People's Republic of China

Ex-Post Evaluation of Japanese ODA Loan Project

"Xinjiang Water-saving Irrigation Project"

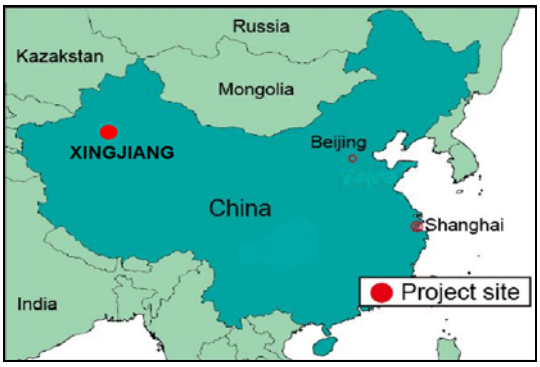
External Evaluator: Makiko Soma, Global Link Management, Inc.

0. Summary

China is one of the world's thirteen countries of the scarcest water endowment where the volume of its total water resources is less than a quarter of the world average. In Xinjiang Uygur Autonomous Region, hereinafter referred to as Xinjiang, annual precipitation is around 150 mm and it embraces a large rural population. For both China and Xinjiang, stable supply of water, improvement in water management ability, and improvement in agricultural productivity are important issues. Thus, this project has been highly relevant with the country's development plan, development needs, as well as Japan's ODA policy; therefore its relevance is high. This project has largely achieved its objectives in terms of volume and ratio of water saved. It also contributed to increase in the crop yield and farmers' income to some extent. Therefore, its effectiveness and impact are both high. Although the project cost was lower than planned, the project period was longer than planned; therefore efficiency of the project is fair. No major problems have been observed in the operation and maintenance system, therefore sustainability of the project effect is high.

In light of the above, this project is evaluated to be highly satisfactory.

1. Project Description



Location of the Project Site

Main Canal (Turpan)

1.1 Background

China is a water poor nation specified by the United Nations, usage of water resources per capita is about one-fourth of the global average. As of 2000, irrigation water accounted for 70% of water supply for agricultural purposes. Xinjiang was faced with many challenges such as

slow development in irrigation facilities, obsolete water facilities not replaced with new ones, inefficient use of agricultural water, unreasonably low water fees not being able to cover the cost of maintenance expenses.

Xinjiang Uygur Autonomous Region is located in the westernmost part of China. Its area covers 1,650,000 square kilometers of land, or about one-sixth of China, which is equivalent to 4.5 times the size of Japan's land, and is the largest among the provinces and autonomous regions of China. About a quarter of Xinjiang was desert as of 2001, accounting for about two-thirds of the total land area of the desert all over China, in which farming was not possible without irrigation. There are great needs for saving water in such an arid area; however, the amount of water loss was extremely high because the irrigation facilities were mostly earth canal. Xinjiang's total population was about 19 million as of 2001, the two thirds was non-Han ethnic minorities. The region suffers from a serious inland poverty and there was a large income disparity between the inland and the coastal area. Maximizing the limited water resources was an important issue for the region to improve agricultural productivity and profitability, hence, to improve living standards of the local residents.

1.2 Project Outline

The Project aims to increase agricultural production while reducing water intake from the riverine system through establishment of canal lining, construction of water-saving irrigation facilities and construction and rehabilitation of wells, thereby contributing to the mitigation of desertification and increased incomes of farmers within the 9 areas of Xinjiang Uygur Autonomous Region.

Loan Approved Amount/ Disbursed Amount	14,400 Million Yen/ 13,347 Million Yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 30, 2001/ March 30, 2001
Terms and Conditions	Interest Rate: 1.3 % p.a. Repayment Period: 30 years (Grace Period 10 years) General untied
Borrower/ Executing Agency	People's Republic of China/ Water Resources Bureau (WRB), Xinjiang Uygur Autonomous Region
Final Disbursement Date	March 8, 2010
Main Contractor	Xinjiang North Construction Co., Ltd. (China)・Xinjiang Sutong Engineering Construction Co., Ltd. (China) (JV)
Main Consultant	NA
Feasibility Studies etc.	F/S conducted by Xinjiang Survey and Design Institute of Water Resources and Hydropower (May, 2000)
Related Projects	JICA: "Model Planning Project for Water-Saving Measures on Large-Scale Irrigation Scheme (2001-2006)," World Bank (IDA) Tarim Basin I (1992-1997): Water resources management, agriculture and livestock etc. World Bank (IDA & IBRD) Tarim Basin II (1998-2003): Water resource management, farmland reclamation, environmental monitoring etc.

Source: WRB

Figure 1 Map of the Project area (Project Areas are specified in squares)

2. Outline of the Evaluation Study

2.1 External Evaluator

Makiko SOMA, Global Link Management Inc.

2.2 Duration of Evaluation Study

This evaluation study was conducted in the following schedule.

