

Ex-Post Project Evaluation 2014: Package I-1 (China)

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JAPAN INTERNATIONAL COOPERATION AGENCY

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People's Republic of China

Ex-Post Evaluation of Japanese ODA Loan
“Anshan Environmental Improvement Project”

External Evaluator: Hiroshi Ishizato, IC Net Limited

0. Summary

This project aims to strengthen the measures taken by the municipal government of Anshan to improve air environment, water quality environment and living environment. Its relevance is high because the implementation of the sub-projects, though selected after a process of adjustment, has been relevant to the development policies and development needs of China and Japan's aid policy. The effectiveness and impact of the project is also high as the effect of pollutant reduction in terms of air and water and the effect of improvement in water supply resulting from the implementation of this project are remarkable, with the expected effects of sub-projects achieved in their respective years of target, the project's contribution to the improvement of air and water quality as well as living environment verified, and the recovery of groundwater having long been decreasing regarded as a positive impact of the project. With respect to efficiency, while the input of project cost was commensurate with the output achieved after the change of scope, the project period was substantially longer than planned even after subtracting the part of project period extension resulted from the necessity for the “Wastewater Treatment Project” to respond to the expanding need for the service. Therefore, the efficiency of this project is fair. The sustainability of the project is generally high considering the fact that the operation and maintenance (O&M) system is confirmed to be wholesome and stable, the efforts made by the implementing entities to maintain their technological level is being institutionalized, most of the adopted equipment are effectively utilized currently, and regarding the financial aspect, although at the moment the implementation entity of the Water Supply System Improvement Sub-project is facing the problem of deficit operation attributed to the cheap water rate, the problem is expected to be solved with the introduction of a new rate system in the near future.

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

1. Project Description



Project Location



Photo1: A Purification Plant Built with This Project

1.1 Background

Anshan, as one of the 113 National Prioritized Environment Protection Cities designated in the “National Environment Protection 10.5 Plan¹”, was required to take comprehensive air pollution countermeasures including acid rain control, with the implementation of measures to address especially the air pollution worsening due to the existence of plenty of small-size heat supply boilers fuelled by high-sulfur coal and the increase of automobile traffic volume becoming an urgent issue. Meanwhile, as described in the section of “Relevance”, the city’s water supply per capita in 2000 was below the average level of urban areas all over the country, and many households in the urban area had to live with a water supply under time restriction and the drinking of low-quality groundwater, which called for improvement of daily life water supply in terms of quantity and quality. In addition, while the Liao River flowing across Anshan was designated as one of the Prioritized Watersheds for Water Pollution Countermeasures Enforcement in the “National Environment Protection 9.5 Plan (1996-2000)” and the subsequent “National Environment Protection 10.5 Plan (2001-2005)”, the exceptionally low sewage treatment ratio in the city’s urban area was contributing to the water contamination of the Liao River Watershed. Therefore, it also became an imperative task to take countermeasures against water pollution.

In order to address the above-mentioned issues, the municipal government of Anshan made the decision in the document of “The 10th Five-Year Plan for Economic and Social Development in Anshan” to further strengthen its measures to improve air environment, water quality environment and living environment by upgrading the environmental infrastructure including heat supply, public transportation, water supply and sewage system.

1.2 Project Outline

The objective of this project is to strengthen the measures taken by the municipal government of Anshan to improve air environment, water quality environment and living environment by upgrading the environmental infrastructure including heat supply, public transportation, water supply and sewage system, thereby contributing to the speed-up of Anshan’s sustainable development.

The project was initially assumed to be composed of four sub-projects in Anshan, i.e. the “Central Heating System Improvement Sub-project”, “Urban Railway System Improvement Sub-project”, “Water Supply System Improvement Sub-project”, and “Wastewater Treatment Sub-project”. However, with the occurrence of adjustment like cancel or replacement of part of the contents in some of the sub-projects during the process of implementation, the previously assumed composition of the project changed significantly. The change of project composition after the commencement of the project and the names of the sub-projects are reflected in the table below.

¹ “10.5 Plan” is the abbreviation for “10th Five-year Plan”, referring to the five-year plan covering the period of 2001-2005. In China, there is the five-year plan covering the nation-wide overall economy and society as well as the five-year plan concerning a specific field for the whole country or the overall economy and society of a specific province or city as referred to hereinafter. Regarding the name of these documents, the abbreviation like “10.5 Plan” is also used officially.

Table 1: Project Outline

Name of Sub-projects	Status	Outline
1. Central Heating System Improvement Sub-project	Significant change of scope and shutdown of part of the adopted equipment	According to the initial plan, a bio-briquette ² factory was to be built to provide cleaner fuel to substitute ordinary coal for boilers of central heating, and a new type of boilers with high combustion efficiency was to be adopted to replace the existing small-size boilers below 10 ton and to start heat supply to the newly established economic development zone. But in actuality, while the work of bio-briquette factory construction was cancelled, additional indoor and outdoor ducts and heat exchange stations were installed. Besides, some of the 40t boilers adopted in this sub-project were shut down after nine years of operation following the introduction of boilers of larger size in response to the growing needs.
2. Urban Railway System Improvement Sub-project	Cancelled	The sub-project was totally cancelled although it had been scheduled to demolish the existing facilities of the antiquated urban railway (surface railway) and to lay new tracks for the expansion of transportation capacity so as to reduce the number of buses in service.
3. Water Supply System Improvement Sub-project	No change of scope	In this sub-project, the river called Xi River, which is 15km to the east of the existing water source of Anshan, was used as the new water source from which a headrace tunnel leading to the Tanghe Dam was laid and a water purification system was built.
4. Wastewater Treatment Sub-project	Expansion of scope	In this sub-project, the Phase 2 facility of Western No.2 Wastewater Treatment Plant was constructed next to the site of Phase 1 facility which had been operated since March 2002. Following the change of Masterplan for Sewage Treatment of Anshan in December 2009, the wastewater discharged from the newly established Dadaowan Development Zone (DZ) was decided to be treated by the Western No.2 Wastewater Treatment Plant built with this project. Accordingly, the cost for laying the wastewater collecting conduit pipe connecting the Dadaowan DZ and the wastewater treatment plant was newly added to the scope of the Japanese ODA Loan.

² Bio-briquette refers to the fuel made from the blended raw materials containing 15-20% vegetative wastes (biomass) such as sawdust, rice straw, crumbled corn core, etc. , which are mixed with some hydrated lime for desulfurization and then molded with high pressure.

Loan Approved Amount/ Disbursed Amount	14,525million yen / 14,524million yen		
Exchange of Notes Date/ Loan Agreement Signing Date	March 29, 2002 / March 29, 2002		
Terms and Conditions	Sub-projects Other Than the Water Supply System Improvement Sub-project	Interest Rate	0.75%
		Repayment Period (Grace Period)	40 years (10 years)
		Conditions for Procurement:	Bilateral untied
	Water Supply System Improvement Sub-project	Interest Rate	1.7%
		Repayment Period (Grace Period)	30 years (10 years)
		Conditions for Procurement:	General untied
Borrower / Executing Agency	Government of People's Republic of China / Anshan Municipal Government		
Final Disbursement Date	April 25, 2012		
Main Contractor (Over 1 billion yen)	<ol style="list-style-type: none"> 1. Liaoning MEC Group Co., Ltd. (China): Procurement of boiler house, heat exchange stations and boiler heat conduits for the "Central Heating System Improvement Sub-project". 2. China Railway Materials Import & Export Co., Ltd (China): Procurement of vehicle and heat conduits for the "Central Heating System Improvement Sub-project" and cement and steel stock for the "Wastewater Treatment Sub-project". 3. Joint Venture of Nishihara Environment Technology Inc. (Japan)/ Hubei Rich States Industry Investment Co., Ltd (China): Procurement of equipment and building materials for the "Wastewater Treatment Sub-project". 		
Main Consultant (Over 100 million yen)	None		

Feasibility Studies, etc.	<ol style="list-style-type: none"> 1. “Feasibility Study Report of Central Heating System Improvement Project”, Anshan Coking and Refractory Engineering Consulting Cooperation & Anshan Heating Design and Research Institute, May, 2001. 2. “Feasibility Study Report of Urban Railway System Improvement Project”, Beijing Urban Construction Designing Institute, May, 2001. 3. “Feasibility Study Report of Water Supply System Improvement Project”, China Northeast Municipal Engineering Design Institute, May, 2001. 4. “Feasibility Study Report of Wastewater Treatment Plant Construction Project”, Anshan Coking and Refractory Engineering Consulting Cooperation, March, 2001.
Related Projects	<ol style="list-style-type: none"> 1. Japanese ODA Loan project “Anshan Water Supply System Improvement Project” as a sub-project of “Water Supply System Improvement Project in Three Cities (Tianjin, Hefei, Anshan)”, 1990. 2. World Bank financed projects: <ol style="list-style-type: none"> 1) “Anshan Western No.1 Wastewater Treatment Plant Construction Project” as a sub-project of “Liaoning Environmental Improvement Project”, 1995. 2) “Anshan Urban Traffic Reconstruction Project” as a sub-project of “Liaoning Urban Traffic Improvement Project”, 1999. 3. “EU-China Liaoning Combined Environment Project” started from October 1999, consisting of seven sub-projects, out of which three had project sites in Anshan : <ol style="list-style-type: none"> 1) Clean Production Sub-project 2) Air Quality Management Sub-project 3) Capacity Building Sub-project

2. Outline of the Evaluation Study

2.1 External Evaluator

Hiroshi Ishizato, IC Net Limited

2.2 Duration of Evaluation Study

Duration of the Study: August, 2014 –November, 2015

Duration of the Field Study: November 2, 2014 – November 15, 2014

March 23, 2015 – March 28, 2015

3. Results of the Evaluation (Overall Rating: A³)

3.1 Relevance (Rating: ③⁴)

3.1.1 Relevance to the Development Plan of China

(1) Development plan at the time of the appraisal

In the document entitled “The Tenth Five-Year Plan for National Economic and Social Development (2001-2005)” (10.5 Plan) publicized in March, 2001, with respect to the concept of China’s national economic and social development during the period from 2001 to 2005, the Chinese government came out with the following six top priority issues: a) economic growth, b) structural readjustment, c) reform and opening to the outside world, d) development of science and technology, e) improvement of people’s living standards, and f) promotion of development balanced between economic and social aspects. It can be said that the aim of this project was consistent with the above-mentioned e) and f).

Meanwhile, the targets of total quantity control concerning emission of air and water pollutants and the targets of emission reduction in sulfur dioxide (SO₂), smoke dust and industrial powder dust, chemical oxygen demand (COD), and ammonia nitrogen, etc. were set up in the “National Environment Protection 10.5 Plan (2001-2005)” announced the same year. As the environmental improving effect expected with this project concerns reduction of the three pollutants of SO₂, smoke dust and COD included in the above-mentioned, it is evident that the project was planned in a manner consistent with China’s national goals.

(2) Development Policy at the Time of the Ex-post Evaluation

In “The Eleventh Five-Year Plan for National Economic and Social Development (2006-2010)” (11.5 Plan) publicized in 2006 after the commencement of this project and the following “The Twelfth Five-Year Plan for National Economic and Social Development (2011-2015)” (12.5 Plan), while the issues of structural readjustment, reform and opening to the outside world, development of science and technology and improvement of people’s living standards continued to be positioned as the top priorities, the issue of economic growth was excluded, and that of resource and environment protection was newly added to this category. This apparently shows that the demand for environmental improvement, which has been the aim of this project, is on the increase.

Moreover, although only two kinds of indicators, i.e. COD and SO₂ were specified as the objectives for the setting of target for pollutant emission reduction in the “National Environment Protection 11.5 Plan (2006-2010)”, the indicators of ammonia nitrogen and nitrogen oxide (NO_x) were added to them in the following “National Environment Protection 12.5 Plan (2011-2015)”, evidencing the intensification of environmental protection measures. As all these have been set as the effect indicators of this project, it is clear that the project is highly consistent with China’s national plans.

As explained above, the position of environmental protection issue in China’s development

³ A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

⁴ ③: High, ② Fair, ① Low

policies at the time of the ex-post evaluation is becoming more important as compared with that at the time of the appraisal, and the strictness of environmental regulation is also increasing. Therefore, it can be said that the consistency of this project with China's development policies is high even at the time of the ex-post evaluation.

3.1.2 Relevance to the Development Needs of China

(1) Relevance to the Development Needs at the Time of the Appraisal

Since the 1990s, the city of Anshan had been suffering from the worsening of air pollution accompanied by the rapid industrialization with the plant equipment getting antiquated, the heat supply by many small-size boilers fuelled by high-sulfur coal, and the increasing volume of automobile traffic, which called for immediate action to improve air quality. In this regard, Anshan was designated as one of the 113 National Prioritized Environment Protection Cities and was required to take comprehensive air pollution countermeasures including acid rain control in the afore-mentioned "National Environment Protection 10.5 Plan (2001-2005)".

In 2000, per capita water supply in Anshan was 171 L/day, falling below the average level of 220 L/day for all the urban areas of the whole country⁵. Besides, residents in 70% of the urban area of Anshan had to live with a water supply under time restriction, which posed a threat to their daily life. Furthermore, in view of the fact that the 250,000 residents in Lishan Ward had to put up with the drinking of groundwater with high manganese and excess iron, the shift of water source from underground to surface was believed to be indispensable.

At the same time, while the Liao River flowing across Anshan was designated as one of the Prioritized Watersheds for Water Pollution Countermeasures Enforcement in the "National Environment Protection 9.5 Plan (1996-2000)" and the subsequent "National Environment Protection 10.5 Plan (2001-2005)", the sewage treatment ratio in the city's urban area was not more than 6.1% and the untreated sewage was discharged into the river, resulting in the water quality of the city's river deteriorating to the extent even worse than the Class V level (the worst level) by the National Water Environment Standard⁶ and becoming one of the causes of water contamination in the Liao River Watershed. Accordingly, it became an urgent task to take measures for water quality improvement.

In response to the above-mentioned development needs of Anshan, four components aimed to strengthen the measures taken by the municipal government to improve air environment, water quality environment and living environment through upgrading the environmental infrastructure in heat supply, public transportation, water and sewerage were selected as the sub-projects of this project. Therefore, it can be said that the project is relevant to the development needs at the time of the appraisal.

(2) Rationale for the Selection of the Sub-projects at the Time of the Appraisal

⁵ "Per capita water supply" here refers to the average value of "daily life water in a broad sense" which includes not only the water used by households, but also the water used in commercial facilities like public bathhouse and restaurant, etc..

⁶ According to the national standard "Surface Water Environment Quality Standard" (GB3838-2002) issued by China State Environment Protection Agency and State Administration of Quality Supervision, Inspection and Quarantine, the quality of surface water is classified into five classes from I to V, with Class V ranked as the worst.

The rationale for the selection of the sub-projects at the time of the appraisal is explained in the following Table 2.

Table 2: Reasons for the Selection of Respective Sub-projects at the Time of the Appraisal

Sub-projects	Major Items	Reasons for the Selection
Central Heating System Improvement	Construction of a bio-briquette factory	It was intended to provide the then prevailing below-10 t boilers with cleaner fuels so as to reduce the emission of SO ₂ .
	Introduction of 40 t boilers	The technical specification was decided taking into account its two advantages, i.e. the heat efficiency as high as over 80%, and the technological stability higher than the then large-size boilers of 80 t and above.
Urban Railway System Improvement	Extension of existing rail track and installation of additional equipment	The option of railway was regarded as better than that of energy-saving and environment-friendly bus in terms of transport efficiency and environmental protection effect.
Water Supply System Improvement	Construction of a purification plant with a capacity of 150,000 t/day	It was intended to provide the 250,000 residents in Lishan Ward with safer surface water in light of the fact that they had long been drinking the groundwater of bad quality.
	Laying of a headrace tunnel leading from Xihe River to Tanghe Dam	It was regarded as a necessary measure to maintain an adequate water volume in Tanghe Dam, the only large-scale source of surface water in Anshan. Besides, as the drawing of water from Xihe River was to be limited to the high-water season of a year, it was assumed that there would not be any impact on the water supply in the downstream area of Xihe River.
Wastewater Treatment	Construction of a wastewater treatment plant with a capacity of 200,000 t/day	It was decided considering the fact that while the future demand for wastewater treatment capacity in the area (Dadaowan) would be 300,000 t/day, there had already existed a wastewater treatment plant with a capacity of 100,000 t/day.

Source: Interview with respective implementing entities

(3) Reasons for the Change of Scope after the Start of Project Implementation

Among the four sub-projects, the two with cancel or significant change of scope occurring are “Central Heating System Improvement Sub-project” and “Urban Railway System Improvement Sub-project”. Regarding the former, the previously scheduled construction of bio-briquette factory was cancelled before the start of equipment procurement and civil engineering work, and part of the adopted 40 t boilers were shut down after a period of operation. As for the latter, the sub-project was totally cancelled before the start of equipment procurement and construction work. The reasons for all these changes of scope are summarized in Table 3 below.

Table 3: Reasons for the Respective Changes of Project Scope

	Change of Scope	Reasons for the Change of Scope
Central Heating System Improvement	Construction of the bio-briquette factory was cancelled before the start of the work.	<ul style="list-style-type: none"> • The tendency for boilers to shift from dispersed and small-sized type to central and large-sized type became apparent all over China after the start of project implementation. • The cost of procuring crop straws as the raw material of bio-briquette was soaring owing to the shrinking of rural area around Anshan with the advancement of urbanization, resulting in the fear of loss-making of the sub-project.
	Out of 11 40 t boilers, 6 were shut down after 9 years of operation.	<ul style="list-style-type: none"> • The heat supply area in “Gaoxin District” (with 6 boilers of 40 t installed), one of the two target districts of this sub-project, was assumed to be two million m² in floor space at the time of the appraisal, but since it has now expanded into 9.2 million m², adoption of boilers of larger size becomes necessary. With the boilers sizing 80-140 t having been introduced successively since 2012, the scale of heat supply system is growing larger.
Urban Railway System Improvement	The sub-project was totally cancelled before the start of the work.	<ul style="list-style-type: none"> • As a part of the state-owned enterprise reform, many of the employees of Angang (Anshan Iron & Steel Company), who had been assumed to be the beneficiaries of the commuting facilitating effect expected by this sub-project, were laid off, relocated or re-employed. In addition, as a result of the massive redeployment of manufacturing companies from the urban area to the suburb, the commuting routes were changing drastically and the initially designed railway line had become irrelevant. • While the prerequisites for the development of urban railway stipulated by the Chinese State Council in 2003 were an annual municipal fundamental revenue of 6,000 million yuan and above and an urban population of over 1.5 million, the respective figures of Anshan at that time were 3,500 million yuan and 1.45 million people, both failing to fulfil the requirements.

Source: Interview with respective implementing entities and information materials provided by JICA

The factors behind the above-mentioned various reasons for the changes of scope are considered to be the stricter regulations for energy-saving and environmental protection⁷, the change of central government’s policies⁸, the change of external conditions resulted from the economic growth and the advancement of urbanization in China.

