of 210%.
Thank You