Duration of the Study: July, 2011 – September, 2012

Duration of the Field Study: October 9, 2011 – October 22, 2011 and
February 21, 2012 – March 2, 2012

2.3 Constraints during the Evaluation Study

In consultation with the Xinjiang Uygur Autonomous Region, three cities/counties were selected for the beneficiary survey and site visits among the eight[1] target cities/counties considering the time constraints and accessibility. The three cities/counties are namely, Turpan, Tacheng, and Changji. Therefore, the results of the field study might not represent the situation of all target areas.

[1] The plan of the target area was scheduled for 9 districts at the time of the appraisal. However, it became 8 districts since Urumqi was canceled. The reasons of the cancelation are detailed in 3.4.1.

3. Results of the Evaluation (Overall Rating: A[2])

3.1 Relevance (Rating: ③[3])

3.1.1 Relevance with the Development Plan of China

In the Ninth Five-Year Plan (1996-2000), China aimed at prevention of desertification and comprehensive water resources management. To achieve the aim, Chinese government set out three national plans and goals; designation of 300 water-saving irrigation production model prefectures, achievement of 18,670,000 ha water-saving irrigation area in total at the end of 2000, and saving of 6 billion cubic meters of agricultural water every year.

In the Tenth Five-Year Plan (2001-2005), to combat the further aggravated desertification during the Ninth Five-Year Plan, the government put further emphasis on the maintenance of vegetation cover in arid lands that had been prone to desertification. In addition, there had been a growing emphasis on the production yield increase in order to meet the growing demand for food along with the population growth. The reclamation of the land had been strictly restricted after the Yangtze River Flood in 1998; thus the production volume had to increase solely by the yield improvement without expanding the cultivation area. Introduction of highly efficient water-saving irrigation had been, in this regard, counted as important measures to ultimately maintain the vegetation cover, to ensure food security, and to address to poverty.

In the Eleventh Five-Year Plan (2006-2010), water-saving technology was promoted in order to accelerate the dissemination of water-saving agricultural technology, to shift to higher-yield cultivation, to expand water saving agricultural area. In addition, continuous emphasis was put on the prevention of desertification through afforestation in the three north (Northeast, Northwest, and North), establishment of a protection forest, and conversion of degraded farmland into forest/grass.

The Twelfth Five-year plan (2011-2015) as well, put emphasis on the prevention of desertification, pursuit of water-saving agriculture and sustainable use of resources, enhancement of agricultural productivity through improved efficiency.

As for the anti-poverty measures, the development policy is currently being implemented to put on track the economic growth in the western district of inland by stages for a period of 50 years from 2001 through the China Western Development as the policy of correcting the disparities that were resulted from the priority development of eastern coastal district.

In the 11th Five-Year Plan (2006-2010), the Government of Xinjiang was placing importance on the water saving by recovering vegetation cover, preventing desertification, and by diffusing both the water-saving agriculture and the irrigation technology. Pursuant

[2] A: Highly Satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

[3] ③: High, ②: Fair, ①: Low

to the "National Construction Plan of Ecological Environment" (January, 1999), they laid out the goals to increase water-saving irrigation area, to raise irrigation water use coefficient, and to enhance water-saving awareness while aiming to realize the water-saving society by 2010.

In Xinjiang's 12th five-year plan (2011-2015), the emphasis was also placed on preventing desertification of the Tarim Basin and the Dzungaria Basin. It laid out the goals to almost double the highly-efficient water-saving irrigation area by 2015, to further increase the irrigation water use coefficient, to increase the number of paved canal, and to reduce the total quantity of water demanded for irrigation.

3.1.2 Relevance with the Development Needs of China

In China, use of irrigation water remained inefficient and its improvement was desired. For example, in 2000, in Israel where irrigation technique was highly advanced, productivity of grain was 2.32 kg per cubic meter of water, while it was only 1 kg per cubic meter of water in China. Adaptation of water-saving irrigation technique was even slower in inland China. In Xinjiang, located in a deprived area of inland China, enhancement of productivity by introducing water-saving irrigation was expected to contribute to income increase of the poor rural households and to redressing the disparity between the inland and coastal areas.

In JICA's technical cooperation project, "Model Planning Project for Water-Saving Measures on Large-Scale Irrigation Scheme (2001-2006)," priority model irrigation schemes established in three provinces were disseminated to twenty irrigation sites. Among these twenty sites, Manas County, one of the target areas of this Project, was included. This inclusion of Manas in JICA technical cooperation project implies the high needs of this Project in the target areas.

In addition to scarce precipitation and severe natural environment, Xinjiang embraced a large rural population. It was 12.09 million, accounting for 64.4% of the total population in 2001; and it increased to 12.41 million in 2009, accounting for 56.9% of the total population.

In Xinjiang, annual flow rates of the rivers were unstable, thus supply of stable irrigation water was a crucial bottleneck in the region's agricultural development. Upgrading of irrigation facilities still had a room for improvement at ex-post evaluation. In Xinjiang, with severe natural environment and large rural population, there still were great needs for upgrading the irrigation facilities for the purpose of supplying stable irrigation water, improvement in water management ability, and improvement in agricultural productivity.