For example, although the bio-briquette factory was initially intended to provide the below-10 t small-size boilers with cleaner fuels, the possibility for these boilers to be shut down in the medium and long terms was actually very high as they failed to meet the heat efficiency target of 75-80% set in the “China Energy-saving Technology Policy Outline” published in 1996. In spite of this, it was known during the field study that the bio-briquette factory had been selected as a part of the sub-project based on the following two considerations: 1) the heat efficiency of 75-80% had no

⁷ In addition to the target of heat efficiency set in the “China Energy-saving Technology Policy Outline”, the aim to transform the existing diversified and small-sized heating boilers into the central heating type and raise the penetration rate of central heating in the urban area from 27% up to 40% was put forward in the “Medium- and Long-Term Plan for Conserving Energy Resources” issued in 2004 by the National Development and Reform Commission (NDRC). Besides, the coal boilers below 10 t were entirely rejected by the “Standards for Emission of Air pollutants from Boilers” issued by the Ministry of Environment Protection in 2014.

⁸ The policies concerning the reform and restructuring of state-owned enterprises enforced by the then National Economy and Trade Commission as well as the document of “Circular Notice Regarding the Issue of Strengthening the Regulation of Urban Rapid Rail Transit System Construction” became the basis for the major restructuring occurring in Angang and cancelling of the railway sub-project.

coercive force, and 2) it was an urgent task to provide the small-size boilers existing in abundance at that time⁹ with cleaner fuels.

As such, the above-mentioned changes of scope are regarded as acceptable in that they were unavoidable responses to the change of Chinese government's policies or change of needs. Additionally, as referred to hereinafter, the cancelation of part of the project as well as the shutdown of part of the adopted equipment after a period of operation did not significantly influence the efficiency and effectiveness of this project.

(4) Relevance to the Development Needs at the Time of Ex-post Evaluation

Although the atmospheric concentration of SO₂ in Anshan has met the Class 2 requirement (0.06mg/Nm³) of the relevant national standard since 2008, as Anshan was continuously designated as one of the National Prioritized Environment Protection Cities in the "National Environment Protection 11.5 Plan (2006-2010)" and the subsequent "National Environment Protection 12.5 Plan (2011-2015)", improvement of air environment remains highly necessary. With respect to water environment, "Complete Development of Urban Water Supply and Drainage System" was determined to be one of the prioritized issues in "The 12th Five-Year Plan for Economic and Social Development in Anshan", and it remains an important task for Anshan municipal government to ensure 24-hour water supply and a high Pass Rate for Comprehensive Water Quality Standard. Furthermore, in the "National Environment Protection 12.5 Plan (2011-2015)", Liao River remains one of the Prioritized Watersheds for Water Pollution Countermeasures Enforcement, and wastewater treatment is expected to continue playing the role of an indispensable solution for water pollution problem. Therefore, the aim of this project to improve air environment, water quality environment and living environment (water supply) is consistent with the development needs even at the time of ex-post evaluation.

3.1.3 Relevance to Japan's ODA Policy

In view of the discussions about a review on Japan's ODA assistance to China, the Japanese government issued a document titled "Program of Economic Cooperation with China" in October 2001, whereby the policy of "prioritizing the fields centering on protection of environment and ecosystem undergoing serious contamination and destruction, livelihood improvement and social development in inland areas, human resource development, institutional development, technology transfer, etc." was put forward. Therefore, it is obvious that the aim of this project has been consistent with Japan's assistance policy for China

This project has been highly relevant to the country's development plan and development needs, as well as Japan's ODA policy. Therefore its relevance is high.

⁹ Although the heat efficiency of the below 10 t boilers was around 60%, which failed to meet the target of 75-80% set in the "China Energy-saving Technology Policy Outline", as this target was not compelling, it had become the reason for the abundant existence of small-size boilers at that time.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The planned and actual outputs of this project and the reasons for their discrepancies are summarized in Table 4 below.

Among the four sub-projects, the “Urban Railway System Improvement Sub-project” was cancelled, and two of the other three sub-projects underwent significant changes of scope. Therefore, it is hard to make a simple comparison between the final outputs and the initial plan. Nevertheless, the final outputs were mostly achieved according to the adjusted plan without notable deviation. Besides, as explained in the section of “Relevance”, the changes of scope were necessary responses to the stricter regulations for energy-saving and environmental protection, the change of central government’s policies, and the change of external conditions resulted from the economic growth and the advancement of urbanization. Moreover, as these changes were decided before the implementation of equipment procurement and construction work, they did not significantly influence the efficiency of this project. In addition, as described hereinafter, the extension of project period was virtually due to other reasons. Accordingly, the changes of scope are regarded as appropriate. Meanwhile, as formal agreements were reached between the Chinese government and JICA on major changes of scope, it can be said that the procedures of changes were also appropriate.

Regarding the “Central Heating System Improvement Sub-project”, due to the reasons described in the section of “Relevance”, bio-briquette factory construction was cancelled and the number of boilers installed was reduced to 11 from the originally planned 22 in accordance with the actual size of heat supply area (3.6 million m² in total for two districts). In addition, as mentioned above, some of the boilers were shut down and replaced by boilers of larger size after nine years of operation. Nevertheless, considering that the cost of the six boilers shut down accounts for only 1.3% of the total investment of the sub-project and 2.3%¹⁰ of the portion of ODA loan used in the sub-project, this change is virtually insignificant as far as project cost is concerned. At the same time, the length of indoor and outdoor ducts and the number of heat exchange stations were increased from the original plan in consideration of the rising demand in the future as well as the rationality of completing altogether the necessary infrastructure installation work before the beginning of the aboveground construction work.

As for the others, the “Water Supply System Improvement Sub-project” and the “Wastewater Treatment Sub-project” were implemented as planned. But, regarding the latter, the wastewater collecting conduit pipe network and related equipment were added to the scope of the sub-project in response to the increased demand resulted from the establishment of the new Economic Zone.

¹⁰ As the unit price of a 40 t boiler was 24 million yen, the total cost of 6 boilers amounted to 144 million yen, accounting for 1.3% of the actual total cost of the sub-project (11.102 billion yen) or 2.3% of the portion of ODA loan (6.182 billion yen).

Table 4: Outputs of the Project (Plan and Actual Results)

Sub-project	Plan	Actual Results and Reasons for Discrepancy
1. Central Heating System Improvement	<ul style="list-style-type: none"> ● Bio-briquette factory: 60,000 t/year ● Boiler for heat supply: 20 (40 t) ● Indoor & outdoor conduit pipe: about 160 km ● Heat exchange station: 14 	<ul style="list-style-type: none"> ● Bio-briquette factory: cancelled (Refer Table 2 for the reasons) ● Boiler for heat supply: 11 (40 t) (Considering that 11 boilers were enough for the actual heat supply floor space) ● Indoor & outdoor conduit pipe: about 447 km ● Heat exchange station: 43 <p>(The length of indoor and outdoor conduit pipe and number of heat exchange station were increased so as to get prepared for the rising demand in the future.)</p>
2. Urban Railway System Improvement	<ul style="list-style-type: none"> ● Extension of current rail: main line about 13 km, others (by-line etc.) about 6 km ● Tunnel: 1 (about 1 km) ● Elevated rail section: 2 (about 0.5 km in total) ● New passenger station: 17 (underground: 2, elevated: 4, aboveground: 11) ● Rail yard: new construction: 1, expansion: 1 ● Substation: 6, communication & signal, rail car: 44 	<p>Cancelled</p> <p>(Refer Table 2 for the reasons)</p>
3. Water Supply System Improvement	<ul style="list-style-type: none"> ● Water-conducting facilities: headrace tunnel 15.3 km ● Water purification facilities: Water purification plant 150,000 m³/day Segmented formation pond 2 Sedimentation pond 2 Rapid filtration pond 10 Water purification pond 1 Water pump 3 Sludge disposal plant 1 ● Water delivery and distribution facilities: Distributing reservoir 1 Pump station 1 Water distributing pipe 24.3 km 	<p>Implementation as planned</p>
4. Wastewater Treatment	<ul style="list-style-type: none"> ● Wastewater treatment plant 200,000 m³/day Pump station: 1 (200,000 m³/day) Primary sedimentation pond: 4 Reaction pond: 1 Secondary sedimentation pond: 4 Sludge treatment facilities (Conveyor type condensation dehydrator: 4) 	<ul style="list-style-type: none"> ● Wastewater treatment plant 200,000 m³/day Pump station: 1 (200,000 m³/day) Primary sedimentation pond: 4 Reaction pond: 1 Secondary sedimentation pond: 4 Sludge treatment facilities (Conveyor type condensation dehydrator: 4) ● Wastewater collecting conduit pipe: 60.7 km Wastewater pump: 3 Adjustment pond: 2 <p>(The installation of wastewater collecting conduit pipe etc. was added to meet the increased need resulted from the revision of Anshan Wastewater Treatment Plant Master Plan in 2009 following the formulation of Dadaowan EZ Construction Plan in 2006.)</p>

Source: Interview with respective implementing entities and information materials provided by JICA

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total project cost of this project was initially planned to be 39,339 million yen, including a foreign currency portion of 14,525 million yen and a domestic currency portion of 1,654 million RMB, with the whole of foreign currency portion raised by Japanese ODA loan.

The actual total project cost was 25,228 million yen, the foreign currency portion was 14,525 million yen and the local currency portion was 778 million RMB, with the whole of foreign currency portion raised by Japanese ODA loan. With the drastic decrease of local currency portion from the planned amount, the actual total project cost was 35.9% lower than planned. However, since the reduction of project cost was originally due to the reduction of outputs resulted from the change of project scope, it is inappropriate to make a simple comparison. Accordingly, here the actual total project cost is compared with the estimated amount of cost after the change of scope, and the result is indicated in Table 5, which shows that the actual total project cost including the local currency portion and the foreign currency portion was lower than the estimated amount of cost after the change of scope. Therefore, it can be said that the input of project cost was commensurate with the output.

Table 5: Comparison between the Estimated Project Cost after the Change of Scope
and the Actual Project Cost

(Unit: Million yen)

Sub-project	Total Project Cost in Original Plan		Total Project Cost after the Change of Scope			
	Scope	Amount	Scope	Estimated Amount	Actual Amount	Difference
Central Heating System Improvement	Bio-briquette factory(Equipment, material. reserve)	1,462	Bio-briquette factory (Cancel)	0	0	0
	Boiler 20 (Equipment, reserve)	541	Boiler 11 (Equipment, reserve)	297	N.A.	N.A.
	Heat exchange station 14 (Equipment, reserve)	395	Heat exchange station 14(Equipment, reserve)	1,214	N.A.	N.A.
	Indoor & outdoor conduit pipe 160 km(Equipment, reserve)	2,130	Indoor & outdoor conduit pipe 447km(Equipment, reserve)	5,949	N.A.	N.A.
	Others (civil engineering, installation, reserve etc.)	8,899	Others (civil engineering, installation, reserve etc.)	4,921	4,921	0
	Subtotal of the Sub-projects	13,427	Subtotal of the Sub-projects	12,381	11,102	-1,279
Urban Railway System Improvement	Extension of rail line etc. (Including reserve fund)	13,241	Cancelled	0	0	0
Water Supply System Improvement	Water-conducting, water purification, water delivery & distribution facilities (Including reserve fund)	6,363	Implementation as planned	6,363	5,440	-923
Wastewater Treatment	Wastewater treatment plant (Including related equipment and reserve fund)	6,309	Wastewater treatment plant (Including related equipment and reserve fund)	6,309	N.A.	N.A.
			Wastewater collecting conduit pipe network 60.7 km Wastewater pump 3 Adjustment pond 2	2,102	2,102	0
	Subtotal of the Sub-projects	6,309	Subtotal of the Sub-projects	8,411	8,685	274
Total of the Project		39,340	Total of the Project	27,188	25,298	-1,928

Source: Interview with respective implementing entities and information materials provided by JICA

Note: The values in the column of “Estimated Amount” were calculated based on an existing unit price or a unit price estimated from the total amount and total quantity (number of unit, length, etc.) available from the column of “Total Project Cost in Original Plan”, with the exception that the estimated amount of “Others” in the sub-project of “Central Heating System Improvement” was an actual value provided by the implementing agency, and the estimated amount of cost for the additional equipment like wastewater collecting conduit pipe network in the sub-project of “Wastewater Treatment” was the value available from JICA’s document regarding approval of the second-time extension of loan period.

3.2.2.2 Project Period

Whereas the project period scheduled at the time of the appraisal was from February 2002 to October 2006, the actual project period was from February 2002 to April 2012 (123 months in total and 215.8% of planned), significantly longer than planned.

Table 6: Project Period (Plan and Actual Results)

Sub-project	Plan	Actual Results	Result/Plan
1. Central Heating System Improvement	February 2002- October 2006 (4 years and 9 months/ 57 months)	February 2002- October 2004 (2 years and 10 months/ 34 months)	59.6 %
2. Urban Railway System Improvement	March 2002- March 2006 (4 years and 1 month/ 49 months)	Cancelled	—
3. Water Supply System Improvement	March 2002- September 2005 (3 years and 7 months/ 43 months)	August 2002- January 2010 (7 years and 6 months/ 90 months)	209.3 %
4. Wastewater Treatment	February 2003- December 2005 (2 years and 11 months/ 35 months)	January 2004- April 2012 (8 years and 4 months/ 100 months)	285.7 %
Total	February 2002- October 2006 (4 years and 9 months/ 57 months)	February 2002- April 2012 (10 years and 3 months/ 123 months)	215.8 %

Source: Interview with respective implementing entities and information materials provided by JICA

The loan period of this project was extended twice. The first-time extension was due to: a) belated approval of the feasibility study reports (hereinafter referred to as “F/S reports”)¹¹, b) outbreak of “Severe Acute Respiratory Syndrome” (SARS)¹², c) application procedures relevant to “The Law of Land Administration of the People's Republic of China”¹³, d) negotiations and formalities regarding land acquisition for the laying of headrace tunnel, and e) influence of snow disaster, etc., while the second-time extension arose from the necessity of installing additional facilities for the “Wastewater Treatment Sub-project”. The specific reasons that resulted in the extension of loan period are to be analysed by sub-project as follows.

In this project, extension of project period actually occurred only in two sub-projects, i.e. “Water Supply System Improvement Sub-project” and “Wastewater Treatment Sub-project”. In the case of the former, the detailed design originally scheduled to start from February had actually not begun until August 2003 because of the belated approval of the F/S Report, and then the outbreak of SARS gave rise to the delay in the completion of detailed design and equipment procurement tendering for up to 11 months and 3 months respectively. Besides, owing to the influence of snow disaster in March 2005 and the negotiations and formalities regarding land acquisition for the laying of headrace tunnel (referring to the later described “Resettlement and Land Acquisition” for further details), the period of civil engineering work was seven months longer than planned. In the case of latter, the start of detailed design was delayed for up to one year and the period of the work itself was eight months longer than

¹¹ The F/S Reports were submitted to NDRC via the implementing agency, Anshan Municipal Development and Reform Commission and Liaoning Provincial Development and Reform Commission, upon which, NDRC designated a special agency to evaluate the F/S Reports and made the decision of approval based on the results of evaluation.

¹² According to various news reports, the first infected person of SARS was confirmed in Guangdong Province of China in November 2002, and the infection became pervasive throughout 25 provinces/municipalities/autonomous regions of the country within 6 months after that. By the date of August 15, 2003, the number of SARS patients and the dead respectively reached 5,327 and 349 nationwide. Although the detection of infected persons peaked in May 2003, as quasi-infected persons were newly detected in Beijing in April 2004, the impact of SARS virtually lasted more than 1 year. Besides, some regions including Beijing and Guangdong were designated as “Plague Outbreak Areas” by WHO for a certain period. During the outbreak of SARS, in an atmosphere of high tension and caution throughout the country where the infected and quasi-infected persons were segregated in hospitals and those places (residential estate, large building, factory, agency, facility) with infected persons detected were temporally closed or blocked up, business activities in the areas with infected persons detected were forced to stop.

¹³ With the enforcement of this new law in August 2004, application for the authority’s review and approval regarding the legality of land use and a series of formalities including investigation, review and approval became necessary.

the originally scheduled 4 months as a result of the belated approval of the F/S Report and the outbreak of SARS. In addition, the application procedures relevant to the law of land administration and the influence of snow disaster caused the delay in the completion of tendering work for up to 3 years and 2 months (38 months), which in turn resulted in the prolonged implementation of civil engineering and installation work of the wastewater treatment plant with a period of 4 years and 2 months (50 months) longer than planned. In view of the delay in various stages of implementation of respective sub-projects attributed to various causes, JICA decided to extend the deadline of the loan period from the planned October 25, 2008 to October 25, 2010 upon consultation with the Chinese government.

The implementation of the above-mentioned two sub-projects was completed before the deadline of the first-time extension approved for the loan period. However, considering the necessity to expand the scope of the “Wastewater Treatment Sub-project” in response to the additional need as described in 3.2.1, JICA decided to authorize the second-time extension for the loan period with the deadline prolonged till April 25, 2012 after a second consultation with the Chinese government.

With regard to the above-mentioned extension of loan period twice, based on the principle of “taking no account of external factors during the evaluation of efficiency”, whereas the first-time extension should be regarded as a basis for judgment in the evaluation of efficiency, it would be proper not to count the second-time extension as such a basis since it was a result of the scope expansion in the “Wastewater Treatment Sub-project”, which should not be regarded as simply an outcome of external factors but rather a necessary measure to respond to the additional need and to effectively utilize the capacity of existing facilities. However, during the evaluation of project period, even after taking into account the above-mentioned and excluding the approved period of second-time extension (October 25, 2010- April 25, 2012) from the scope of evaluation, the actual project period of this project could still be counted as 8 years and 9 months (105 months), starting from February 2002 and ending in October 2010, which was 84% longer than planned (57 months).

3.2.3 Results of Calculations of Internal Rates of Return (Reference only)

The results of calculations of Internal Rates of Return (IRR) at the time of the ex-post evaluation were as follows:

As far as the “Central Heating System Improvement Sub-project” is concerned, owing to the earlier-than-expected shutdown of part of the adopted 40 t boilers, it was not possible to calculate its IRR based on the project scope of the original plan. Accordingly, a recalculation of FIRR was made by including the boilers sizing 80-140 t adopted to replace the shut-down 40 t boilers in the project scope with an eye to verifying the efficiency of the sub-project. By doing so, the result of FIRR was worked out as -14.35%, which arose from the problem that, while the investment cost increased with the additional equipment, the revenue from the heat supply charge remained unchanged.

With regard to the “Water Supply System Improvement Sub-project”, FIRR was -2.65% as a result of the inappropriately low existing water rate. In the case of the “Wastewater Treatment Sub-project”,

owing to the fact that the gap between the existing wastewater treatment charge and the operation and maintenance (O&M) cost was even larger, the calculation of FIRR was not possible.

As described above, the results of IRR for respective sub-projects were all negative values. These results need to be considered in the evaluation of effectiveness or sustainability where they could be used as an auxiliary factor for the rating of the respective items.

To sum it up, although the scope of this project underwent significant changes, these changes were appropriate in that they were necessary response to the changes of needs, and the input of project cost was commensurate with the outputs after the changes of scope. Meanwhile, the extension of project period was over 50% longer than planned even after excluding the part of extension regarded as reasonable. Therefore, efficiency of the project is fair.

3.3 Effectiveness¹⁴ (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

As explained in the previous analysis regarding relevance, out of the four sub-projects of this project, three are now in operation with the cancellation of “Urban Railway System Improvement Sub-project” as an exception. The operational status of equipment adopted in respective sub-projects up to now since the beginning of the project was illustrated in Table 7.

Table 7: Operational Status of Equipment Adopted in Respective Sub-projects

Sub-project	Major Equipment	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Central Heating System Improvement	40 t boilers	■	■	■	■	■	■	■	■	■	△
	Indoor and outdoor conduit pipe	■	■	■	■	■	■	■	■	■	■
	Heat exchange station	■	■	■	■	■	■	■	■	■	■
Water Supply System Improvement	Purification plant						■	■	■	■	■
	Headrace tunnel						■	■	■	■	■
Wastewater Treatment	Wastewater treatment plant						△	△	■	■	■
	Wastewater collecting conduit pipe network								■	■	■

Note: ■ Fully operated、△ Partially operated

Detailed analysis of operation and effect indicators by sub-project is conducted as follows.

¹⁴ Sub-rating for Effectiveness is to be put with consideration of Impact.

(1) Central Heating System Improve Sub-project

The 11 boilers of 40 t adopted in this sub-project were installed in boiler houses of two districts called “Gaoxin District” and “Yingchengzi District”, with six in the former and five in the latter. The implementing entity of the sub-project, Anshan Heating Corporation, now operating 13 boiler houses, was in charge of heat supply to a floor space¹⁵ of 21 million m² in total as of 2013. Out of this, 3.6 million m² including the above-mentioned two districts were covered by the service of the boilers adopted in this sub-project, which accounted for one sixth of the company’s total heat supply floor space. Meanwhile, as the total heat supply floor space covered by all the 35 heat supply companies in Anshan now reached 63 million m², Anshan Heating Corporation roughly accounts for one third of the total, while this sub-project accounts for only 5.7%.

The operation and effect indicators of the sub-project are reflected in the Table 8. The operation indicators like Coal Consumption for Heating Boilers, Number of Boilers in Operation and Total Floor Space of Heat Supply show that the eleven 40 t boilers adopted in this sub-project were in full operation during the nine years from 2005 to 2013, and the target values set for 2007, which had been expected to be one year after completion, at the time of the appraisal were all achieved in the year of 2005¹⁶. Meanwhile, due to the reasons explained in “Relevance”, among the eleven 40 t boilers, only the five installed in “Yingchengzi District” are continuing to operate after 2014. However, as this district is an old urban area with a constant resident population and a stable heat supply floor space, it has been confirmed that the possibility for these boilers to be replaced by boilers of larger size is very low.

Table 8: Operation and Effect Indicators of the Central Heating System Improvement Sub-project (in “Gaoxin District” and “Yingchengzi District”)

Indicator	Baseline	Target	Actual Values					
	2000	2007	2005	2010	2011	2012	2013	2014
	Year of Appraisal	1 Year after Completion	1 Year after Completion	6 Years after Completion	7 Years after Completion	8 Years after Completion	9 Years after Completion	10 Years after Completion
Coal Consumption for Heating Boilers (Kt/year)	160	115	115	115	115	115	115	51
Number of 40t Boilers in Operation	0	11	11	11	11	11	11	5
Total Floor Space of Heat Supply (thou.m ²)	0	3,600	3,600	3,600	3,600	3,600	3,600	1,600
Heat Supplied Family (thou. families)	0	36	36	36	36	36	36	16
Annual Heat Supply (Gcal/year)	0	126	126	126	126	126	126	56
SO ₂ Emission (t/year)	3,955	887	543	380	362	450	466	N.A

Source: Anshan Heating Corporation and Anshan Environmental Protection Bureau

Note: 1. The boilers for heat supply in Anshan operate from Nov. 1 to Mar. 31 every year.

Note: 2. The heat supply area of this project includes 2 million m² in “Gaoxin District” and 1.6 million m² in “Yingchengzi District”.

¹⁵ In China, the scale of heat supply is indicated in the total floor space of the heat supplied families.

¹⁶ The sub-project was completed two years earlier than planned.

In 2005, practically one year after the completion of the sub-project, the value of SO₂ Emission¹⁷ appeared lower than target and had been kept at the level lower than target till 2014 when some of the boilers were shutdown. Although six out of the 11 boilers adopted in this sub-project were shut down earlier than scheduled, the overall effectiveness of this sub-project was high in that the emergence of expected effect of the sub-project during the in-service period was verified, the remaining five adopted boilers and the facilities of indoor and outdoor heat conduits and heat exchange stations which made up most of the investment cost of the sub-project have been continuing to operate, and by utilizing these facilities, the boilers of larger size introduced by the implementing entity at its own expense have been in service with higher efficiency. Therefore, it can be said that, in spite of the shutdown of part of the equipment, the initially expected effect of this sub-project has been well-maintained. At the same time, in view of the afore-mentioned result of IRR analysis which stood at a negative value owing to the additional cost of investment, it can hardly be said that the investment efficiency has been high. However, taking into account the fact that the expected effect did appear during the period of operation, and the part of the replaced output virtually accounted for a small proportion of the project cost, it is proper to say that the effect of the sub-project has emerged to some extent.



Photo 2: A 40 t Boiler Installed in a Boiler House in “Gaoxin District”



Photo 3: The 150,000 m³/day Purification Plant Constructed in the Sub-project

(2) Water Supply System Improvement Sub-Project

The 150,000 m³/day water purification plant planned for the sub-project is located next to the Phase 1 water purification plant constructed in the Japanese ODA loan project, “Water Supply System Improvement Project in Three Cities (Tianjin, Hefei, Anshan)” implemented in 1990. As indicated in Table 9, it can be said that the expected effect of the sub-project has already arisen.

It deserves high evaluation that, as one of the major purposes of this sub-project, the aim to lift the time restriction in water supply was realized. In the whole city of Anshan including the target area of the sub-project (Lishan Ward and part of Tiexi Ward), 24-hour water supply has been achieved since

¹⁷ The data of this indicator were acquired from the observation point of the Environmental Protection Bureau established near the boiler house in “Gaoxin District” where six out of the eleven 40 t boilers of this sub-project were installed. As there were other boiler houses in the surrounding area, these data did not solely reflect the effect of all the equipment of this sub-project. However, they would allow for an estimation of their relevance with the sub-project to some extent.

2010, the year of completion of the sub-project. Also, the target values of effect indicators such as Non-Revenue Water Ratio (NRWR)¹⁸, Water Supply per Person, Pass Rate for Comprehensive Water Quality Standard and Coverage of Water Supply System were all achieved in the year of completion of the sub-project.

Table 9: Operation and Effect Indicators of the Water Supply System Improvement
Sub-project (Anshan)

Indicator	Baseline	Target	Actual				
	2000	2005	2010	2011	2012	2013	2014
	Year of Appraisal	Year of Completion	Year of Completion	1 Year after Completion	2 Years after Completion	3 Years after Completion	4 Years after Completion
Water Supplied Population in Anshan (thou.persons)	1,310.0	1,440.0	1,452.1	1,456.1	1,444.3	1,449.2	1,553.2
Water Supplied Family in Anshan (thou. families)	485.0	520.0	524.1	533.8	524.0	524.0	582.4
Hour of Water Supply in Anshan (hour/day)	12	24	24	24	24	24	24
NRWR in Anshan (%)	41	39	38	37	35	33	30
Water Supply per Person in Anshan (L/day)	85	110	115	115	115	115	120
Pass Rate for Comprehensive Water Quality Standard (%)	99.4	99.5	99.7	99.7	99.9	99.9	99.9
Coverage of Water Supply System (%)	90	95	100	100	100	100	100

Source: Anshan Water Corporation

Note: 1. “Water Supply per Person” refers to the daily life water used by households only instead of the daily life water in a broad sense including that of the bathhouses, restaurants, etc.

Note: 2. “Pass Rate for Comprehensive Water Quality Standard” is an indicator stipulated in the National Standard, “Drinking Water Sanitary Standard” (GB-5749), which is a weighted average of Number of Common Bacterial, Coli Group, Residual Chlorine, Degree of Pollution, Chromaticity, Smell & Taste, COD and other 35 items (altogether 42 items).



Photo 4: A Primary Sedimentation Pond in Dadaowan Wastewater Treatment Plant¹⁹



Photo 5: The Wastewater Pumps Additionally Adopted in the Sub-project

¹⁸ China’s Industry Standard for NRWR is 18% (“Urban Water Supply Pipe Network Leakage Control and Evaluation Criteria” (Cjj92-2002), but according to the explanation by the implementing entity, in the frigid Northeastern China where all the water supply pipes have to be laid underground instead of above ground, as it is hard to conduct normal checkup and maintenance, NRWR is significantly higher than that of other areas. In view of the fact that the average level of NRWR in urban area here is 35%, the target set for this sub-project was an annual reduction rate of 1.2% beginning from the year of 2000. As a result, the actual level of NRWR of the sub-project has been reduced to 30.2% by now.

¹⁹ It was called “Western No. 2 Wastewater Treatment Plant” at the time of the appraisal, but it was changed to “Dadaowan Wastewater Treatment Plant” in 2008.

(3) Wastewater Treatment Sub-project

With respect to this sub-project, the target values set for the year of completion were all achieved in the year of 2012, including the operation indicators of Volume of Treated Wastewater, Wastewater Treatment Area and Capacity Utilization Ratio as well as the effect indicators of Sewage System Penetration Rate, Discharge Amount and Concentration of COD, BOD and SS.

Table 10: Operation and Effect Indicators of the Wastewater Treatment Sub-project
(Anshan Dadaowan Wastewater Treatment Plant)

Indicator	Baseline	Target	Actual				
	2000	2005	2010	2011	2012	2013	2014
	Year of Appraisal	Year of Completion			Year of Completion	1 Year after Completion	2 Years after Completion
Volume of Treated Wastewater (thou. m ³ /day)	20	200	140	160	175	183	182
Area of Wastewater Treatment (km ²)		48	48	48	48	48	48
Capacity Utilization Ratio (%)		100	70	80	100	100	100
Sewage System Penetration Rate (%)		100	90	95	100	100	100
COD Discharge Amount (t/year)	31,390	8,760			4,407	4,809	2,431
COD Concentration (mg/L)	430	100			69	72	36.6
BOD Discharge Amount (t/year)	11,680	2,190			639	735	392
BOD Concentration (mg/L)	160	30			10	11	5.9
SS Discharge Amount (t/year)	22,484	2,190			958	868	438
SS Concentration (mg/L)	308	30			15	13	6.6

Source: Anshan Dadaowan Wastewater Treatment Plant

Note: 1. The data of discharge amount concentration of pollutants in 2014 were measured data up to October, with the data of concentration measured in the outlet of the wastewater treatment plant.

2. The data of "Sewage System Penetration Rate" were that of Anshan as a whole

3.3.2 Qualitative Effects

The qualitative effects of the project assumed at the time of the appraisal were the antipollution measure facilitating effect, living environment improving effect and global warming countermeasure facilitating effect. As the three effects are relevant to the issue of impact, they are to be dealt with in the following section.

3.4 Impacts

3.4.1 Intended Impacts

(1) Antipollution Measure Facilitating Effect

The antipollution measure facilitating effect assumed at the time of the appraisal included the effect of desulfurization by changing the fuel for central heating boilers and the effect of improving the polluted river water quality in Anshan. However, as far as the former is concerned, with the cancel of bio-briquette factory construction and the subsequent shutdown of the small-size boilers below 10 t, the way of achieving the desulfurization effect has become one of improving combustion efficiency to reduce SO₂ emission through adopting boilers of larger size instead of changing the boilers' fuel. The two effects are to be analysed in the following paragraphs.

1) Effect of SO₂ Emission Reduction through Improvement of Combustion Efficiency

As seen in Table 8, while the annual coal consumption for heating boilers in “Gaoxin District” and “Yingchengzi District” (where the boilers adopted in this project were installed) in 2000 was 160,000 t, this figure reduced to 115,000 t during the period from 2005 to 2013 with the adoption of the 11 boilers of 40 t, a 39% reduction from the baseline value. Based on this, the annual amount of SO₂ emission reduction during this period can be estimated at 450 t²⁰. Moreover, as the 6 boilers installed in “Gaoxin District” under this project has been replaced by boilers of larger size with better performance since 2014, the actual values of annual reduction in coal consumption and SO₂ emission relevant to the same area of heat supply should be larger than the above-mentioned.

According to the year-wise data of atmospheric SO₂ concentration in Anshan as indicated in Table 11, the value of atmospheric SO₂ concentration peaked in 2005, the year of completion of the “Central Heating System Improvement Sub-project”²¹, and exhibited a declining trend after that. Besides, the result of the Beneficiary Survey²² shows that, with regard to the air quality of Anshan, those answering “slightly improved as compared with 5 years ago” stood at 53%, while those answering “significantly improved as compared with 14 years ago” and those of “slightly improved” amounted to 62%. Meanwhile, 95% of those answering “improved as compared with 14 years ago” cited “adoption of large-size boilers and shutdown of outdated small-size boilers” as the reason for the improvement of air quality. Accordingly, although it can hardly be said that the implementation of the sub-project itself has given rise to the significant improvement of the overall air environment of Anshan in light of the fact that the heat supply floor space covered by the sub-project accounts for not more than 5.7% of the total heat supply floor space of the whole city, it is appropriate to say that the sub-project has contributed to the city’s air quality improvement to a certain extent.

Table 11: Change of Atmospheric SO₂ Concentration in Anshan

Indicator	2000 Baseline	2001	2003	2005	2007	2008	2009	2010	2011	2012	2013
Atmospheric SO ₂ Concentration in Anshan (mg/Nm ³)	0.071	0.07	0.078	0.078	0.069	0.058	0.054	0.045	0.057	0.048	0.048

Source: Anshan Environmental Protection Bureau

²⁰ Calculating formula: $SO_2=2Cx$ (C=amount of combusted coal, x=content rate of sulfur, 2 refers to the phenomenon where the sulfur content grows to double in mass via chemical reaction during the process of coal combustion. In addition, the sulfur content of coal used in China differs from place to place, and the coal used in Anshan is said to be basically a kind of low-sulfur coal mined within Liaoning Province with a content rate of 0.5% on average.)

Annual amount of SO₂ emission reduction= $2 \times 45,000t \times 0.005 = 450t$

²¹ The test run of the sub-project was completed in November 2004.

²² The survey was held in November 8, 2014 in the 219 Park at the center of Anshan with the visitors as respondents. The number of sample selected at random and number of effective response were both 34. The survey was conducted by the investigators who queried based on the questionnaire and filled in the answers on it.

2) Effect of Improving the Polluted River Water in Anshan through Construction of the Wastewater Treatment Plant

As seen in Table 10, the amount and concentration of the three kinds of pollutants discharged from the Dadaowan Wastewater Treatment Plant in 2012, the year of completion of the “Wastewater Treatment Sub-project”, all achieved their targets set for the year of completion. Although the values of concentration that year all satisfied the Class 2 level of the National Standard, a new treatment technology was introduced in 2013, whereby the values of concentration were further improved to reach the Class 1A level²³.

Table 12: Change of Major Indicators of River Water Quality in Anshan

Indicator	National Standard	2000	2001	2003	2005	2007	2008	2009	2010	2011	2012	2013
COD Concentration (mg/L)	30.0	30.4	31.0	38.0	27.7	35.7	29.4	24.2	16.9	16.8	14.3	13.1
BOD Concentration (mg/L)	6.0	6.4	6.5	6.7	6.6	6.3	6.0	3.5	3.5	5.1	4.2	3.5

Source: Anshan Environmental Protection Bureau

Note: 1. The actual data were acquired via samples collection from the observation point in the Taizi River where all the rivers of Anshan converge.

2. The values of National Standard are of Class IV level stipulated in “Environmental Quality Standard for Surface Water” (GB3838-2002).

Meanwhile, as indicated in Table 12, a declining trend in the concentration values of COD and BOD began from 2008, but especially the value of COD registered a significant year-on-year decrease in 2010 when the facilities of the sub-project started operating with a capacity utilization rate of 70%, and it declined further in 2013, the year after the completion of the sub-project. Taking account of the proportion of the sub-project (36%) to the total capacity of wastewater treatment in Anshan (560,000 m³), it can be said that its contribution to the improvement of river water quality has been significant.

²³ According to the existing National Standard, “Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant” (GB-18918-2002), the values of Class 1A and Class 2 for the concentration of the above-mentioned three kinds of discharged pollutants are as follows. Class 1A: COD 50mg/L, BOD 10mg/L, SS 10mg/L, Class 2: COD 100mg/L, BOD 30mg/L, SS 30mg/L.



Photo 6: Yunliang River near Dadaowan Wastewater Treatment Plant



Photo 7: Residents Enjoying Fishing along the Yunliang River (Part of the Respondents to the Beneficiary Survey)

At the same time, the result of Beneficiary Survey²⁴ also bears out the contribution of the sub-project to the improvement of river water quality in Anshan. In this survey, with regard to the river water quality in Anshan, those answering “significantly improved as compared with 5 years ago” and “slightly improved” added up to 89%, while those answering “significantly improved as compared with 14 years ago” and those of “slightly improved” amounted to 91%. Meanwhile, 72% of those answering “improved as compared with 14 years ago” cited “construction of Dadaowan Wastewater Treatment Plant” as the reason for the improvement of river water quality.

Additionally, according to the respondents to the survey, as a river running through the nearby area of Dadaowan Wastewater Treatment Plant, Yunliang River used to be seriously polluted due to the direct discharge of untreated industrial effluent as well as domestic wastewater into the river. However, with the wastewater treatment plant coming into being, the river water quality has been improved, the habitat of fish has recovered, and the scene of anglers enjoying fishing has come back since 2014. All these points to the fact, the progress of water environment improvement has also brought about favourable change of living environment to the residents.

(2) Living Environment Improving Effect

As currently the four water purification plants²⁵ add up to a total capacity of 580,000 m³/day and thus the “Water Supply System Improvement Sub-project” accounts for 26% of the total, it can be said that a considerable contribution has been made by this sub-project to the improvement of living environment reflected by the realization of 24-hour water supply and amelioration in drinking water quality in Anshan. Especially, what deserves high commendation is that the 250,000 people living in Lishan Ward have been able to drink the safer surface water from Tanghe Dam thanks to the

²⁴ The survey was held in November 9, 2014 along the Yunliang River near Dadaowan Wastewater Treatment Plant with mainly the anglers as respondents. The number of sample selected at random and number of effective response were both 35. The survey was conducted by the investigators who queried based on the questionnaire and filled in the answers on it.

²⁵ The purification plant operated by Angang itself is excluded here.

implementation of the sub-project, who used to live with the drinking of groundwater with high manganese and excess iron.