3.1.3 Relevance with Japan's ODA Policy

JICA's Strategy for Overseas Economic Cooperation Operations (December 1999 to March 2002) set out three prioritized areas, namely, "environment," "Food/Poverty," and "prioritization of inland for redressing the regional disparity." Japanese government, in its Economic Cooperation Program for China, publicized that they would emphasize controlling desertification, environmentally sustainable agriculture, rural development and poverty alleviation through improvement in agricultural productivity, water projects for efficient water use.

This project has been highly relevant with the development plan and development needs of China and of Xinjiang, as well as Japan's ODA policy; therefore its relevance is high.

3.2 Effectiveness[4] (Rating: ③)

3.2.1 Quantitative Effects (Operation and Effect Indicators)

(1) The water-saving ratio

One of the objectives of this project is the reduction of water intake from a river-system, and the main indicator to measure the project effect is the water-saving ratio[5] of the targeted area of the project. As shown in Table 1, the volume of irrigation water demand decreased from 18,040 million m^3 to 17,180 million m^3, indicating the water-saving ratio of 4.8% which almost achieved the targeted ratio of 4.9%[6]. The water use efficiency[7] of all of the irrigation method introduced, namely, canal, sprinkler, drip, and pipe, also exceeded the target.

Table 1 Irrigation water demand and amount of water-saving

(Unit: 100 million m^3)

Indicators	Before the project	After the project	Amount of water-saving	
Irrigation water demand	180.4	171.8	8.6 (Water saving rate 4.8%)	
			Breakdown of water-saving	
			Canal lining	4.3
			Sprinkler	1.5
			Drip	2.3
			Pipe	0.5

Source: Appraisal document, WRB

[4] Sub-rating for Effectiveness is to be put with consideration of Impact

[5] Water-saving ratio is obtained as the volume of water saved divided by the total water irrigation water demand before the Project.

[6] Agricultural production volume of the Project sites increased from 2,017,220 tons in 2000 to 2,205,262 tons in 2010. Cultivated land area increased from 1.27 million ha in 2000 to 1.29 million ha in 2010. Thus, the saving of water is not a result of decrease in agricultural production.

[7] The water use efficiency, in this report, is obtained as the water reached to the crop root zone divided by the total volume of water got into the farm.

Table 2 Water-use efficiency

	Target	Achievement (2009)
Canals	57%	93%
Sprinkler	81%	97%
Drip	85%	100%
Pipe	84%	97%

Source: Appraisal document, WRB

Pumping machine and fertilizer mixing machine (Tacheng)

Cotton field with drip irrigation (Changji)

(2) Farm products unit yield

The unit yields of the major crops in the Project targeted areas increased as shown in Table 3. At the time of the ex-post evaluation, the unit yield increased by 176% from the original value for wheat, 139% for corn, 140% for cotton, and 143% for fruit. Owing to upgrading and improvements of irrigation facilities as well as various technical trainings on water management, the stability and timeliness of water supply have improved. These facility improvements and trainings on water management greatly contributed to increase the yields. As another contributing factor, the guidance provided by Xinjiang agricultural bureau and by the local governments' agricultural offices on the technical matters such as effective use of fertilizers, pesticides and mulching[8] seem to have been effective. The drip irrigation facilities, for example, can improve water-saving efficiency when combined with farming technologies such as mulching that has moisture retention and the thermal effects. This kind of combination can further improve farm productivity. In this project, there seems to have been no particular cooperation between the Xinjiang WRB and the agricultural bureau for conducts of the trainings. There might have been a possibility of overlaps in the contents of the training and the training schedules may not have been the most efficient. If both agencies had cooperated in planning and in implementation of the

[8] Mulching is to place plastic or paper over the soil surface to maintain soil moisture, to gain thermal effect, to prevent runoff of fertilizers and pesticides and overgrowth of weeds etc.

training, the overlaps of the training contents would have been avoided and the contents might have been enriched further.

Table 3 Unit yield by major crops

(Unit: kg/ha)

	Before the project (2000)	After the project (2011)	Rate of increase
Wheat	4,978	8,774	176%
Corn	7,781	10,828	139%
Cotton	3,403	4,751	140%
Fruits	39,625	56,643	143%

Source: WRB

3.2.2 Qualitative Effects

In this ex-post evaluation, the questionnaire survey has been carried out for 25 people in four areas (100 people in total), namely, Changji, Shā-wān, Turpan and Xinhe, of the project sites. According to the survey, 100% of the respondents answered positively to the question, "Water-saving has become more effective owing to the irrigation facilities introduced by this project compared to the time before the Project." From this, it is clear that the farmers recognize that this project has contributed to water-saving. In addition, 96% replied positively to the question, "the productivity of the farm had improved." The farmers also recognized the yield increase in their farm products.

3.3 Impact

3.3.1 Intended Impacts

(1) Prevention of desertification through the vegetation coverage

The Xinjiang government does not have the data such as the secular changes of the desert area in the autonomous region, but the forest coverage of the targeted areas increased from 2.22% to 4.52% and the vegetation coverage from 12.8% to 26.4%, as shown in Table 4; thus, exacerbation of desertification has been restrained to a certain degree. The direct cause of the increase in the vegetation coverage should be ascribed to the result of the tree planting project of the Chinese government, thus it is difficult to clarify the direct causality of this project and vegetation increase. However, effective water resources management through the facilities maintenance of this project should have contributed to prevention of desertification, as one of the important and appropriate, though not a direct, countermeasures. In the beneficiary survey, it was revealed that the local inhabitants recognized the following effects and changes.

・ Desertification has been alleviated 96%

・ Dust storms have been reduced 97%

・ Wind erosion has been reduced 95%

Table 4 Vegetation coverage increase

(Unit: Million ha)

	Baseline (2000)	Target (2006)	Achievement (2009)	At ex-post evaluation (2011)
Forest area	1.86 (2.22%)	2.06 (2.45%)	2.94 (3.5%)	4.02 (4.52%)
Vegetation coverage area	10.75 (12.8%)	12.0 (14.27%)	14.95 (17.78%)	23.5 (26.4%)

Source: WRB

(3) The livelihood improvement of the farmers

Unit revenue of major crops in the Project sites has increased except for cotton, as shown in Table 5[9]. Unit yield increase, as mentioned earlier and the rise in trading prices of major crops except for cotton have contributed to the income increase. This is confirmed by the result of the beneficiary survey, in which 98% of respondents replied that their "Agricultural income had increased."

Table 5 Revenue per unit of major crops

(Unit: RMB/Mu[10])

	Before the project (2000)	After the project (2011)	Rate of change (%)
Winter wheat	365.2	1228.5	336%
Corn	467.1	1225.7	262%
Cotton	2837.5	2528.0	89%
Fruits	2907.3	8684.8	299%

Source: WRB

Table 6 compares the before- and after-change in the annual agricultural incomes of the farmers in the Project sites according to the irrigation methods. Income increase among the farmers is apparent.

[9] Unit price of major crops other than cotton has increased when comparing the data before the project (2000) and ex-post evaluation (2011) (1.9 times increase for winter wheat and corn, 2.1 times for fruits). The unit price of cotton has been reduced to about two-thirds.

[10] Mu is a unit that represents the land area in China. 1 mu = 0.0667ha.

Table 6 Agricultural income per year (per person) by irrigation types

(Unit: RMB)

	Before the project (2000)	At project completion (2009)	At ex-post evaluation (2011)	Increase in the rate between 2000 and 2011 (%)
Canal Irrigation	2,520	4,634	5,902	234%
Sprinkler Irrigation	2,095	4,644	6,236	298%
Drip Irrigation	2,808	6,352	7,588	270%
Pipe Irrigation	2,755	4,235	5,410	196%

Source: WRB

The result of the beneficiary survey is shown in Table 7. Since the improvement of the living standard among the respondents should be, at least partially, ascribed to the general economic growth of China, it cannot be simply concluded that it is the direct effect of this project. In the beneficiary survey, however, following effects were reported; decrease in the total consumption of water with the introduction of water-saving irrigation technology, reduced workload by automation of the watering, reduction in the amount of fertilizer application by sending the pesticides or chemical fertilizers to the root zones directly with drip pipes. These savings in irrigation water and amount of applied fertilizer must have decreased the production cost. Thus, through the effective and stable irrigation water supply, remarkable income improvement, and the savings in production cost for water and fertilizers as well as workload, the Project's contribution to improvement in standard of living among beneficiary farmers should be granted to a certain extent

Table 7 Beneficiary survey results

Effect on the improvement of livelihood	Respondents with positive answers.
Labor has been reduced	90%
Personal property has increased	99%
Savings has increased	98%
Children's educational level has improved	93%
The health of the family members has improved	99%
Livestock population has increased	93%
Spending on furnishings has increased	98%
Housing environment has improved	97%

Source: Beneficiary survey results

3.3.2 Other Impacts

Impacts on the natural and social environment

At the time of the appraisal, salinization, increase in the pumping groundwater, influence of construction activities on vegetation had been of major concerns. In actual conduct of the Project, no major problems have been reported at the time of ex-post evaluation. Part of the canal lining site was canceled because it was designated as afforestation site by the Chinese government, which should have actually contributed to the improvement of

vegetation recovery. Pumping groundwater has been strictly regulated by the government, thus overuse of groundwater has not been a problem. Land acquisition and resettlement did not take place in the Project.

This project has largely achieved its objectives; therefore its effectiveness is high.

3.4 Efficiency (Rating: ②)

3.4.1 Project Outputs

In the eight Project sites of Xinjiang, except Urumqi which was excluded from the Project in 2005, the followings were carried out: earth canal pavements, improvement of water-saving irrigation facilities (sprinkler, drip, and pipe), and establishment and rehabilitation of the pumping wells. In the original plan, nine sites had been targeted but later became eight sites because of cancelation of Urumqi. The reasons for cancellation were as follows. Between the time of a feasibility study (1998) and the start of the actual construction (2003), many farmers had begun to adopt a relatively high irrigation technology, because of which the Urumqi city government changed their plan and wanted to invest in private corporations instead of farmers. Xinjiang government, however, did not approve this new idea of Urumqi since their intension and one of the main purposes of this Project was poverty alleviation among poor farmers. Therefore, in 2005, the WRB decided to distribute the project budget that had originally been allocated for Urumqi to the other counties (Changji, Shā-wān, Turpan, and Hami) where there were greater needs for the Project among the farmers.