Furthermore, the result of Beneficiary Survey²⁶ held with the residents of Lishan Ward as respondents confirms that, the effect of the sub-project in “reducing the cases in interruption of water supply” and “decreasing the content of manganese and iron in drinking water” as compared with the situation before the implementation of the sub-project has been recognized by many of the residents. In this survey, with regard to the situation of water supply in Lishan Ward, those answering “significantly improved as compared with 5 years ago” and “slightly improved” added up to 95%, while those answering “significantly improved as compared with 14 years ago” and those of “slightly improved” amounted to the same proportion. Meanwhile, among those answering “improved as compared with 14 years ago”, 76% and 47% of the answerers respectively cited “reduction of the cases in interruption of water supply” and “decrease of the content of manganese and iron in drinking water” to substantiate the answer.

(3) Global Warming Countermeasure Facilitating Effect

As illustrated by the afore-mentioned Table 9, the implementation of “Central Heating System Improvement Sub-project” resulted in the reduction of annual coal fuel consumption from 160,000 t in 2000 to 115,000 t after 2005. Based on this, by converting the amount of coal combustion into that of CO₂ emission, it can be estimated that the annual reduction of CO₂ emission since the completion of the sub-project has been 83,252 t as compared with the figure at the time of the appraisal²⁷. Furthermore, as the 6 boilers installed in “Gaoxin District” under this project has been replaced by boilers of larger size with better performance since 2014, the actual values of annual reduction in coal consumption and CO₂ emission relevant to the same area of heat supply should be larger than the above-mentioned.

3.4.2 Other Impacts

(1) Impacts on the Natural Environment

1) Contribution to the Recovery of Groundwater Resource with the “Water Supply System Improvement Sub-project”

The implementation of the “Water Supply System Improvement Sub-project” has brought forth the positive impact unintended at the time of the appraisal with its contribution to the recovery of groundwater resource in Anshan.

A study²⁸ shows that, over the past several decades in Anshan, groundwater had been excessively

²⁶ The survey was held in November 8-9, 2014 with the visitors of Mengtai Park in Lishan Ward as respondents. The number of sample selected at random and number of effective response were both 36. The survey was conducted by the investigators who queried based on the questionnaire and filled in the answers on it.

²⁷ The way of calculation: 1) The conversion factor to convert CO₂ into coal combustion amount: $CF=A \times B \times C=1.850037$
(A=standard coal/raw coal=0.7143, B=carbon/standard coal=0.7, C=CO₂/carbon=3.7)

2) Annual CO₂ emission reduction with the sub-project after 2005:

Annual CO₂ emission reduction=(160,000t-115,000t)×1.850037= 45,000t×1.850037=83,252t

²⁸ Tong Lian-jun (Researcher, Institute of Northeast Geography and Agricultural Ecology, Chinese Academy of Science)

taken due to the lack of water resource, which resulted in the declining of groundwater level to the depth of 24.25 m from the ground surface as of 1986, with the deepest level even reaching 30 m in some places. Moreover, according to the result of another study²⁹, the level of groundwater in Shoushan as part of the water resource in Anshan had declined at a speed of 0.3 m per annum by the year 1999, which gave rise to the fear of aggravation of water quality, degradation of soil and ground subsidence resulted from excessive groundwater intake. In light of this, together with the formulation and enforcement of “Water-saving Regulation” and “Water Resource Protection Regulation”, the municipal government has taken steps to convert the water resource from groundwater to surface water as an important countermeasure, including the work of “Transmitting Water from Xihe River to Tanghe Dam”³⁰ which was virtually a part of the sub-project. As a result, surface water has now mostly replaced groundwater which was the major source of raw water in Anshan at the time of the appraisal, and the used amount of water taken from the remaining groundwater resource has greatly decreased. Consequently in recent years, the level of groundwater has been observed rising 5.8 m in accumulated total, with the increase in the year of 2014 reaching 1.8 m, which has been highly publicized in the recent mass media³¹.

2) The Problems of Offensive Odor and Noise during the Operation of Facilities

At the time of the appraisal, it was assumed that negative effects would arise during the construction work of the “Urban Railway System Improvement Sub-project” and problems of offensive odor, sludge and noise accompanied by the operation of the “Wastewater Treatment Sub-project” would occur. In this regard, countermeasures were proposed at the time of the ex-ante evaluation, and the status of implementation regarding these countermeasures was verified as described below.

With the cancellation of the “Urban Railway System Improvement Sub-project”, the concern about negative effects arising from its construction work has been out of the question. As for the concern over the problems of offensive odor and sludge, the concern has been skirted with the installation of deodorization equipment at the spot of offensive odor emission source to significantly ease the stink, and the introduction of a facility at a cost of 14.8 million yuan to handle sludge treatment. With regard to the concern over noise, in the first place, the fact that there have been no resident at all living within a two km radius suggests that even if a noise was generated by the facility, it would not constitute a problem. The residents living around the wastewater treatment plant also confirmed that they were not feeling disturbed by the operation of the wastewater treatment plant when responding to the

“Sustainable Development and Rejuvenation of the Old Industrial Base in Northeast under the Framework of Environmental Economy” (2005)

²⁹ Geng Xiao-mei (Liaoning Province Environmental Engineering Evaluation and Review Center) “Study on the Issue of Groundwater Environment and the Trend of Development in Liaoning Province” (*Liaoning Urban and Rural Environmental Science and Technology*, No.3, 2007)

³⁰ The “Laohushan Water Purification Plant” constructed in 2013 was also intended to be a part of this countermeasure by drawing surface water from the Dahuofang Dam in Fushun City.

³¹ One of the reports was posted in the 1st page of “Anshan Daily” on March 24, 2015, entitled “A Desirable Situation of Recovery in the Altitude of Groundwater in the Prioritized Regions of Anshan”

Beneficiary Survey. Accordingly, it can be said that the problems of offensive odor and noise have actually not occurred.

As for the other two sub-projects, it was confirmed during the field study that no complaint about offensive odor and/or noise had been received.

3) Measures against Possible Environmental Impacts during the Period of Construction Work

The possible environmental impacts during the construction period of the three sub-projects assumed and the counter-measures taken by the implementing entities are summarized as follows.

Among the major concerns over the environmental impacts arising during the construction period, three were common to all the sub-projects, i.e. the concerns about air pollution caused by dust stirred up during the process of transporting the earth and sand and building materials, noise generated by the operating machines at the construction sites, and wastes discharged from the construction sites. As the measures against dust, high fences were installed to enclose the construction sites and the vehicles transporting construction materials were closely covered with plastic sheets. With regard to the concern about noise, on the one hand low-noise construction machines were adopted preferentially, and on the other, muffling devices were mounted especially to the heavy excavation machines with high noise. As for the wastes discharged from the construction sites, distinction was made between construction wastes like sludge and gravels and kitchen garbage, with the former disposed of by landfill and the latter conveyed to the special waste treatment plant for disposal.

In the case of “Water Supply System Improvement Sub-project”, in addition to the above-mentioned, there was also the concern about pollution of river due to the construction of headrace tunnel. Against this concern, measures like implementing the work of river-crossing pipeline laying only in the dry season and constructing a cofferdam before implementing the work, etc. were adopted.

It can be said that various concern were prevented owing to the above- measures.

(2) Land Acquisition and Resettlement

With respect to the issue of land acquisition in this project, the following points were verified.

Among the three sub-projects, land acquisition was actually needed in the “Wastewater Treatment Sub-project” and “Water Supply System Improvement Sub-project”.

The area of land acquired for the “Wastewater Treatment Sub-project” was 10.8 ha (=108, 000 m²), and the unit price of the land acquired was 151 yuan/m² decided by the Anshan Land and Resources Bureau according to the relevant national law. As resettlement did not happen, the acquisition of land was carried out without trouble.

In the case of the “Water Supply System Improvement Sub-project”, according to the implementing entity, the total area of land acquired was 13.2 ha (=132,000 m²) due to the necessity to build a 15.3 km long headrace tunnel across the three cities of Benxi, Liaoyang and Anshan, resettlement was not required and the price for land acquisition was decided based on the national

standard, the same as that of the “Wastewater Treatment Sub-project”. As the negotiations regarding land acquisition required cooperation from the relevant government agencies of three cities, six wards and over 10 townships, it took virtually more than two years to complete the work of acquisition for all the needed land. Specifically, as far as land acquisition within the city of Anshan is concerned, the implementing entity was required to apply to all the relevant agencies of the municipal government (Land and Resources Bureau, Planning Bureau, Urban Construction Commission and Public Security Bureau) for their approval and support to the implementation of land acquisition. Upon receiving the application, the relevant agencies gave notice to their respective subordinate agencies of the wards and townships where land acquisition was to be conducted. Following this, the implementing entity started to hold briefing sessions, pay visits to and conduct negotiations with relevant farm families respectively accompanied by the government officials of the relevant wards and townships. Regarding the land acquisition in Liaoyang and Benxi, the application procedures became far more complicated due to the necessity to submit applications or give notice not only to the relevant government agencies of Anshan, but also to the relevant government agencies of the two cities, and the relevant wards and townships before the implementing entity was allowed to start negotiations with the relevant farm families. Nevertheless, owing to the appropriate steps taken during this process, the negotiations for land acquisition were completed without significant trouble.

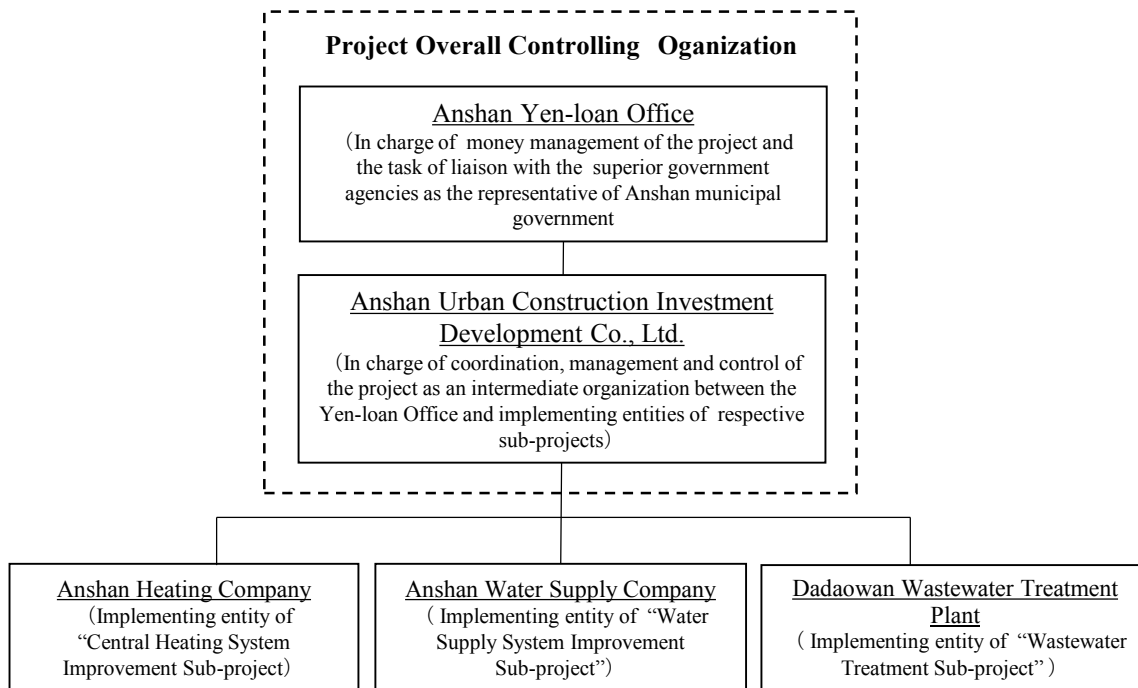
As described above, the project has largely exerted its effect as planned. The shutdown of part of the equipment earlier than expected has not significantly generated unfavourable effect on the project, and while no negative impact has arisen, some unintended positive impact has appeared. Therefore, effectiveness and impact of the project are high.

3.5 Sustainability (Rating: ③)

As the project was composed of multiple sub-projects, evaluation of its sustainability has been conducted in a comprehensive manner with the implementing entities of respective sub-projects (except the one already cancelled) and the municipal government of Anshan presiding over the whole project as the targets of evaluation.

3.5.1 Institutional Aspects of Operation and Maintenance

The organizational structure of this project in terms of Operation and Maintenance (O&M) is illustrated by the Figure below:



Source: Interview with Anshan Yen-loan Office

Figure 1: The Project’s Organizational Structure in Terms of O&M

(1) The Project’s Overall Controlling Organization

The project’s overall controlling organization consists of two agencies, i.e. Anshan Yen-loan Office and Anshan Urban Construction Investment Development Co., Ltd, with their division of roles clearly defined. The former has been functioning as the representative of the Anshan municipal government by taking charge of money management of the whole project (Yen-loan and funding from the domestic financial institutions) and liaison with the superior government agencies (the government of Liaoning Province and the central government), while the latter, as an intermediate organization between Yen-loan Office and the implementing entities of respective sub-projects, has been in charge of coordination, management and control of the project.

Anshan Yen-loan Office was set up inside Anshan Financial Bureau, with its Director and Deputy Director assumed respectively by a Deputy Chief of the Financial Bureau and the Director of the Debt and Finance Division under the Financial Bureau. Meanwhile, Anshan Urban Construction Investment Development Co., Ltd was set up as a state-owned company wholly owned by Anshan Municipal government, with its Vice President taking charge of the operation and management of this project. Over the project period, concerned personnel of the two agencies met at least once a week to share information, and this kind of meeting has been continued since the completion of this project though on an irregular base. On the occurrence of a critical issue, the Director or Deputy Director of Yen-loan Office should take the responsibility to report it to NDRC and the Ministry of Finance and to receive their instructions.

It can be said that the project has been operated and managed without significant trouble under this

kind of overall controlling organization system.

(2) Implementing Entities of the Sub-projects

An overview of O&M organizational structure in respective sub-project implementing entities is given in Table 13 as below. Among these implementing entities, Anshan Heating Corporation has designated its subsidiary to take charge of the O&M work of “Central Heating System Improvement Sub-project”, while in the case of “Water Supply System Improvement Sub-project”, this work has been assigned to a branch company of Anshan Water Supply Corporation. The following points are the features of O&M organizational structure common to all implementing entities of the project:

- 1) A state-owned company practically 100% owned by the Anshan municipal government without any schedule of privatization currently.
- 2) Basically stable personnel positioning since the start of the facilities’ operation.
- 3) Regularly held meetings on issues of production and safety and emphasis on safety education.
- 4) Record of equipment inspection and retention of records being institutionalized.

Accordingly, the O&M organizational structure also appears to be stable and sound at the level of sub-project.

Table 13: O&M Organizational Structure of Sub-projects

Sub-project	Implementing Entities	O&M Organizational Structure
Central Heating System Improvement	Anshan Heating Corporation (Subsidiary “Urban Heating Company”)	<ul style="list-style-type: none"> • A state-owned company 100% owned by Anshan municipal government without any schedule of privatization currently. • O&M of this sub-project taken care of by an organization of the whole company instead of a separate organization set up solely for this sub-project as equipment of this sub-project has functioned as part of the overall facilities of the company. • Meetings on production and safety held weekly to discuss and solve problems of this kind, with the safety education conducted irregularly. • Record of equipment and retention of records being institutionalized.
Water Supply System Improvement	Anshan Water Corporation (Branch “Water Supply Company”)	<ul style="list-style-type: none"> • A state-owned company 100% owned by Anshan municipal government without any schedule of privatization currently. • The number of employees of the branch company “Water Supply Company” fixed at 380 since 2010 when the equipment of the sub-project started operation. • O&M of this sub-project taken care of by an organization of the whole company instead of a separate organization set up solely for this sub-project as equipment of this sub-project has functioned as part of the overall facilities of the company. • Meetings on production and safety held weekly to discuss and solve problems of this kind, with the safety education conducted irregularly. • Record of equipment and retention of records being institutionalized.
Wastewater Treatment	Anshan Dadaowan Wastewater Treatment Plant	<ul style="list-style-type: none"> • A state-owned company 100% owned by Anshan municipal government without any schedule of privatization currently. • O&M organization set up for the purpose of this sub-project with the equipment of this sub-project installed as an independent facility. • The number of employees fixed at 85 since 2010 when the equipment of the sub-project started operation. • Meetings on production and safety held weekly to discuss and solve problems of this kind, with the safety education conducted irregularly. • Record of equipment and retention of records being institutionalized.

Source: Interview with respective implementing entities

3.5.2 Technical Aspects of Operation and Maintenance

(1) Technological Level of Employees of the Implementing Entities

The implementing entities of sub-projects all possess a proper number of technicians required for their respective works.

As far as “Urban Heating Company”, the actual implementing entity of the “Central Heating System Improvement Sub-project” is concerned, the total number of 143 staff members includes two senior engineers, 10 engineers, and 86 skilled workers. In the case of “Water Supply Company”, the actual implementing entity of the “Water Supply System Improvement Sub-project”, among the 380 staff members in total, there are three (3) senior engineers, 12 engineers, 10 skilled workers and other 45 staff members with an education background of junior college or university or above. With regard to the implementing entity of the “Wastewater Treatment Sub-project”, “Dadaowan Wastewater Treatment”, the total number of 85 staff members consists of one senior engineer, 10 engineers, 12 associate engineers and 62 skilled workers, which means that every one of the staff members has obtained some kind of technological qualification.

It is worth notice that while the equipment adopted in the respective sub-projects are practically not that sophisticated technologically, each of the implementing entities is equipped with a technical staff required for the O&M work. Additionally, in light of the fact that, as already verified in the section of “Effectiveness”, all the three sub-projects have been operating stably so far, it can be said that no significant problem has been detected in the technical aspects of O&M.

(2) Institution Aimed to Maintain and Improve the Technological Level of Employees

All the implementing entities have established their respective training systems to maintain and improve the technological level of employees, which include in-house training and outside training. Both “Urban Heating Company” and “Dadaowan Wastewater Treatment Plant” dispatch managers and technicians to attend training courses on practical operation in the plant of the equipment manufacturer. In the case of “Water Supply Company”, training courses are conducted by the company itself separately to cater to the respective needs of managers, technicians and frontline workers. Moreover, in the case of “Dadaowan Wastewater Treatment Plant”, in addition to the continuation of training courses on practical operation, outside training in a design institute intended for theoretical study is also under contemplation, which reveals the company’s proactive stance toward establishing a sound training system.

(3) Manuals Available for O&M

All the implementing entities have the manuals for the O&M of their respective sub-projects, which are being used practically. The manuals for the O&M of equipment are provided by respective manufacturers.

As described above, it can be said that there is no problem in the technical aspects of O&M for the project.

3.5.3 Financial Aspects of Operation and Maintenance

(1) Financial Resource Necessary for O&M

According to the results of IRR calculation in the section of “Efficiency”, the IRR values of respective sub-projects turn out to be negative numbers, which points to the fact that each of the sub-projects is hardly profitable by itself. Therefore, with the view to evaluating the sustainability of O&M in the financial aspects, it is necessary to make a comprehensive analysis of the implementing entities’ capacity for project implementation in terms of financial resource as to whether there is any plan to improve the profitability of individual sub-projects and whether a package of comprehensive financial measures are in place.

First of all, the current state of financial resource and the future prospect of improvement for respective sub-projects are summarized in Table 14 below.