There were changes in the target figures of the outputs as shown in Table 8. The changes were made after the visit of mid-term supervisory team by JICA in September, 2002. The reasons for changes in output targets are as follows.

- As a result of detailed survey conducted for each county and city in 2002, the detailed figures for the entire scopes including all types of irrigation facilities that had not been finalized at the appraisal were finalized.
- Since a part of the scheduled sites for the branch canal construction was designated as a forest plantation site in 2002, the scale for branch canal construction was reduced.
- The sprinkler irrigation was reduced largely from the scientific standpoint that it should be avoided as much as possible because of the high water evaporation rate and strong wind in the Project sites.
- The drip irrigation facilities were increased to replace the sprinklers and for the purpose of fruit cultivation.
- Since the overuse of groundwater was raised as an issue to be avoided, the new well development was canceled, and changed to renovation and the improvements only.

・ In Southern Xinjiang (the southern part of Xinjiang), the "Tarim river conservation plan" was to be carried out in 2001 by the Chinese national grant investment of 10,700 million RMB in total. Thus the WRB excluded the overlapped portion in Aksu and Bazhou from the scope of this Project.

The Table 8 shows the changes made for the output. Actual achievements of the "(6) Rehabilitation of the pumping well" was substantially modified because, in the construction package of the well, all the bidders outbidded the price and they were not accepted. This unsuccessful bidding portion was changed to drip irrigation construction that had great needs.

Table 8 Outputs

	Target (Target year 2006)	Target after 2002 amendments (Target year 2006)	Achievement (2011)	Differences (Compared to the 2002 plan)
(1) Laying concrete lining on main canals	1,256 km	1,265 km	1,692 km	+427 km
(2) Improvement of irrigation facilities on branch canals	2,401 ha	1,333 ha	1,333 ha	0
(3) Improvement of sprinkler	68,550 ha	25,392 ha	23,628 ha	-1,764 ha
(4) Improvement of drip irrigation facilities	24,767 ha	43,135 ha	50,154 ha	+7,019 ha
(5) Pipe irrigation facilities	6,797 ha	6,535 ha	6,647 ha	+112 ha
(6) Rehabilitation of pumping wells	2,401	1,745	1,033	-712

Source: WRB

As noted above, there had been changes in the Project outputs and in the target sites. These changes were made after thorough reviews of the local needs during the Project implementation, and the responses are considered appropriate to evade negative influences and to achieve the purpose of the Project.

3.4.2 Project Inputs

3.4.2.1 Project Cost

The project cost was within the planned budget (79% of the original plan on a yen basis, 74% on a local currency basis). This is because the outputs of the project decreased as a whole along with the changes in the target figures, and the cost for the project was reduced accordingly as shown in table 9. The total project cost estimated at the time of the appraisal was 25,678 million yen (with 14,400 million yen that was to be loaned by yen, and the remainder was going to be covered by the budget of the local governments). The actual

cost was 20,221.02 million yen (with 13,346.54 million yen loaned by yen, and the remainder was defrayed by the Xinjiang government for the amount of 129.7 million RMB, 59.8 million RMB by the district government, and 309.2 million RMB by the city and the prefectural governments).

Table 9 Actual project cost

(Unit: million yen)

Items	Local Currency (million RMB)		Total (million yen)	
	Entire	Loan	Entire	Loan
Canal lining	739.7	488.2	10,194.58	6,728.40
Sprinkler irrigation facilities	145.9	96.3	2,010.80	1,327.21
Drip irrigation facilities	426.3	281.4	5,875.29	3,878.27
Pipe irrigation facilities	32.4	21.4	446.54	294.94
Rehabilitation of pumping wells	122.9	81.1	1,693.81	1,117.72
Total	1,467.20	968.4	20,221.02	13,346.54

Source: Appraisal document, WRB

Exchange rate:1RMB = 13.78205yen (Average throughout the project period)

In this project, "participation in the form of labor," in which farmers voluntarily offer their labor without compensation, was not applied.

The Table 10 shows the planned cost, amended project cost at the time of the mid-term supervisory mission in 2002, and unit price comparison for every component. Changes in the project cost were mostly accompanied with changes in the figures of the outputs, thus the changes are considered appropriate. When the planned budget and the actual expenditures are compared, the unit cost of the component decreases or they remain about the same level except for the "(1) Laying concrete lining on main canals". The unit cost rose for this item because part of the costs of "(2) Installation of branch canal irrigation facilities", "(3) Installation of sprinkler," "(4) Installation of drip irrigation facilities", and "(5) Installation of pipe irrigation" are included here for accounting reasons. Other reasons include the rise in the material cost and additional expenditure incurred for the treatment applied to canal lining to prevent water leakage.