With regard to the “Central Heating System Improvement Sub-project”, although the IRR value yielded taking into account the investment cost is low, since it is possible to cover the cost of ordinary O&M by the revenue from the heating project, there is not too much concern over the financial resource for ordinary O&M of the project. As for the issues of recoupment of the initial investment and financial schedule, relevant analysis will be given in later sections.

In the case of the “Water Supply System Improvement Sub-project”, although the current water rate is a kind of flat-rate system and has been kept at a low level, the situation is expected to improve against the background of a new trend of policy started by the central government and followed by the local government. To be more specific, in the document “Guidance on Accelerating the Establishment of Graduated Water Rate System for Urban Household Water” announced by the NDRC and the Ministry of Housing, Urban and Rural Development (MOHURD) in December 2013, it was set up as a target to “put the Graduated Water Rate System into operation for household water in all the cities with subordinate municipalities by the end of 2015 in principle” and to “practice this system actively in those townships (including administrative districts of the same class) with conditions permitted”. In addition, it was also specified as a principle of the Graduated Water Rate System that “the water rate should be adjusted to the level which will be able to reflect the overall cost of water supply”. Upon this, the Housing Construction Commission of Anshan is now in the process of deliberation on a working plan to be put forward by the end of 2015. Therefore, it is expected that the revenue from water rate in the future will be able to cover the O&M cost when looking at O&M only, regardless of the IRR value which takes account of the initial investment cost also.

As for the “Wastewater Treatment Sub-project”, since the O&M cost is entirely funded by the municipal government, there is nothing to be worried about regarding the issue of O&M.

Table 14: Financial Resource Necessary for O&M of Respective Sub-projects

Sub-project	Financial Resource Necessary for O&M
Central Heating System Improvement	<ul style="list-style-type: none"> • The average annual O&M unit cost has been 27 yuan/m² since 2010, while the fee for heating has been 28 yuan/m². • The fee structure is proper that the operation of the sub-project is expected to be sustainable even without financial support from the government.
Water Supply System Improvement	<ul style="list-style-type: none"> • The O&M cost is paid by water rate (household water at 1.9 yuan/m³, and non-household water at 3.6 yuan/m³). • The current water rate is too low, but it is expected to be adjusted to the proper level.
Wastewater Treatment	<ul style="list-style-type: none"> • The annual O&M cost has been 1,627 yuan on average, but the revenue from wastewater treatment has been totally paid to the Anshan municipal government while the O&M cost has been covered by the disbursement from the government's budget in return. Therefore, the sub-project (as well as the whole company) is not financially independent.

Source: Interview with respective implementing entities

(2) The Income and Expenditure and Financial Indicators of Implementing Entities

Based on the income statements acquired from the implementing entities of respective sub-projects through the field study, the status of revenue and expenditure of the implementing entities are summed up in Table 15 below.

The implementing entity of “Central Heating System Improvement Sub-project” is Urban Heating Company, the subsidiary of Anshan Heating Corporation. The balance of business income and expenditure of the company moved from deficit in 2012 to successive two years of surplus in 2013 and 2014. The business operation is expected to continue in a stable manner in years to come under the the appropriate rate system³².

In the case of the “Water Supply System Improvement Sub-project”, the income statement was provided by Anshan Water Supply Corporation³³. Due to the low level of current water rate as mentioned before, the balance of business income and expenditure was in deficit over the three years from 2011 to 2013. However, this situation is expected to be improved steadily in the years to follow with the introduction of the Graduated Water Rate System. The above-mentioned deficit in the balance of business income and expenditure suggests a tendency of decreasing with the amount falling from 24.63 million yuan in 2011 to 17.79 million yuan in 2013. This improvement is mainly attributed to the increase in revenue by reducing NRW (refer to Table 9) through measures to step up management by way of segmenting water supply region, strengthening staff management and concretizing the division of role and responsibility. Furthermore, the implementing entity is aiming at attaining the final goal of NRW at 25%. With this background, the scheduled introduction of the new water rate system is believed to further contribute to the elimination of deficit³⁴.

³² According to the implementing entity, the policy of Anshan municipal government on heating service is to ensure the sustainability of public utility by setting the fee for heating in a way that allow for a small margin of profit over the O&M cost.

³³ Though the branch company, “Water Supply Company” is the actual implementing entity of the sub-project, since it is not financially independent, the income statement is not available from it.

³⁴ According to the trial calculation done by Anshan Water Supply Corporation, the prerequisite for the company to turn a good profit under the current condition of NRW level (30%) is to raise the water rates of both household water and non-household water by one yuan from the current 1.9 yuan/m³ and 3.6 yuan/m³ to 2.9 yuan/m³ and 4.6 yuan/m³ respectively. But, in the case that NRW declines to 25%, it would become profitable even if the raise in the above-mentioned two kinds of water rates is not more than 0.5 yuan.

As for the implementing entity of the “Wastewater Treatment Sub-project”, Dadaowan Wastewater Treatment Plant, on the one hand the government’s subsidy accounts for more than 99% of its revenue, and on the other, all the fees for wastewater treatment has been paid to the government and has not been counted as the revenue of the wastewater treatment plant. As the only one among the implementing entities of this project that receives subsidy from the municipal government, it can be said that its financial sustainability is ensured by the government’s support.

Table 15: The Status of Revenue and Expenditure of the Implementing Entities of Respective Sub-projects (Unit: 10 thousand yuan)

Sub-project (Implementing Entity)	Item	2011	2012	2013
Central Heating System Improvement (Urban Heating Company)	Cost of O&M and Others	27,735	34,452	36,686
	Income from the Fee for Heating	27,636	34,888	37,016
	Balance of Revenue and Expenditure	-99	436	330
Water Supply System Improvement (Anshan Water Supply Corporation)	Cost of O&M and Others	27,156	27,910	29,116
	Income from the Water Rate and Others	24,693	25,675	27,337
	Balance of Revenue and Expenditure	-2,463	-2,235	-1,779
Wastewater Treatment (Dadaowan Wastewater Treatment Plant)	Cost of O&M and Others	1,648	2,427	2,516
	Income from Financial Subsidy and Others	1,918	2,099	2,609
	Financial Subsidy Included in the Above	1,911	2,096	2,586
	Balance of Revenue and Expenditure	270	-328	93

Source: Income statements from Urban Heating Company, Anshan Water Supply Corporation and Dadaowan Wastewater Treatment Plant

Note: The data of Urban Heating Company are of the years from 2012 to 2014.

In addition, based on the balance sheets acquired from the implementing entities of the “Central Heating System Improvement Sub-project” and “Water Supply System Improvement Sub-project”, their major financial indicators are summarized as follows:

Both of the implementing entities have increased equipment investment in recent years in response to the increasing demand accompanying the advance of urbanization, which has resulted in the tendency of increase in debt ratio of both companies. Nevertheless, as this kind of increase has been in a gradual manner that capital ratio of both companies has been kept at the level of around 30%, it can be said that the financial soundness has been ensured properly.

Moreover, as aforementioned, since both the sub-projects are expected to be operated under appropriate rate systems, it is conceivable that the financial sustainability will be maintained without problem.

Table 16: Major Financial Indicators of Implementing Entities of Respective Sub-projects

Sub-project	Implementing Entity	Major Financial Indicators	2011	2012	2013
Central Heating System Improvement	Urban Heating Company	Capital Ratio	34%	32%	32%
		Debt Ratio	198%	213%	215%
Water Supply System Improvement	Water Supply Company	Capital Ratio	40%	33%	28%
		Debt Ratio	150%	204%	261%

Source: Balance Sheets acquired from Urban Heating Company and Anshan Water Supply Corporation

Note: The data of Urban Heating Company are of the years from 2012 to 2014

(3) Analysis of the Financial Sustainability Taking Account of IRR Results

Although the IRR results of respective sub-projects all turn out to be negative values, this fact does not necessarily deny the financial sustainability of the project. To be more specific, as all the sub-projects are public utilities of Anshan, their initial investment costs were paid by expenditure from the municipal government's budget, and loan repayment will also be the obligation of the municipal government³⁵. Besides, it is confirmed that the financial status of Anshan municipal government poses no problem³⁶. For this reason, the financial sustainability in the future can be verified by focusing the analysis on the balance of annual O&M cost and utility bill revenue. As previously described, with regard to the "Central Heating System Improvement Sub-project", the utility bill revenue either confined to the sub-project itself or including the overall heat supply business of the implementing entity has been sufficient to cover the O&M cost. As for the "Water Supply System Improvement Sub-project", the balance of revenue and expenditure in terms of either the sub-project itself or the overall business activities of the implementing entity is expected to improve in the years to follow. In the case of the "Wastewater Treatment Sub-project", there is nothing to be worried about since the O&M cost is entirely paid by the municipal government.

3.5.4 Current Status of O&M

The current status of O&M for respective sub-projects is generally desirable as described below based on the result of field study.

(1) Central Heating System Improvement Sub-project

Although six out of the 11 40 t boilers adopted in this sub-project are now being used only as a kind of provisional substitute for larger boilers at the time of equipment inspection, all of them are in a condition available for operation as observed during the field study. As for the other five boilers in normal operation, it is confirmed that they are unlikely to be replaced by boilers of larger size since the

³⁵ Interview with the Director of Debt and Finance Division under Anshan Finance Bureau.

³⁶ According to the "Report on the Status of Annual Budget Use of Anshan Municipal Government" (2010-2014) published by the Secretariat of Anshan Municipal Government, although the annual government expenditure increased 12.7% year-on-year on average during this period as compared to the 7.6% increase of revenue, and the amount of deficit balance reached 8.9 billion and 8.31 billion respectively in 2013 and 2014, since Anshan, as an old heavy industrial production zone in Northeastern China, has been designated as a prioritized city to receive subsidy from the central government and Liaoning provincial government and the amount of subsidy received each year so far has always exceeded the amount of deficit balance, the balance of each year's revenue and expenditure taking into account the subsidy has become surplus.

heat-supplied district “Yingchengzi” is an old urban area with a stable population and hence there is no need for introduction of larger boilers. Meanwhile, the indoor and outdoor conduit pipes and heat exchange stations are connected to the larger boilers introduced after the completion of this sub-project, and are functioning normally.

According to the person in charge of the implementing entity (Vice President of Urban Heating Company), ordinary equipment checkout is conducted once every shift, or three times every day, while the “Annual Safety Inspection of Special Equipment” required by the General Administration of Quality Supervision, Inspection and Quarantine of P. R. C. (AQSIQ) is carried out once every year by the National Boiler Inspection Institute. Meanwhile, the maintenance works are implemented in three different scales with different frequency. The large-scale repair is conducted once every three years to mainly replace the heatproof plate of boilers on a mandatory basis, the medium-scale conducted once in a year for component replacement on a voluntary basis, and the small-scale conducted irregularly for the repair or replacement of components when needed. As a result, no trouble or accident³⁷ relevant to the operation of equipment has occurred so far.

(2) Water Supply System Improvement Sub-project

It has been confirmed through the field study that the water purification facilities and the water conveyance and distribution facilities are in normal operation as designed. Also, the state that the raw water transmitted from the water source normally flows into the purification facilities has been confirmed through interview with the person in charge of the implementing entity as well as visual observation.

According to the person in charge of the implementing entity (Manager of Water Supply Company), equipment inspection is required to be carried out before each important public holiday in addition to the ordinary equipment checkout conducted on a daily basis. At the same time, apart from equipment inspection and checkout, safety examination is conducted on a monthly basis and is reinforced by the campaign named “Month of Safety Activities” executed in June every year as stipulated in the “Law of Safe Production”. Based on the results of these equipment inspection and safety examinations, equipment maintenance works of different scales are carried out, with the small-scale repairs conducted regularly every half year, and the medium-scale and large-scale on an irregular basis. With these efforts, no trouble or accident relevant to the operation of equipment has occurred so far.

(3) Wastewater Treatment Sub-project

The on-site visual observation confirmed that the wastewater treatment plant, pump station, sedimentation ponds, reaction pond, sludge treatment facilities, wastewater pumps constructed or installed with this sub-project were all in normal operation.

According to the person in charge of O&M work, equipment inspection has been conducted on a

³⁷ “Accident” here is defined as serious damage of equipment or heavy injury or even death of employee resulted from the trouble related to the operation of equipment.

quarterly basis to make sure of the extent of wear and tear on the plant facilities, operating hours of equipment, consumption of lubricant, etc. Besides, as in the case of the “Water Supply System Improvement Sub-project”, the monthly safety examination and “Month of Safety Activities” campaign in June every year have been enforced rigorously. With regard to the maintenance of equipment, small-scale repairs are conducted regularly based on the results of quarterly inspections while the medium-scale and large-scale repairs are on an irregular basis. Similarly, major troubles or accidents have not happened so far owing to the above measures.

To sum it up, no major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance system. Therefore sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project aims to strengthen the measures taken by the municipal government of Anshan to improve air environment, water quality environment and living environment. Its relevance is high because the implementation of the sub-projects, though selected after a process of adjustment, has been relevant to the development policies and development needs of China and Japan’s aid policy. The effectiveness and impact of the project is also high as the effect of pollutant reduction in terms of air and water and the effect of improvement in water supply resulting from the implementation of this project are remarkable, with the expected effects of sub-projects achieved in their respective years of target, the project’s contribution to the improvement of air and water quality as well as living environment verified, and the recovery of groundwater having long been decreasing regarded as a positive impact of the project. With respect to efficiency, while the input of project cost was commensurate with the output achieved after the change of scope, the project period was substantially longer than planned even after subtracting the part of project period extension resulted from the necessity for the “Wastewater Treatment Project” to respond to the expanding need for the service. Therefore, the efficiency of this project is fair. The sustainability of the project is generally high considering the fact that the operation and maintenance (O&M) system is confirmed to be wholesome and stable, the efforts made by the implementing entities to maintain their technological level is being institutionalized, most of the adopted equipment are effectively utilized currently, and regarding the financial aspect, although at the moment the implementation entity of the Water Supply System Improvement Sub-project is facing the problem of deficit operation attributed to the cheap water rate, the problem is expected to be solved with the introduction of a new rate system in the near future.

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

Necessity to Draw Up a Checklist Specifying the Risk Factors at the Time of Deciding the Contents of Cooperation

The cancellation of bio-briquette factory construction work and the early shutdown of 40 t boilers adopted in the “Central Heating System Improvement Sub-project” and the total cancellation of the “Urban Railway System Improvement Sub-project” can be attributed to the change of needs perceived at the stage of project formulation due to the drastic change of external environment, and thus it could be regarded as unavoidable. However, one thing here needs to be borne in mind as a lesson to learn. In the case of an emerging country like China, the request to JICA for an ODA loan is submitted normally at a stage of relatively high economic growth, with which it is most likely that many of the external conditions will change drastically in terms of renewal of industrial technology and equipment, readjustment of environmental and energy saving policies, relocation of industrial facilities, urban redevelopment and so on. In this regard, it is necessary for JICA to foresee these changes of external conditions as much as possible at the time of deciding the contents of cooperation. To take the “Central Heating System Improvement Sub-project” as an example, the work of bio-briquette factory construction was selected initially with an eye to supplying cleaner fuels to the small-size coal boilers existing in great abundance at that time in response to the urgent need to curb the deterioration of air environment. However, as it has become evident nowadays, such a decision then contained two potential risks: the market risk where the supply of raw materials of bio-briquette, i.e. the straws of crops like wheat and corn would dwindle away and become insufficient as a result of the advancement of urbanization, and the policy risk arising from the government’s push for the replacement of small-size boilers with low combustion efficiency by large-size boilers. Although these risks might not rise to the surface at that time, they ought to have been assumed at the very beginning especially in the case of an emerging country featuring a rapid growth and a drastic change. Therefore, it is necessary to draw up a checklist based on specific assumption of the market risk and policy risk at the stage of project formulation and review. Moreover, it is also recommendable that the risks likely to arise from these changes of external conditions be closely monitored even after the start of the project apart from the stage of project review, and the possible negative effect of these changes on the efficiency and effectiveness be avoided as much as possible by taking timely and appropriate measures whenever a risk is detected.

END.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1.Project Outputs Central Heating System Improvement	Bio-briquette factory: 600,000 t/year Boiler for heat supply: 20(40 t) Indoor & outdoor conduit pipe: about 160 km Heat exchange station: 14	Bio-briquette factory: cancel Boiler for heat supply: 11 (40 t) Indoor & outdoor conduit pipe: about 447 km Heat exchange station: 43
Urban Railway System Improvement	Extension of current rail: about 19 km Tunnel: 1(about 1km) New passenger station: 17 Rail yard: new construction 1, expansion 1 Substation: 6 Communication & signal: (not specified) Rail car: 44	Cancelled
Water Supply System Improvement	Water-conducting facilities: headrace tunnel 15.3 km Water purification facilities: Water purification plant 150,000 m ³ /day Segmented formation pond 2 Sedimentation pond 2 Rapid filtration pond 10 Water purification pond 1 Water pump 3 Sludge disposal plant 1 Water delivery and distribution facilities: Distributing reservoir 1 Pump station 1 Water distributing pipe 24.3 km	Water-conducting facilities: headrace tunnel 15.3 km Water purification facilities: Water purification plant 150,000 m ³ /day Segmented formation pond 2 Sedimentation pond 2 Rapid filtration pond 10 Water purification pond 1 Water pump 3 Sludge disposal plant 1 Water delivery and distribution facilities: Distributing reservoir 1 Pump station 1 Water distributing pipe 24.3 km
Wastewater Treatment	Wastewater treatment plant 200,000 m ³ /day Pump station 1(200,000 m ³ /day) Primary sedimentation pond 4 Reaction pond 1 Secondary sedimentation pond 4 Sludge treatment facilities(Conveyor type condensation dehydrator 4)	Wastewater treatment plant 200,000 m ³ /day Pump station 1(200,000 m ³ /day) Primary sedimentation pond 4 Reaction pond 1 Secondary sedimentation pond 4 Sludge treatment facilities (Conveyor type condensation dehydrator 4) Wastewater collecting conduit pipe 60.7 km Wastewater pump 3 Adjustment pond 2
2.Project Period	February 2002 – October 2006 (57 months)	February 2002 – April 2012 (123 months)
3.Project Cost		
Amount paid in Foreign currency	14,525 million yen	14,525 million yen
Amount paid in Local currency	24,814 million yen (1,654 million yuan)	10,773million yen (778 million yuan)
Total	39,339 million yen	25,298 million yen
Japanese ODA loan portion	14,525 million yen	14,525 million yen
Exchange rate	1 yuan = 15 yen (As of September 2009)	1 yuan = 13.75 yen (Average between 2002 and 2012)
		Source: State Administration of Foreign Exchange

People's Republic of China

Ex-Post Evaluation of Japanese ODA Loan Project
“Nanning Environmental Improvement Project”

External Evaluators: Kenji Momota and Makiko Oleynikov, IC Net Limited

0. Summary

The objective of the Nanning Environmental Improvement Project is to construct a sewage treatment plant and improve the city’s drainage channels, in order to improve the quality of its rivers and lakes, and the drainage system running center of the city, thereby contributing to improving capacity to control floods, and bolstering sustainable development of Nanning city, the provincial capital of Guangxi Zhuang Autonomous Region in the south-western region of China.

Since the time of project appraisal to the present, the project has been aligned with the Chinese national and city level development policies. It is also consistent with Japan's economic cooperation policy. Thus, its relevance is high. After the project was completed, the sewage treatment plant is operating smoothly, having achieved the expected effect of sewerage water quality improvement, and is a vital sewer water treatment plant in Nanning City. In regards to its effectiveness, the city's flood response capability by the development of drainage channels has achieved its planned level, and maintains this capacity to this day. Furthermore, local residents regarded the project as something that improved their living condition. Therefore, effectiveness and impact of the project are high. In regards to the efficiency, although the project cost was within budget, there were significant delays. Thus, the efficiency is fair. As for sustainability, no major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance of the project. Therefore sustainability of the project effects is high.

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

1. Project Description



Project Location



Photo 1: In Nanning city, revetments and bridges were constructed

1.1 Background

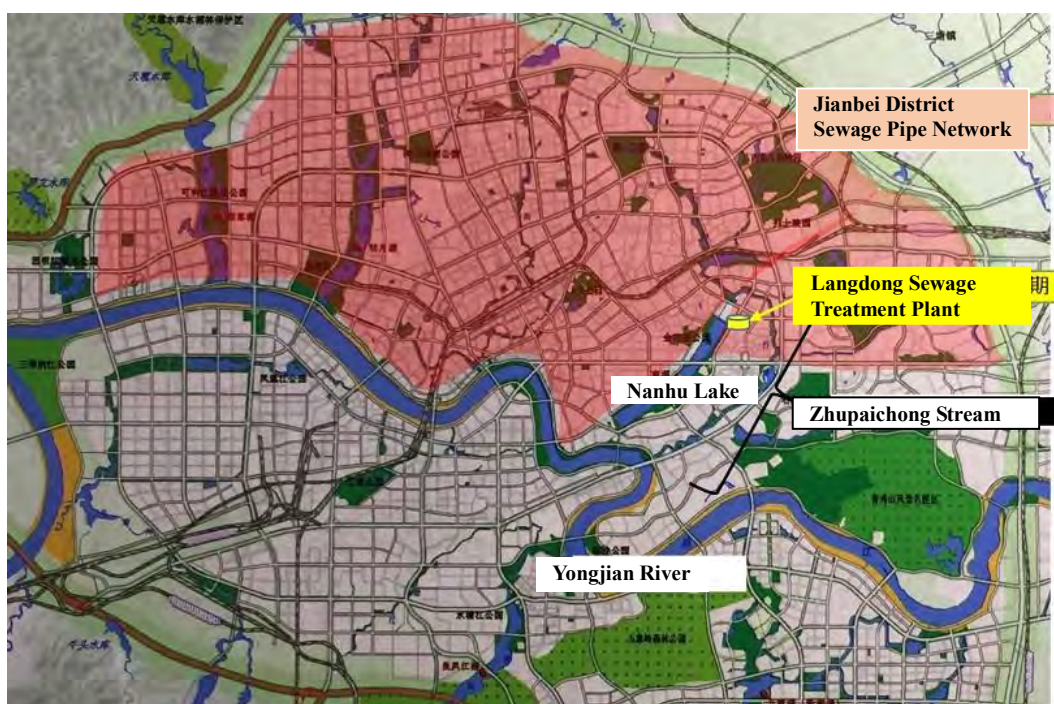
Though China had undergone a rapid economic development, industrialization and population growth led to environmental degradation. The Chinese government, in the late 1990s, strengthened its environmental protection policies and achieved certain amount of success. However, pollution was still considered very serious. A significant factor that contributed to this degradation was the rapid urbanization and improvement of living standards that caused a spike in waste water from homes. This treatment rate of urban areas remained at 36.4 %. Furthermore, among China's major rivers and lakes¹, the water sources below the national drinkable water standard (Water Quality Grade III) reached 49.4 %, with 23.4 % being at the worst quality (National water quality V and below V). Against this backdrop, the Chinese government in its 10th Five-Year Plan period announced the goal of increasing the sewage treatment rate in major cities to 60 % or more.

The Zhujiang River basin of southern China has historically been plagued by flooding. This flooding was exacerbated by rapid development without sufficient environment, natural protection measures in place. During 1988 and 1998, Guangdong and Guangxi provinces suffered economic damages of 183.7 billion yuan (about 2.75 trillion yen). Nanning City, located in the same watershed, suffered damages of 4,000 km², or about 10,000 households with economic losses topping 3 billion yuan (about 45 billion yen). In response, the Chinese government designated Nanning City as an important flood control city in its national policy. Henceforth, it had become urgent to develop the city's sewage treatment capacity and flood control facilities.

1.2 Project Outline

The objective of the Nanning Environmental Improvement Project is to construct a sewage treatment plant and improve the city's drainage channels, in order to improve the quality of its rivers and lakes, and the drainage system running through the city center, thereby contributing to the improvement of its capacity to control floods, and bolster sustainable development of Nanning city.

¹ Results are from the national water quality monitoring sites of seven major rivers, including Songhua River, Yellow River, Zhujiang River, the Yangtze River, with most significant pollution found at the Huaihe, Liaohe, Haihe Rivers.



Source: Nanning Urban Planning Museum

Figure 1: Distribution of the Three Subprojects in Nanning City

Loan Approved Amount/ Disbursed Amount	12,115 million yen / 9,907 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2003 / March 2003
Terms and Conditions	Interest Rate 0.75 % Repayment Period 40 years (Grace Period) (10 years) Conditions for Procurement: General Untied
Borrower / Executing Agency(ies)	Government of the People's Republic of China / Guangxi People's Government
Final Disbursement Date	January, 2013
Main Contractor (Over 1 billion yen)	<ul style="list-style-type: none"> • China Railway 18th Bureau (Group) Co., Ltd. (China) • The Fifth Engineering Company Of China Construction Engineering Bureau (China)
Main Consultant (Over 100 million yen)	—

Feasibility Studies, etc.	Beijing Municipal Institute of City Planning and Design (September 2001)
Related Projects	[Other Donors] France “Langdong Waste Water Treatment Plant First Stage construction” (1997) World Bank “Gangnam Waste Water Treatment Plant First Stage Construction” (2005)

2. Outline of the Evaluation Study

2.1 External Evaluator

Kenji Momota, IC Net Limited
Makiko Oleynikov, IC Net Limited

2.2 Duration of Evaluation Study

Survey period: August 2014 – November 2015
Field Survey: November 16, 2014 - November 26, 2014 and April 26, 2015 - May 1, 2015

2.3 Constraints during the Evaluation Study

Nanning Water Abstraction Company had been preparing for an Initial Public Offering to the domestic stock market, and was not able to disclose its financial information. Therefore, analysis of financial sustainability was based on a limited amount of data.

3. Results of the Evaluation (Overall Rating: B²)

3.1 Relevance (Rating: ③³)

3.1.1 Relevance to the Development Plan

1) Consistency with the Development Plans at the Time of the Appraisal

The main purpose of the project was (1) To improve the flood control capacity of Nanning and (2) To improve the city's sewage treatment capacity. The position of each in relation to policies and its needs will be verified.

1. Flood Control Measures in the Development Plan

The Chinese government in its “Ninth Five-Year Plan (1996-2000)” and “10th Five-Year Plans (2001-2005)”, set goals on controlling flood damage and on achieving its national flooding standards by ensuring people’s safety from water damage in the major cities and regions, and improving capacity for flood prevention around cities that are in the middle and downstream of the seven major rivers (including the Zhujiang River), tributaries and lakes, as it was important to ensure socio-economic

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

³ ③: High, ②: Fair, ①: Low

stability. Under this rubric, specific measures proposed included, construction of dams and levees, strengthening unified basin management, protection of forests that retains water, thereby promoting water resources comprehensive development. In 1993, the “Zhujiang River Basin Comprehensive Utilization Plan” was formulated to expand Zhujiang River’s⁴ watershed water retention and improve Nanning city’s utilization of urban drainage facilities and water resources.

2. Water Pollution Measures in the Development Plan

In the “10th Five-Year Environmental Protection Plan (2001-2005)”, the Government set an ambitious target of reducing emissions of major contaminants by 10 % compared to the 2000 level. Regarding water quality, the Government set to achieve a sewage treatment rate of more than above 45 % in urban areas⁵, water quality of the "Three Rivers Three Lakes" at the reference level, water quality improvement of the upstream of the Yangtze River, the midstream of the Yellow River, and the Songhua River basin through comprehensive measures. As described above, the flood control, water resources management, including water quality improvement were determined as high-priority areas in the national development plan at the time of the project plan. In the Guangxi Zhuang Autonomous Region including the Nanning city in particular, it can be observed that flood control and water quality management has been positioned as an important policy issue in urban development.

2) Consistency With The Development Plan at the Time of The Ex-Post Evaluation

1. Flood Control Measures in the Development Plan

In the “12th Five-Year Plan (2011-2015)”, the Government puts priority on further strengthening of the country’s flood prevention capacity, and formulated the “National Water Development Plan (2011-2015).” The plan calls for (1) Enhancing construction of regulating reservoirs to large rivers and lakes, (2) Comprehensively improving breakwater and estuaries construction, and (3) Repairing and reinforcing dams and water gates. In May 2011, the Guangxi Zhuang Autonomous Region released its “Environmental Protection and Ecological Construction 12th Five-Year Plan (2011-2015).” It promotes the plan to reinforce important rivers, tributaries and to establish a flood-drought mitigation system that connects important embankments and dams. Even after the completion of the project, there has been comprehensive development of small and medium-sized inland rivers such as Kelijiang River, Xinweijiang River for effective flood control.

2. Water Pollution Measures in the Development Plan

The “Circular Economy Promotion Law” came to effect in January 2009 that limits the expansion of polluting industries to the northern Gulf Economic Zone in Guangxi Zhuang Autonomous Region. According to the Nanning City Environmental Protection Bureau, the “Comprehensive Plan for Reducing Emissions of Saving Energy and Pollutants (2007),” promotes the construction of wastewater treatment facilities within companies and in urban areas, and setting of new emissions

⁴ As one of the Zhujiang River tributaries, Yongjiang flows through the center of the city.

⁵ Cities with population of over 500,000 are mandated to have a 60 % sewage treatment rate.

standards.

3.1.2 Relevance to the Development Needs

1) Consistency with the Development Needs at the Appraisal Phase

1. Water Resources Management (Water Pollution)

As the capital city of Guangxi Zhuang Autonomous Region, Nanning is the economic, political and cultural center, as well as the pivotal city of passage to the western region. In recent years, along with the rapid development of Nanning, the volume for urban sanitary waste and industrial waste water increased rapidly. However, the sewage treatment rate in urban district at the time in 2000 was only 17 %. Due to dumping into rivers and lakes, as well as illegal dumping of waste water, the pollution of two urban rivers such as Chaoyangxi River and Zhupaichong stream, and South Lake had become serious. At the time, the water quality of Nanhu Lake was below grade V and IV⁶. The water quality deterioration of the Yongjian River was of concern, and there was a need of upgrading the capacity of Langdong Sewage treatment plant located upstream.

2. Water Resources Management (Flood Damage)

The Zhujiang River basin of southern China has historically been plagued by flooding due to the rainfall level of the subtropical region to which it belongs. At the time the Project was planned, flood damage in the basin had become even worse. This flooding was exacerbated by rapid development without sufficient environment, natural protection measures in place. During 1988 and 1998, Nanning City suffered damages of 4,000 km², or about 10,000 households with economic losses topping 3 billion yuan (about 50 billion yen). The lack of investment in flood mitigation coupled with deforestation is seen to be the primary causes.

2) Consistency with the Development Needs at the Evaluation Phase

Nanning City recognizes the need for ongoing measures in the flood control measures and water environment.

1. Water Environment

The table below shows the water quality in the major discharge areas of sewage and treated water of the Yongjian River. There has been no significant improvement after the project, even though Nanning City has been strengthening water pollution measures. However, untreated sewage from upstream requires a response.

⁶ The Environmental Quality Standard for Surface Water GB 3838—1998, came into force in 1998. It classifies water based on 30 pollutants, from grades I to V, with I being the highest. Chemical Oxygen Demand (COD) concentration is classified as grade I/II-15 mg/l or less, grade III-15 mg/l, grade IV-20 mg/l, grade V-25 mg/l. The COD level of the revised standard of 2002, the GB3838 – 2002, relaxed the threshold, as grade I/II being-15 mg/l or less, grade III -20mg/l, grade IV-30 mg/l, grade V-40 mg/l.

Table 1: Nanning City's River Water Quality (the Roman numeral denotes the grade)

	2006 (One year before project completion)	2009	2013 (At the time of project completion)	2014 (One year after the project completion)
Average (Yongjian River basin)	III	III	III	III
Laokou cross section	II	II	II	II
Shuitangjiang cross section	III	III	III	III
Pumiao cross section	IV	III	III	III

Source: Nanning City Environmental Protection Agency

These river water problems have been a major issue in the city. In response, the city plans to expand the sewage treatment plant in the future, by expanding the current processing volume from 350,000 tons per day to 850,000 tons, and further strengthen the measures to improve waste water quality.

2. Water-resource management (Flood damage)

Although there have been few large-scale heavy rainfall causing a flood, there have been no major changes in the Zhujiang River basin that feed from large and small rivers, the River still poses a high flood risk. A study conducted by the Water Electric Power Research Institute of Nanning City recommends⁷ an improvement in the flood control function of the canal and drain flowing into the Yongjian River, which is a tributary to the Zhujiang River. The study also points out that there is a lack of water flowing in the Yongjian River from surrounding rivers caused by rapid development, and that this has an adverse effect on the health of local residents through the stench, etc. The study further recommends that constructing artificial lakes, dams and dikes, as well as cleaning and dredging the riverbed would be beneficial. The needs to carry out these measures were corroborated by the interviews with the Nanning Environmental Protection Agency. This is an issue that required addressing ever since the project was appraised.

In view of the above, there is still a big need to strengthen the water environment and water resources management.

3.1.3 Relevance to Japan's ODA Policy

At the time of the appraisal of the project, Japan's "Economic Cooperation Program for China" in 2001 focused on the conservation of ecosystems and environment affected by pollution and destruction, the improvement of living standards and social development in the inland regions, human resource development, institution building, and technology transfer, shifting away from its continued focus on infrastructure development of the coastal regions. Japan's ODA policy highlighted the following areas: (1) Cooperate to deal with global issues such as environmental issues, (2) Support reform and the open-door policy, (3) Promote mutual understanding, (4) Support poverty reduction,

⁷ Nanning River Waterway Environment Comprehensive Improvement Project Analysis (2010)

(5) Support the private sector, (6) Enhance bilateral cooperation. The project is in line with priority area (1) which supports the pollution control in water and others and the sustainable use of water resources. The project is evaluated to be consistent with Japan's ODA policy.

This project has been highly relevant to the country's development plan, development needs, as well as Japan's ODA policy. Therefore its relevance is high.

3.2 Efficiency (Rating: ①)

3.2.1 Project Outputs

The planned and actual output of the project is shown in Table 2 below.

Table 2: Planned and Actual Output

Subproject	Item	Plan (2004)	Detailed design (2005)	Performance (2012)	Plan implementation ratio (%)	Detailed design implementation ratio (%)
1.Zhupaichon Stream Environment Comprehensive Improvement	1.Sewage pipe network (km)	84 km	46.5 km	38.1 km	45 %	82 %
	2.Waterway repair (km)	9 km	10 km	7 km	78 %	70 %
	3.Reservoir remodelling (number)	2	1	1	50 %	100 %
	4. road (km)	45 km	45 km	45 km (18 km using yen loan, 27 km using domestic funds)	100 %	100 %
	5.Bridge construction and/or renovations (number)	Ten	Eight	5 (4 bridges using yen loan, 1 bridge using domestic funds)	80 %	63 %
2.Langdong Sewage Treatment Plant Phase 2	6.Pump station, sand basin, biological reaction pond, final sedimentation tank, sludge treatment facility, etc.	Same as left	Same as left	Same as left.	100 %	100 %
3.Jiangbei District Sewage Pipe Network	7.Sewer pipe (km)	117 km	72.3 km	57.4 km	49 %	79 %

Source: Planning value provided by JICA. Actual value gathered from the Executing Agency's answers to the questionnaire.

As shown above, the outputs had changed significantly from the original plan. Many of these changes came about when the city reviewed the designs during the detailed design stage. Their plan changed to use domestic capital. The reasons for the major changes are explained below.

(1) Subproject 1 Zhupaichon Steam

The length of sewage pipe network to be constructed decreased to about half, or 46.5 km, in the detailed design, due to the city's decision to fund the construction on the upstream side through a separate project, as it was excluded from an area financed by the yen loan project. Additionally, the

number of bridges was reduced to five from ten, because the city switched its source of financing to domestic. Regarding the construction of one of the three reservoirs, Luosanlin dam, was found to cost more than initially planned, and as a more efficient usage of the fund was agreed upon⁸. Therefore, it was cancelled.

(2) Subproject 3 Jiangbei District Sewage Pipe Network

The overall length of the sewage pipe network was initially expected to be 117 km, but during the detailed design phase, it was reduced to 63 km. Pump stations were added to the detailed design to pump up the sewage⁹. During the detailed study, the Nanning city plan was modified, where the priority areas for development shifted from the Jiangbei district to the south of the city¹⁰. There were also changes to the route of the sewerage network after detailed geological studies were undertaken. Furthermore, pumping of the sewage was required, something that had not been part of the original plan.

As seen above, major changes to the scope led to a significant delay. These changes may have not been avoided, as the sources of funding were switched from foreign to domestic, and as there were changes stemming from revisions to the city's master plan. Described in more detail in the Efficiency chapter, these changes have had little bearing on the effectiveness of the project. While this project was placed within the framework of Nanning city's overall development plan, there had been updates and changes to the plan, causing shifts in the scope of this project. The following information was collected through the interview with the Executing Agency:

- This project is a small part of an overall city development plan, and the range of the project outputs were not classified as strictly, but rather through the overall city planning. Since these adjustments were intended to be managed during the detailed design phase, the city did not scrutinize the scope sufficiently enough at the time of basic design (Feasibility Study).
- During the basic design phase, there was not enough coordination between the various municipal agencies, as sewage construction had to be carried out underground. Additionally, because the consultant lacked yen loan experience, it did not include contingencies in the plan with these unforeseeable changes. As a result, there was a gap between the actual and the planned project output, due to the modifications to the city development plan, modifications to the municipal regulations, etc. which caused scope changes and delays.

Some of these changes would have not been predicted, i.e. changes in government policies, etc. However, considering predictable adjustments, such as the delay in constructing on existing pipes and

⁸ The Luosanlin dam was far from the city center, the water storage is small, and it was costly to construct an access road. The Huangmaoping dam was chosen as a more suitable alternative to Luosanlin dam due to its cost and efficiency. The construction to the Luosanlin dam was discontinued.

⁹ The Keyuanlu area is low in elevation, making it difficult for the sewer water to drain naturally through gravity.