Table 10 Changes in project cost unit price of each component

	Plan(Target year 2006)			Amended plan(2002)			Attained Results(2009)			
	Quantity	Cost (million yen)	Unit price (million yen)	Quantity	Cost (million yen)	Unit price (million yen)	Quantity	Cost (million yen)	Unit price (million yen)	Unit price compared to plan (%) [11]
(1) Laying concrete lining on main canals	1,256 Km	5,805	4.622	1,265 km	8,472	6.7	1,692 km	10,194.58	6.025	130%
(2) Improvement of irrigation facilities on branch canals	2,401 ha	52	0.022	1,333 ha	45.5	0.03	1,333 ha	Included in ①	--	--
(3) Improvement of sprinkler	68,550 ha	5722	0.083	25,392 ha	2,159	0.09	23,628 ha	2,010.80	0.085	102%
(4) Improvement of drip irrigation facilities	24,767 ha	3316	0.134	43,135 ha	5,835	0.14	50,154 ha	5,875.29	0.117	90%
(5) Pipe irrigation facilities	6,797 ha	611	0.090	6,535 ha	570	0.09	6,647 ha	446.54	0.067	74%
(6) Rehabilitation of pumping wells	2,401	4,033	1.680	1,745	2,592	1.49	1,033	1,693.81	1.640	98%

Source: Appraisal document, WRB

3.4.2.2 Project Period

The project period was longer than planned. The actual period was 105 months from March, 2001 (L/A) to November, 2009 (commissioning of all the facilities to the county/city), which was 150% of the planned period at appraisal. The planned period was 70 months from March, 2001 (L/A) to December, 2006.

The reasons that the project period exceeded the plan are as follows.

- Extreme weather with very cold winter and hot summer shortened the construction period, thus some construction work was prolonged to the following years.
- It took time to change and make adjustments in the scope of the Project because the targeted farms were scattered over a large area and because it was the first yen loan project for Xinjiang government who were unfamiliar with the procedures.
- The competitive bidding in 2003 was delayed due to the influence of SARS.
- As previously mentioned, it took time to solve the trouble in the process of the competitive tender bid of the construction package of the wells.

Although the overall project period was extended, the period for each construction item was not extended or even shortened from the original plan except for the concrete lining. The delay was largely due to external factors, such as SARS or the weather conditions,

[11] Comparison with the plan at the time of the appraisal.

which are considered unavoidable.

3.4.3 Results of Calculations of Internal Rates of Return (IRR)

The Economic internal rate of return (EIRR) of this project is calculated with the project life of 50 years, and with the benefits of increased incomes from the farm products produced in the Project such as wheat, vegetables and fruits. The value of the EIRR was 15.0% at the time of the appraisal, and it was recalculated to be 15.27% at the time of ex-post evaluation by the same calculating method.

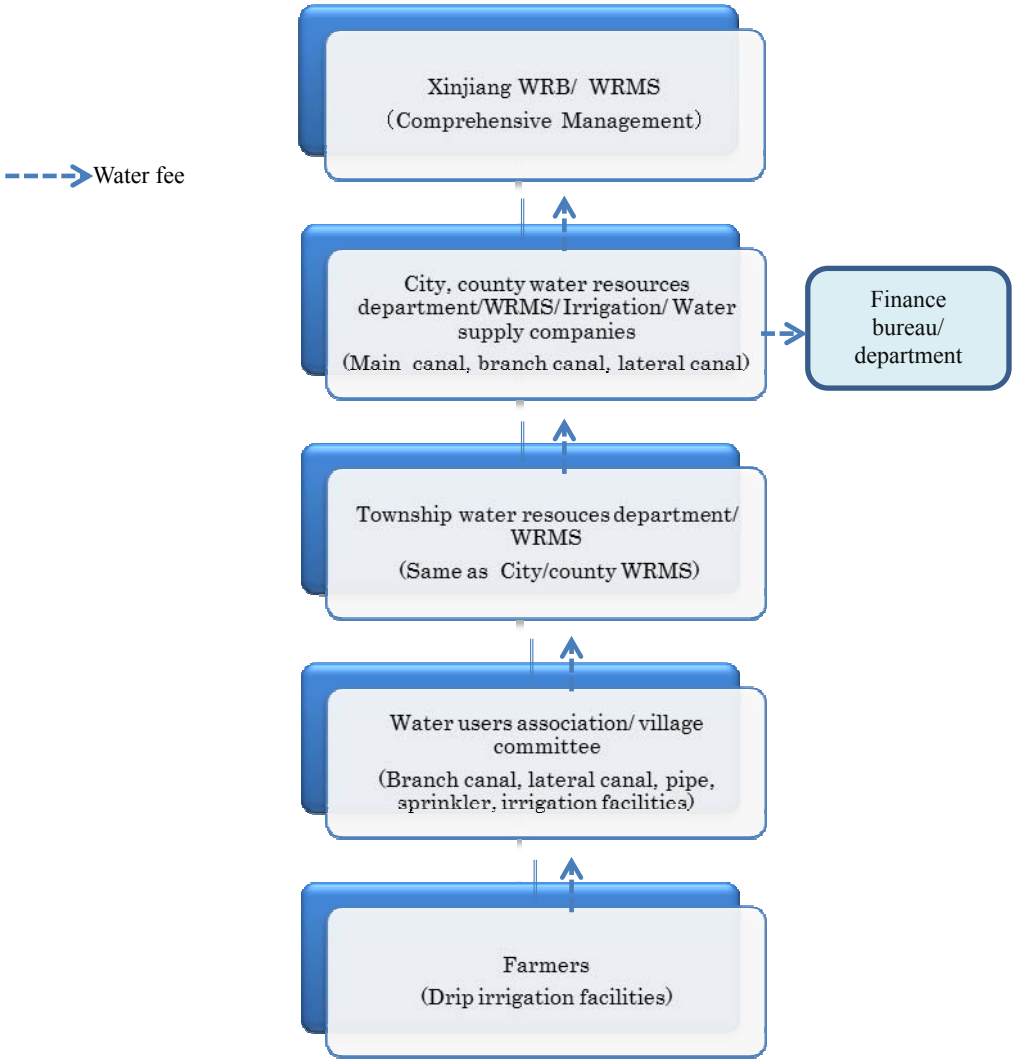
Although the project cost was within the plan, the project period was exceeded, therefore efficiency is fair.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspect of Operation and Maintenance

As for the operation and maintenance structure of facilities, there were no major changes from the original plan. The operation and maintenance of the main canals are carried out by the Water Resources Management Stations, WRMS hereafter, under county/city's Water Resources Bureaus (or Water Supply Companies in some places). The operation and maintenance of branch canals, lateral canals, drain ditches, water-saving irrigation facilities including the pipes or the sprinklers are carried out by the Water Users' Associations[12], WMA hereafter, and the village committees. As for the drip irrigation facilities in the farms, they are managed by individual farmers. According to the beneficiary survey, 89% of farmers maintain irrigation facilities every six months or more frequently, and 22% maintain them once a month or more.

[12] Water Users' Association is in charge of maintenance of irrigation facilities and collection of water fee, etc.



Source: WRB

Figure 2 Management Structure

Branch canal (Turpan)

Grapes grown by drip irrigation (Turpan)

3.5.2 Technical Aspects of Operation and Maintenance

Technical aspect of the maintenance of main canals should not entail a problem since sufficient numbers of engineers are placed in each of the counties/cities as shown in Table 11, and the manuals are available and well-utilized. During and after the project implementation, being led by the WRM and the local government, a lot of trainings were carried out on the construction, management technology of the canals and irrigation facilities for WMAs, village committees, and the WRMS of the local governments. At every WRMS, the technical levels of the staff are classified as junior technician, intermediate technician, and advanced technician; and evaluations are conducted to maintain the technical levels of the staff. For the farmers, to get them acquainted with the use of the facilities that require high technique such as the drip or the sprinkler irrigation facilities, the technical staffs selected from the WRMS visited the villages and instructed the farmers directly about the use and management of the water-saving irrigations. Particularly, the trainings carried out in winter time (agricultural off-season) were called "The winter for science and technology," and the technical training for the WMA and village committees were carried out intensively. At the beginning of the Project, many farmers had hesitated to participate in this project because of the high level of techniques required to operate the irrigation facilities. But when the Project effects gradually became visible among some of the farmers, the neighbor-farmers who witnessed the success were inspired and became willing to learn the technique. WMA played a central role in improving the water-saving consciousness of the farmers as well as in improving the technical capability of pipe installing technology, and operation and maintenance capability of the drip and the sprinkler irrigations. In addition, WRM and the city/county governments monitored river flow and groundwater levels to control the volume of diverted water.

Table 11 Operation and maintenance work, the number of workers and technicians

	Number of groups or people	Contents of operation and maintenance work	Number of staff	Number of technicians (%)
City/county water resource management station	35 groups	Reservoir, Main canal, Branch canal	1,298	763 (59%)
Water Supply Companies (10 cities/counties)	80 groups	Branch canal	1,313	742 (57%)
Village committee	853groups	Branch & lateral canal	1,209	265 (22%)
Water Users' Association	898 groups	Water-saving irrigation facilities	1,875	686 (37%)
Farmers using drip irrigation	228,529 people	Management of drip irrigation	--	--

Source: Appraisal document, WRB

3.5.3 Financial Aspects of Operation and Maintenance

Rates of water fees vary in different cities/counties, but in general, the water fee paid by farmers ranges around 0.1 to 0.18 RMB/m^3, of which about 0.02 to 0.03 RMB/m^3 are saved for maintenance of the branch canals at WUA, and the remaining 0.07 to 0.16 RMB/m^3 is used for the maintenance of the main canals at WRMS. The average collection rate of water fees in the target sites is very high around 99%; however, the total collected amount is still insufficient to cover the maintenance cost. The local governments and the Xinjiang government subsidize the operation and maintenance costs to make up for the expenses for the shortage. Since there are financial resources such as the "basic construction budget for the water supply in small agricultural farms" in Xinjiang government, maintenance and administration of the facilities do not encounter a serious problem. As for the management of the sprinkler and pipe irrigation facilities and the branch canals, WUAs can cover the maintenance and administration expenses with the water fees collected. The facilities of the drip irrigations installed inside the farms, individual farmers bear all the maintenance and administrative expenses.