¹⁰ In the Nanning City General Plan (2004-2020) announced in 2005, there was shift towards developing the southern part of the city. As a part of the Plan, there was a new development framework which included the Gozo district.

roads, there would have been room for improvement because it was possible to develop a more efficient project plan.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The plan called for a total project cost of 18,461 million yen at the time of the appraisal (yen loan 12,115 million yen, local currency 6,346 million yuan), while the actual total project cost was 17,696 million (yen loan of 10,517 million yen, local currency 7,179 million yuan). The actual planned cost ratio was 96%, which was lower than the planned. As shown in Table 2, however, given that the scope of subprojects 1 and 3 were reduced by half, the actual output was not proportional to the actual cost. In other words, despite the reduction of scopes in both subprojects, it cost more to construct them due to factors that were found in the construction phase, such as the procurement of additional equipment and additional construction work. The main reasons for this are the following:

- Common causes between Subproject 1 and 3:

(Increases in cost) The increase in man-hours due to plan changes such as construction methods and routes, and in additional materials procured.

(Decrease in cost) The reduction in the length of the sewage pipe network and in the number of bridges and of reservoirs.

- Subproject 1 Zhupaichong Stream (actual to plan ratio 112 %)

(Increase in cost) Geological conditions were worse than expected, and necessitated the additional foundation treatment construction.

- Subproject 2 Langdong Sewage treatment plant Phase 2 Construction (actual to plan ratio 85 %):

(Increases in cost) Additional foundational work was required due to heavy rain at the time of construction. There were increases in equipment costs.

(Decrease in cost) Reduction in scope due to the design review.

- Subproject 3 Jiangbei district sewage pipes (actual to planned ratio 108 %):

(Increases in cost) Delays were caused by the procurement of additional pump stations, adjustments to the locations of pipes and changes in the materials for landfills which caused modifications to construction methods. These delays resulted in increased costs.

(Increases in cost) Rise in the material cost due to the delay, as well as due to the exchange rate fluctuations.

3.2.2.2 Project Period

The project period at the time of the appraisal was from May 2003 to December 2006 (44 months), while the actual period was from March 2003 to December 2013 and (a total of 128 months), with significant delay (291 % against the plan). Table 3 shows the project period of each subproject.

Table 3: Planned and Actual Project Period

Subproject	Plan	Actual (at the time of the ex-post evaluation)	Actual to Plan ratio
1. Zhupaichon Stream Environment Comprehensive Improvement	May 2003 - December 2006 (44 months)	May 2003 to June 2010 (84 months)	191 %
2. Langdong Sewage Treatment Plant Phase 2	May 2003 - December 2006 (44 months)	May 2003 to December 2008 (70 months)	159 %
3. Jiangbei District Sewage Pipe Network	May 2003 - December 2006 (44 months)	May 2003 to December 2013 (128 months)	291 %

Source: Planned values are taken from JICA appraisal document. Actual values are taken from the answers given by the Executing Agency.

*: The definition of the completion of the project is when the subproject is checked as complete.

The causes of the delay are explained below:

- Delay in processing the paperwork (30 months): delay in land acquisition procedures, delay in construction due to modifications and changes of the pipe network plan (example: difficulties in adjusting the pipe network construction period to the existing road).
- Delay in construction (approximately 25 months): additional adjustments that were required to strengthen the foundation, additional geological construction at the time of pipe network laying, a longer time spent on spring water measures during construction and the unforeseen interruption due to heavy rain and snow.
- The detailed design had to be modified because a subway line was also being constructed at the Daxuelu road (24 months).

As seen in the Table 3 above, the most delays occurred in the sewage network construction, exacerbating the construction delay to the entire project. Some sections even had delays that spanned 2-3 years of delays, though each cause differed from each other. There were many changes between the F/S to D/D, which required redesign and land acquisitions causing further delays. For the reasons described above, the project period had become longer than planned.

3.2.3 Results of Calculations of Internal Rates of Return (Reference only)

At the time of the appraisal, the economic internal rate of return (EIRR), and the financial internal rate of return (FIRR) which were calculated for Zhupaichong Stream and Langdong sewage treatment plant were 15.7 % and 2.9 %, respectively. For the former subproject, there has not been enough time elapsed to calculate the EIRR, and there have been no major floods, making the data collection difficult. The EIRR was not calculated. The re-calculation of the FIRR was performed on Langdong sewage treatment plant at the time of the ex-post evaluation was -5.7 %. As described in Sustainability chapter, current water fees levied onto consumers is set to maintain the current annual operation, but it is not sufficient to ensure the project profitability including the initial investment.

Both the project cost and project period significantly exceeded the plan. Therefore efficiency of the project is low.

3.3 Effectiveness¹¹ (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

(1) Operational Status of the Subproject

The purpose of this project is to improve the city’s capacity in flood control and water quality. For each of the following areas, comparisons will be drawn between the actual results to the expected effects.

1) Flood Mitigation (Subproject 1 Zhupaichong Environment Comprehensive Treatment Project)

There has been no torrential rain nor enough years passed to measure whether the project has had an effect on flood mitigation. For this reason, the potential effect has been measured by determining whether the flood mitigation capacity is still in place, whether the capability has been maintained, and whether there has been proper maintenance. Based on the city’s flood prevention standards, the project aimed to develop the capability to control the damage even if a large flood occurs in the city, from the standard of the planned flood that occur “once every 20 years” to “once every 50 years.”¹² As described earlier, the Zhupaichong sewage network was updated as planned, and this standard is still effective today. There has been an adequate maintenance management system established, to be described further in the Sustainability chapter. It can be said that this subproject has achieved the flood control capacity as originally planned.

Table 4: Flood Control Capacity in Nanning City

	Baseline	Target	Actual
	2002	2006	2013
	Baseline Year	Completion Year	Completion Year
Flood control levels	occurs once in every 20 years	occurs once in every 50 years	occurs once in every 50 years
Highest water level	74.0 m above sea level	70.0 m above sea level	70.0 m above sea level

Source: Documents provided by JICA and the city’s response to the questionnaire.

At the time of the evaluation, not enough years had passed nor the rainfall to verify the effect of the subproject. In order to assess current drainage capacity functioning as designed, during the field visit an attempt was made to check items such as the maintenance status and discharge capacity of the stream. Also, it was not possible to check the discharge capacity and the annual maximum flow since the Executing Agency had not been measuring discharge rates. Therefore, the evaluation of the capacity was based on the operational methods and the conditions of the operations and maintenance

¹¹ Sub-rating for Effectiveness is to be put with consideration of Impact.
¹² The Nanning City “Urban Flood Prevention Standards (CJJ50-92)” set the highest water level of Zhupaichong Stream for flood prevention at 69 m or less, by taking the maximum of 24-hour rainfall (263 mm) over the years 1936-1998.

of the stream.



Photo 2: A revetment built on the Zhupaichong Stream



Photo 3: A park built under the project

Zhupaichong sewage network regulates the water level of the Yongjian River, which is the biggest factor of flood in Nanning city. In order to maintain this function, the city conducts regular maintenance. Daily patrols of the river banks, inspection of flood reference points, cleaning and dredging from May to August before the water level swells are conducted (described in 3.5 Sustainability in detail). Although for the time being, since the construction, the reduction of flood damage could not be confirmed, the stream has maintained the required flood prevention standard, as construction was completed as planned and adequate maintenance has been carried out. Therefore, it can be said that the project has a high probability of achieving the intended effects on flood control.

2) Sewage Treatment Capacity Improvement (Subproject 2 and 3 Langdong Sewage Treatment Plant/ Jiangbei District Sewage Pipe Network)

The following table illustrates the operational capacity of the Langdong sewage treatment plant Phase II. Even though the utilization rate during the first year of operation was slightly low, it steadily increased after year two. At the time of the ex-post evaluation, it was operating at nearly its designed capacity.

Table 5: Operational Indicators of Langdong Sewage Treatment Plant Phase 2

	Target value	Actual value					
	2006	2009 1 year after completion *	2010	2011	2012	2013 5 years after completion	2014
Sewage treatment amount (m ³ /day)	100,000	64,200	80,900	91,600	88,700	91,000	95,400
Utilization rate (%)	75 %	64 %	81 %	92 %	89 %	91 %	95 %
Treatment rate (%)		100 %	100 %	100 %	100 %	100 %	100 %
City sewage treatment rate		76 %	78 %	81 %	83 %	84 %	86 %

Source: Data provided by JICA, Executing Agency's responses to the questionnaire. Since the construction was completed in December 2008, the data from 2009 was used.



Photo 4: The biological reaction pool of the Treatment Plant

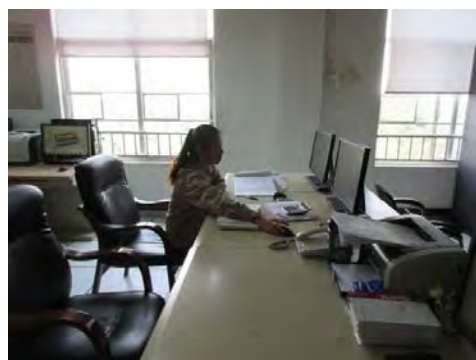


Photo 5: The central control room of the Treatment Plant

Because the construction of the sewage network was behind schedule, the utilization rate was low during the first year. As the sewage network was constructed under this project, the rate has been incrementally improved, and at present it is being maintained at the expected operational level.

The demand for sewage treatment increased as the city urbanized, and the construction of Phase III was undertaken. At the time of the evaluation, the three phases had a capacity to treat 300,000 m³ per day, with a planned expansion of increasing the capacity by 50,000 m³ in the future. The city further has plans to increase the processing capacity to 850,000 m³ per day by 2020, as this demand is expected to continue.

(2) Effect of the subproject

1) Flood Mitigation (Subproject 1 Zhupaichong Environment Comprehensive Treatment Project)

During the planning phase, a reduction of flood area was set as an indicator. This effect could not be confirmed because no torrential rain or flooding had happened since project completion. However, for the time being, it can be concluded that, along with the city's comprehensive efforts in flood control

such as the construction of a sewage pipe network and embankments, the expected capacity has been developed, as it was confirmed that waterway construction has been progressing so as to cope with flood levels of every 50 years, and its capacity has been maintaining its planned capacity.

2) Sewage Treatment Capacity Improvement (Subproject 2 and 3 Langdong Sewage Treatment Plant/Jiangbei District Sewage Pipe Network)

The effect of reducing pollutants is shown in Table 6. The water treatment facility had reduced the major pollutants beyond the national standard and the target set by the project. The BOD level in 2013 was 95 % less than the level at the time of appraisal. For other substances including SS, the level was reduced by more than 90 % compared to that at the time of appraisal. The effect of the project was significant.

Table 6: Langdong Treatment Facility’s Reduction in Pollutants

Quality of water discharged		Baseline	Target value	Actual values				
		2002 Appraisal	2006 Project Completion	2009 1 year after Project completion	2010 2 years after Project completion	2012 3 years after Project completion	2013 4 years after Project completion	2014 5 years after Project completion
BOD emissions (t/year)		4,380	730	166.33	220.1	259.0	229.0	206.5
BOD concentration (mg/l)	20	120	20	7.1	7.45	8.0	6.9	7.1
COD emissions (t/year)				351.4	472.7	980.6	937.2	841.2
COD concentration (mg/l)	60			15	16	30.3	28.2	29
SS emissions (t/year)		7,300	730	559.9	839.05	485.5	481.9	423.5
SS concentration (mg/l)	20	200	20	23.9	28.4	15	14.5	14.6

Source: Data provided by JICA, Executing Agency’s responses to the questionnaire.

At the sewage treatment plant, treated water was monitored daily. When the treated water was inspected during the field visit, the pollutant measurements did not vary significantly from what was reported. The effect of the plant on effused water quality was well sustained.



Photo 6: Treated water monitors



Photo 7: The water after treatment

3.3.2 Qualitative Effects

The Langdong Sewage treatment plant was planned to recycle the sludge and treated water in the following manner.

- The treated water would be used for greening of the city, cleaning roads and official vehicles.
- The sludge would be reused as greening and agricultural fertilizer after testing.

However, the current ways of usage are as follows:

- 1) Because the treated water had not been processed further to be apt for use in the city, i.e. plant watering, road cleaning and official vehicle washing, it is used in water sprinklers within the plant, diverted to the Zhupaichong Stream and Nanhu Lake. The plan is to carry out further processing of the water. They have already secured a space for this process in the second plant premises.
- 2) After testing, the sludge will be crushed to make pellets as soil improvers used for road construction.

Though there have been slight changes in its usage from the original plan, a recycling system has been established. It is expected that there will be further effective use in the future.

3.4 Impacts

3.4.1 Intended Impacts

The intended impact of the project was “to reduce damage by improving water quality and controlling floods in the lakes and rivers.” Furthermore, the higher level goal was to promote urban development through these improvements. As mentioned in Relevance, there have been no significant improvements from a statistical standpoint in the water quality of the Yongjian River. The City’s Environmental Protection Agency personnel gave some insight on the current condition of the impact.

- There has been a certain degree of progress made in the reduction of pollutants emitted. The COD emission in 2010 was 135,600 tons, while in 2014, it decreased to 122,300 tons. As a result, the water quality downstream of the Yongjian River at the Pumiao cross section improved from grade IV to III. However, no significant improvement has been seen in the Yongjian River basin as a whole at the time of the ex-post evaluation.
- There has been an improvement in the COD concentration at the conflux of the Zhupaichong Stream to the Yongjian River. Nonetheless, the Stream itself is categorized as grade V. This is due to the fact that the sewage treatment rate has not reached 100 % yet, and there is a fair amount of untreated sewage discharged directly into the Stream.
- The municipal government announced a “Three-year Sewage Plan (2013-2015)” investing 13.5 billion yuan to build 700 km of sewer pipes, improve 18 areas of waterways, and construct additional waste water treatment plants. By the end of 2013, 524 million yuan had been invested to build 139 km of sewer pipes, the Santang and the Wuxiang sewage treatment plants. Thus, the water quality is expected to improve further.

Due to the fact that the indicator of “damages reduced by flood control” could not be verified as a result of the direct impact thanks to the project because there have been no major damages, the beneficiary survey in which the 100 residents of Nanning were asked about the changes that have taken place since the construction of the subprojects, supplemented the information. They verified the positive effects of the sewage treatment plant, as well as the secondary effects and socio-economic changes brought about by the project¹³. Regarding improvement of the living conditions compared to 4-5 years ago, about 60 % or more responded that stench and the untreated sewage was reduced. In addition, 71 % said that there have been no sewage and drainage problems in their area. Also, 75 % responded that the water quality of Zhupaichong Stream improved. The residents positively view the improvement of the water quality and waterways as well as the efforts related to environmental improvement in Nanning. The improvements to Zhupaichong Stream and its surrounding parks and fixtures have been clearly recognized, because it flows through the middle of the city and residents have many opportunities to be in contact with the stream.

3.4.2 Other Impacts

(1) Impacts on the Natural Environment

The project was categorized as “B”¹⁴ during appraisal as it was expected to have limited adverse social and/or environmental impacts. In regards to the sediment discharged by the exit drain at the Langdong sewage treatment plan, it was eliminated by reinforcing the discharge area by concrete. Regarding exhaust and waste water associated with the treatment plant, the following measures have been taken:

- Exhaust is processed in an underground deodorizing machine, and is then released after the odor meets the standard.
- Wastewater flows to the interior of the processing facility, and is discharged into the Stream after it meets the standard of treated water.
- Solid waste is properly disposed of at the Nanning Environmental Health Office.

The Environmental Protection Agency monitors the effluent water quality online, and the EPA adheres to a strict monitoring system by performing regular site inspections. All of the treatment plants have an enclosed treatment pond that sufficiently removes odor, and no complaints have been filed by local residents so far.

¹³ Interviews with 100 local residents (59 % male, 41 % female / age composition 20-29 years (15 %), 30-39 years (37 %), 40-49 years (19 %), 50-59 years (20 %) 60-69 years (7 %) 70-79 years (2 %) were conducted at various districts of Nanning City in January 2015. The breakdown is as follows: Qingxiu district (46 %), Xixiangtang district (28 %), Xingning district (16 %). 25 % of the respondents experienced some flood damage experience while 75 % did not.

¹⁴ The Environmental Impact Assessment of the project was approved by the National Environmental Protection Agency in August 1999. Projects are assigned a category of A, B, or C, in descending order of environmental and social sensitivity, Projects with “B” ratings are expected to have limited adverse social and/or environmental impacts that can be readily addressed through mitigation measures.

(2) Land Acquisition and Resettlement

The project expected a land acquisition of 42ha, while the actual land acquired was 17 hectares. Land acquisition was carried out as planned in both the Zhupaichon Stream Environment Comprehensive Improvement and the Langdong Sewage Treatment Plant Phase 2, and no resettlement took place in either of these subprojects. Since the Jiangbei district sewage pipe network had underground construction work, temporary resettlement measures were taken. For this reason, no compensations were given. All acquisition paperwork were filed according to domestic regulations by the time of the appraisal.

(3) Unintended Positive/Negative Impacts

This project not only improved the flood control and urban wastewater standards, but the City also self-financed the construction of reinforcing embankment, improving the greenery and landscaping, developing the pedestrian walkway. In fact, five new parks were constructed along the Stream. These facilities improved the living conditions of the local residents.

The effectiveness and impact of this project can be evaluated as follows.

In regards to water quality improvement, it was observed that the sewage pipe network expanded and water treatment plants were effective in the reduction of pollutants as they were constructed as planned and achieved its intended capacities as planned. However, the water quality of the Yongjian River basin nor the Stream has not improved. To achieve quality improvements in all of the waterways, it is important to implement comprehensive measures continuously. The project has been functioning as the center of the city's sewage treatment while the citywide sewage treatment demand has been increasing, and has contributed to curbing the water quality deterioration.

Regarding flood control, it was difficult to evaluate the capacity because there were no floods that occurred after the project completion. However, structures were constructed as designed, and the city flood control measures were implemented in parallel. Therefore, it can be said that the mitigation measures were put in place against future flood damage.

This project has mostly achieved its objectives. Therefore effectiveness and impact of the project are high.

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

(1) Operating System in Project Implementation

As planned, the project office was established within the Guangxi Zhuang Autonomous Region People's Government's Bureau of Finance. The project office oversaw the entire operation, being comprised by the Planning Bureau, the Construction Bureau, the Environment Protection Agency, the Water Affairs Bureau, and the Finance Bureau. The Nanning Investment and Development Company

was responsible for the construction in, and the operation and maintenance of the Zhupaichong Stream Environmental Improvement subproject. The Nanning Water Abstraction Company was responsible for the construction in, and the operation and maintenance of the Langdong Sewage Treatment Plant Phase II subproject and Nanning Sewage Network Construction subproject. These are state-owned enterprises, wholly owned by the municipality.

(2) Operation and Maintenance After Project Completion

Nanning Investment and Development Company is responsible for the maintenance of the Zhupaichong Stream Environmental Improvement subproject. The Nanning Water Abstraction Company was responsible for the subprojects 2 and 3, though in 2006, it was absorbed into the Guangxi Green City Water Affairs Company. The Guangxi Green City Water Affairs Company is responsible for the operations, and there is no significant change to the actual situation of the operating system.