According to the beneficiary survey, 91% of the farmers replied that the collected amount of the water supply costs was adequate, and 97% replied that they paid the water fees without deficiency or delay.

At the time of the appraisal, there had been a concern that collecting water fees from the poor farmers would be difficult in two counties in south of Xinjiang, namely Kashgar and Aksu. But it has turned out that the water fee collection rates in both counties are close to 100% at the time of ex-post evaluation. The wary of difficulty in collection did not become a problem because the farmers were able to save expenditure for water fees compared with before. They reduced total consumption of the irrigation water with the introduction of water-saving irrigation facilities. Before this Project was introduced, a large quantity of irrigation water had been used for inefficient surface irrigation, which kept the water consumption and associated water fees very high. By switching to water-saving irrigation, it became possible for them to control and lessen the expenditure for water fees.

3.5.4 Current Status of Operation and Maintenance

The main canals, branch canals, pumping facilities, pipes for the drip irrigation, low-pressure pipes etc. in Turpan City, Changji City, and Shā-wān County observed during the site visit were maintained in good condition. In beneficiary survey, 98% of farmers replied that the facilities introduced by this project are operating in good condition.

No major problems have been observed in the operation and maintenance system, therefore sustainability of the project effect is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion (same as "0. Summary")

China is one of the world's thirteen countries of the scarcest water endowment where the volume of its total water resources is less than a quarter of the world average. In Xinjiang Uygur Autonomous Region, hereinafter referred to as Xinjiang, annual precipitation is around 150 mm and it embraces a large rural population. For both China and Xinjiang, stable supply of water, improvement in water management ability, and improvement in agricultural productivity are important issues. Thus, this project has been highly relevant with the country's development plan, development needs, as well as Japan's ODA policy; therefore its relevance is high. This project has largely achieved its objectives in terms of volume and ratio of water saved. It also contributed to increase in the crop yield and farmers' income to some extent. Therefore, its effectiveness and impact are both high. Although the project cost was lower than planned, the project period was longer than planned; therefore efficiency of the project is fair. No major problems have been observed in the operation and maintenance system, therefore sustainability of the project effect is high.

In light of the above, this project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

None

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Since the facilities adopted in this project, such as the drip or the sprinkler irrigation, require a high level of technique for operation and maintenance, WRB and WRMS at local governments made significant efforts in the trainings and awareness raising activities for the farmers. According to WRB, it was difficult to get the understanding of the farmers for the first couple of years because the farmers thought the required techniques were too difficult for them. But after continuation of on-site technical guidance and the awareness raising activities with effective involvement of WUAs, the effects of the Project gradually became visible among some farmers. The successful cases of such farmers caught attention of neighbor-farmers. This way, the willingness had spilled over to other farmers and ended up in the active participation of many farmers in the Project. In this kind of Project where the beneficiaries are required to acquire relatively high technology or technique, awareness building is obviously important. Moreover, the presence of the farmers acting as "role models" is very important and effective to stimulate others to be their followers, as observed in this project. For a Project such as this one where

beneficiaries' ownership is crucial for technology dissemination, selecting well-motivated farmers at the initial stage to intensively strengthen their capacity to create good models would be an effective strategy.

Another lesson learned is about the cooperation of different agencies. To disseminate and to promote water-saving irrigation technology, it is considered that, by cooperating not only with the water resources sectors, but with the agricultural sectors, a higher synergy effect would be achieved. In this project, the expected effects such as the yield increase in the major crops were achieved; thus, absence of cooperation of the WRB and Agricultural Bureau was not particularly brought into question. But to avoid overlap in training menus and to make its contents even more meaningful, it would be desirable for both agencies to cooperate in planning and carrying out the trainings.

Comparison of the plan and actual of the project[13]

Items	Plan	Actual
① Outputs	① Laying concrete lining on main canals:1,256 km ② Improvement of irrigation facilities on branch canals:2,401 ha ③ Improvement of sprinkler:68,550 ha ④ Improvement of drip irrigation facilities:24,767 ha ⑤ Pipe irrigation facilities:6,797 ha ⑥ New establishment and rehabilitation of pumping wells:2,401	① Laying concrete lining on main canals:1,692 km ② Improvement of irrigation facilities on branch canals: 1,333 ha ③ Improvement of sprinkler:23,628 ha ④ Improvement of drip irrigation facilities:50,154 ha ⑤ Pipe irrigation facilities:6,647 ha ⑥ Rehabilitation of pumping wells:1,033
② Project Period	March, 2001 - December, 2006 (70 months)	March, 2001 – November, 2009 (105 months)
③ Project cost Amount paid in Foreign currency Amount paid in Local Currency Total Japanese Yen loan portion Exchange rate	 0 million yen 25,671 million yen (1,975 million RMB) 25,671 million yen 14,400 million yen 1RMB=13yen (as of March 2001)	 0 million yen 20,221.02 million yen (1,467.20 million RMB) 20,221.02 million yen 13,346.54 million yen 1RMB = 13.78205yen (Average throughout the project period)

[13] Comparison with the plan at the time of the appraisal