1) Subproject 1 Zhupaichon Stream Environment Comprehensive Improvement

Under the supervision of the Executing Agency, the city's Water Agency was in charge of the maintenance, water utilization in rural areas, irrigation canals, and dams, while the city's Waterway Management Agency was in charge of the drainage, artificial lake management, water volumes and the level of rainfall. The Waterway Management Agency staffs monitor the water levels, including the case where there is rainfall in at the reference points around the city. The Agency has six departments, including the project office, river management department, and there are a total of 54 staff members, including nine executives, 32 technicians, and 13 clerks.

2) Subproject 2 and 3 Langdong Sewage Treatment Plant/ Jiangbei District Sewage Pipe Network

The Green City Water Affairs Company is responsible for the majority of the sewerage water plants. It is responsible for the operation and management of seven water purification plants and the four sewage treatment plants. The current number of staff is more than 1,500, of which 62 work at the Langdong sewage treatment plant and 55 of them, the majority, are technical positions. The department in charge of the maintenance of the sewage pipe network is staffed with 78 people, including 70 technicians. The Langdong sewage treatment facility operates by teams with three shifts. The teams are comprised of sub-teams that play a role in dewatering the sludge, measuring water quality, and carrying out the maintenance and repair. The pipes are managed by the Pipe Management Agency specialists who carry out manhole inspections and regular pipe cleaning. According to the interviews conducted with the management of each agency, the current staff level was appropriate and adequate. The municipality directly manages the Zhupaichon Stream, and as described in the chapter on Relevance, given the importance of the measures for water environment in the city, it is believed that stable organizational functions will be maintained. In addition, regarding the sewage treatment plants and sewage pipe network, a state-owned enterprise is responsible for all of the water and sewerage operations of the city. It can be said that there are no issues pertaining to the actual staffing

or management structure.

3.5.2 Technical Aspects of Operation and Maintenance

1) Subproject 1 Zhupaichon Stream Environment Comprehensive Improvement

The staffs of Waterway Management Agency are in charge of monitoring the water level in the waterways and are deployed as patrols during flood season and period of rain. The patrols remove small debris during their shifts. A full-fledged cleaning of the waterway is contracted to an external firm two to three times a year. The manager said that the work itself was not technically challenging, so through appropriate supervision they were able to sustain the required technical standards.



Photo 8: Periodic cleaning of the Stream



Photo 9: Discharge to the Yongjian River

2) Subproject 2 and 3 Langdong Sewage Treatment Plant/ Jiangbei District Sewage Pipe Network

Routine maintenance and inspection are carried out by the staff, while more serious issues are dealt with through monthly inspection and occasional technical guidance from Green City Water Affairs Company’s head office. In the field visit conducted during the ex-post evaluation, the record of machines and water quality monitoring were stored. The maintenance is carried out well. The sewage treatment plant and sewage pipe network are headed by technical veterans with 16-17 years’ experience, under which there are a stable number of placement of personnel. Green City Water Affairs Company is providing training and exchanges between facilities thanks to its large number of employees, which enables the stable supply of staff to the facilities.

In summary, as there have been no major technical issues observed, there is an appropriate level of technical skills and knowledge to operate each subproject.

3.5.3 Financial Aspects of Operation and Maintenance

1) Subproject 1 Zhupaichon Stream Environment Comprehensive Improvement

The Nanning City Investment and Development Company did not disclose detailed financial information. The Water Conservancy Stations officials said that there were no issues with regular maintenance of the waterways, including the cleaning and water level monitoring. There were no

financial problems in carrying out such maintenance.

2) Subproject 2 and 3 Langdong Sewage Treatment Plant/ Jiangbei District Sewage Pipe Network

Although the Green City Water Affairs Company did not disclose its detailed financial statements, as an alternative, the sales, revenue, ordinary income and fixed asset investment were obtained, as shown in Table 7. This table shows the changes in the key performance metrics and capital investments. With the growth of Nanning City, the demand for water and sewerage grows steadily. In 2013, the operating revenue is 900 million yuan (approximately 18 billion yen) up 30% from 2011 where the revenue was 700 million yuan.

Table 7: Green City Water Affairs Company Sales, Revenue, Ordinary Income and Fixed Asset Investment, years 2011 to 2013

Item	2011	2012	2013
Sales of water (ten thousand m ³)	27,710	29,620	31,477
Annual growth rate (%)		7 %	6 %
Operating revenue (ten thousand yuan)	70,341	84,663	90,900
Annual growth rate (%)		21 %	7 %
Ordinary income (ten thousand yuan)	17,714	21,190	23,800
Annual growth rate (%)		21 %	12 %
Annual fixed asset investment (ten thousand yuan)	78,875	40,215	50,500
Annual growth rate (%)		-49 %	26 %

Source: Data provided by the Green City Water Affairs Company.

The city has been continuing its active capital investment, and constructions to expand Henan water treatment plant phase 1, six water supply pump stations at Wuxiang, Yongwulu, Santang, Jiangnan, and others, the Wuxiang sewage treatment plant, and 29.6km of sewage pipe network are all ongoing. The sewage fee is 1.17 yuan/m³ after a few rounds of rate increases. The rate is adequate, and is a stable source of revenue. The balance for the Langdong Sewage Treatment Plant was: income 54.7 million yuan, expenditure 53.06 million yuan, resulting in nominal revenue. According to the Facility Director, there is a balance of payments though the revenue is small. The City ratifies the sewage fee increases necessary in order to maintain its operations financially afloat. The subproject is financially sound.

In summary, though the financial disclosures were not made to the evaluators, there seems to be no major financial concerns with the Green City Water Affairs Company nor the Langdong Sewage Treatment Plant. The Green City Water Affairs Company has been growing rapidly as it has been maintaining a growth rate at a high level of ordinary income and operating revenues. In addition, there is an increase in capital investment to expand its facilities. Given the trend of increasing water and sewerage demand, the growth of the company is projected to be high for the time being.

3.5.4 Current Status of Operation and Maintenance

1) Subproject 1 Zhupaichon Stream Environment Comprehensive Improvement

Problems such as sediments or trash accumulation in the stream are being solved through regular cleaning and daily patrols. According to the Executing Agency, the frequency of regular cleaning is sufficient and adequate, given the current state of dirt and sediment and flow. Conditions such as garbage deposits that would compromise the functioning of waterway was not observed during the field visit to the various points on the stream.

2) Subproject 2 and 3 Langdong Sewage Treatment Plant/ Jiangbei District Sewage Pipe Network

At the sewage treatment plant, the only problem that exists is the influent wastewater containing low levels of COD, prolonging the time it takes for the microorganisms to decompose the contaminants. However, this has not been a critical issue that affects the project's planned capacity. Regarding the sewage network, there are clogging of the sewer pipe by sediments such as trash and sediment that occur regularly and are not unusual. Based on the water level and flow rate that they monitor daily, the operation and maintenance of the two subprojects are carried out well.

No major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance system. Therefore sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The objective of the Nanning Environmental Improvement Project is to construct a sewage treatment plant and improve the city's drainage channels, in order to improve the quality of its rivers and lakes, and the drainage system running center of the city, thereby contributing to improving capacity to control floods, and bolstering sustainable development of Nanning city, the provincial capital of Guangxi Zhuang Autonomous Region in the south-western region of China.

Since the time of project appraisal to the present, the project has been aligned with the Chinese national and city level development policies. It is also consistent with Japan's economic cooperation policy. Thus, its relevance is high. After the project was completed, the sewage treatment plant is operating smoothly, having achieved the expected effect of sewerage water quality improvement, and is a vital sewer water treatment plant in Nanning City. In regards to its effectiveness, the city's flood response capability by the development of drainage channels has achieved its plan, and maintains this capacity to this day. Furthermore, local residents regarded the project as something that improved their living condition. Therefore, effectiveness and impact of the project are high. In regards to the efficiency, although the project cost was within budget, there were significant delays. Thus, the efficiency is fair. As for sustainability, no major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance of the project. Therefore

sustainability of the project effects is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

None.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

(1) Scrutinize the project Plan

Even though this project has been evaluated highly in many of the evaluation criteria, it was rated low in its efficiency. A major cause for this was the significant change in output. It is thought that there was a difference of ideas between the project plan and the implementation and supervision. The plan at the time of appraisal does change up to a certain degree after the detailed design is conducted. However, the basic design did not include additional construction of pump stations, further geological studies, significant reductions in the length of the pipes, to the point that there was a significant change in the costs and schedules. Geological surveys were not adequately carried out during the basic design. Local implementing agencies recognized that the plan of the basic design was not accurate enough, and it lacked the level of scrutiny they could have undertaken on contents and requirements. In order to reduce the delay due to the adjustments in the plans during implementation, there should be more guidance provided to the Executing Agency on how yen loan projects are carried out, and on the processes and time required to make changes, and provide supervision on the important requirements during the initial planning phase. A realistic project plan would have minimized these delays, and would have been effective for the entire project.

(2) Establish a Better Mechanism that coordinates each subproject to the overarching development plan

The planning of this project was mainly carried out by the Nanning Investment and Development Company, the Executing Agency of the time and the Nanning Water Abstraction Company. As described before, the project was treated as a project within the Nanning City's Master Development Plan. There was not sufficient coordination with other project offices and implementing agencies. The changes in the scope by the Chinese were also viewed from the perspective of achieving an efficient allocation of resources within the overall development plan. As a result, these adjustments caused delays in the construction of sewage pipes and affected the operational effectiveness of the Langdong sewage treatment plant, as mentioned in the chapter on Effectiveness. Regarding the core elements of the project that interacts with the expression of the effect, it would have been desirable to set certain

conditions during the project formation process from the point of view of the project purpose. In particular, road and sewage pipe constructions that are affected by the plans of other ministries and agencies could have been coordinated better by establishing among them a coordination function with those responsible for planning in each agency from the time the feasibility study was undertaken, and to create a project plan that incorporates the consistency of the entire city and its development plan as much as possible.

Comparison of the Original and Actual Scope of the Project

Item	Plan (detailed design from 2005)	Actual
<p>1. Project Outputs</p> <p>[Zhupaichon Stream Environment Comprehensive Improvement] a. Sewage pipe network maintenance b. Waterway repair c. Reservoir remodelling (number of areas) d. Road construction</p> <p>5 bridge construction and renovation (number of bridges)</p> <p>[Langdong Sewage Treatment Plant Phase 2]</p> <p>[Jiangbei District Sewage Pipe Network] a. Keng district and Zhaoyangxi district b. Nanhu, Zhupaichon stream district c. Xixiangtang</p>	<p>84 km (46.5 km) 9 km (10 km) 2 (1) 45 km</p> <p>5 bridges (1 bridge using domestic funds, and the remaining four places using yen loan)</p> <p>Pump station, sand basin, biological reaction tank, final sedimentation tank, sludge treatment facility</p> <p>Total 117 km 20.3 km 15.6 km 36.4 km (Subtotal 72.3 km)</p>	<p>38.1 km 7 km 1</p> <p>As planned (18 km paid for by the yen loan, the remaining 27 km domestic funds) As planned</p> <p>As planned</p> <p>15.8 km 13.0 km 28.6 km (Subtotal 57.4 km)</p>
<p>2. Project Period</p>	<p>May 2003 - December 2006 (44 months)</p>	<p>May 2003 - December 2013 (128 months)</p>
<p>3. Project Cost</p> <p>Amount paid in Foreign currency Amount paid in Local currency</p> <p>Total Japanese ODA loan portion Exchange rate</p>	<p>12,115 million yen 6,346 million yen (4,298 million yuan)</p> <p>18,461 million yen 12,115 million yen 1 yuan = 15 yen (As of September 2002)</p>	<p>10,517 million yen 7,179 million yen (2,852 million yuan)</p> <p>17,696 million yen 10,517 million yen 1 yuan = 14.4509 yen (Provided by the Executing Agency)</p>

End

People's Republic of China

Ex-Post Evaluation of Japanese ODA Loan

Hunan Environmental and Living Conditions Improvement Project

External Evaluator: Hiromi Suzuki S., IC Net Limited

0. Summary

This project aimed to improve the living conditions of the residents of the Wuling Mountain region¹ located in the northwest part of Hunan Province, where the population living in poverty is concentrated, by constructing small to mid-sized infrastructure related to education, health, water supply, and rural markets.

This project has been highly relevant to both China and Hunan Province's development plans and development needs, as well as Japan's ODA policy, at the times of both appraisal and ex-post evaluation; therefore its relevance is high. In relation to operation and effect indicators, all subprojects on education, health, water supply and rural market sectors have achieved the goals of both the indicators set at the time of appraisal, as well as auxiliary indicators added at the time of ex-post evaluation. Satisfaction levels of the beneficiaries are also high, and on the whole, the expected effects from the project can be recognized, thus the effectiveness and impact are high. Project cost was within the plan, but the project period exceeded the plan, therefore, efficiency of the project is fair. As for operation and maintenance, although there is no major problem in the financial aspect, there are some concerns in the organizational aspect; especially the health centers located in small villages are facing difficulties in order to secure medical doctors and nurses. In the technical aspect, although manuals and training systems are in place, the level of awareness when it comes to the importance of maintenance is still low, thus maintenance in the work place is not being fully implemented. Due to this, the maintenance status especially of schools and hospitals, need to be improved. In sum, some minor problems have been observed in the organizational, technical and current status of the operation and maintenance, therefore sustainability of the project effects is fair.

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

¹ The Wuling Mountain region in the northwestern part of Hunan Province consists of the Xiangxi Tujia and Miao Autonomous Prefecture, and the Zhangjiajie City.

1. Project Description



Photo 1: Yongshun County's Shidi Town Rural Market: view of the garment market

1.1 Background²

Hunan Province was a typical inland region where its rural population accounted for 70% of the total population (country average: 64%). Due to poverty alleviation efforts conducted throughout 20 years after the market-opening reform policy was adopted, approximately a total of 1.2 billion people have come out of poverty, however, in 2002, 20 counties (cities and districts) out of 127 counties were designated as National Level Poverty counties. The “Hunan Province Rural Poverty Alleviation Plan (2001-2010)” aimed to improve the enrollment ratio of elementary and middle schools to 99% and 95% respectively; to increase the ratio of villages with health centers to 90% and to increase the water-supply system coverage rate to 90%.

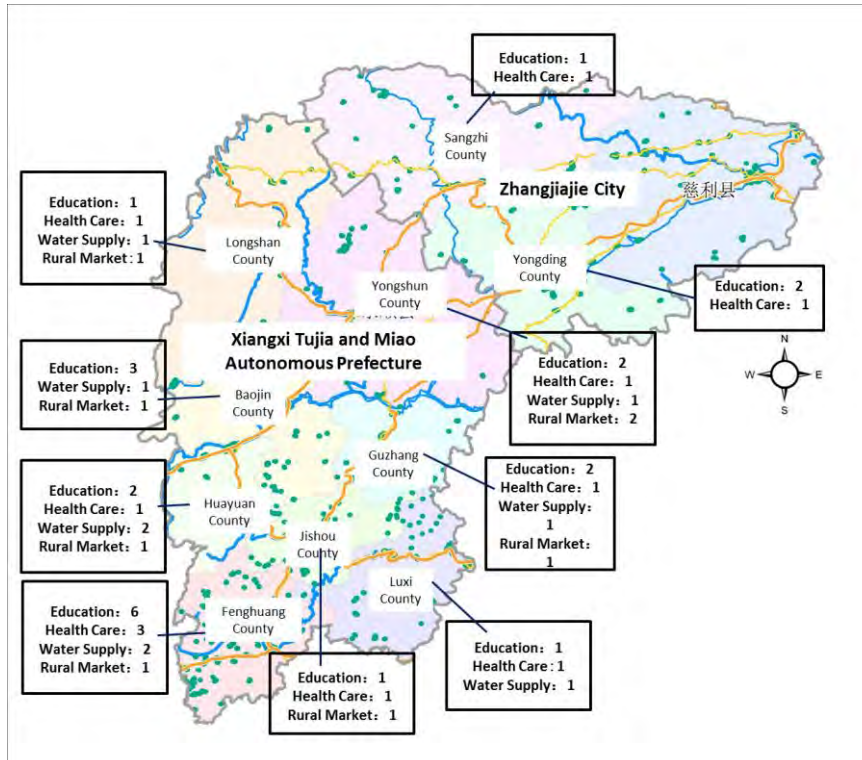
The target area of this project, namely the Wuling Mountain Area in northwest of Hunan Province, is a mountainous area where the Province's poorest population was concentrated. Agricultural productivity was low, and although the majority of the residents were making a living on agriculture, most of the crops were for self-consumption. The annual per capita net income in the region was as low as 1,360 Yuan (in the year 2000). While the national average poverty rate was approximately 3%, the said region's rate stood out at 9% (in the year 2000). Low economic and livelihood levels in the region and difficulty in accessing public services resulted in a low Human Development Index (which is based on health conditions, literacy rates, etc.), which in turn made it even more difficult to come out of the vicious cycle of poverty.

1.2 Project Outline

The objective of this project is to improve the livelihood of residents living in the Wuling Mountain Region in the northwest part of Hunan Province where poverty is

² Based on documents provided by JICA and the Executing Agency.

concentrated, by constructing social service facilities (i.e. education, health, water supply) and rural markets, thereby contributing to the region’s social and economic stability.



Source: Based on documents provided by the Executing Agency.

Figure 1 Location of Subprojects by County

Loan Approved Amount/ Disbursed Amount	7,882 million yen / 7,460million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 28, 2003 / March 31, 2003
Terms and Conditions	Interest Rate: Education, Health, Rural Market 2.2%, Water Supply 0.75% Repayment Period: Education, Health, Rural Market 30 years (Grace Period 10 years), Water Supply 40years (Grace Period 10 years) Conditions for Procurement: General Untied
Borrower / Executing Agency	Government of the People’s Republic of China / Hunan Provincial People’s Government
Final Disbursement Date	July 30, 2012
Main Contractor (Over 1 billion yen)	None
Main Consultant (Over 100 million yen)	None
Feasibility Studies, etc.	F/S: Hunan Province International Construction Consultancy Company, July 2002 “Special Assistance for Project Formation” JICA, February to June 2002
Related Projects	“General Poverty Alleviation Project” World Bank, 1995 to 1999

2. Outline of the Evaluation Study

2.1 External Evaluator

Hiromi Suzuki S., IC Net Limited

2.2 Duration of Evaluation Study

Duration of the Study: August 2014 – November 2015

Duration of the Field Study: November 27, 2014 – December 18, 2014;

April 6, 2015 – May 18, 2015

2.3 Constraints during the Evaluation Study

At the time of appraisal, operation and effect indicators and their targets were set for

each subproject and were officially agreed between JICA and the Executing Agency in order to quantitatively assess the effectiveness of the project. However, at the time of the ex-post evaluation the following four problems became clear: (1) there were subprojects that did not have any indicators set, or even if they did, the indicators were not sufficient to thoroughly assess the effects; (2) the exact definition and formulae of the indicators were not clearly defined; (3) there were cases where different indicators were set even though the subprojects belonged to the same sector and had a similar scope; and (4) the above problems were an obstacle to assess the effect of the project at the sector level. In order to deal with these problems, in this ex-post evaluation, homogeneous definitions and formulae were established for the officially agreed indicators. In addition, an attempt was made to establish auxiliary indicators in order to more accurately assess the operation and effectiveness of each subproject. For this, while taking into consideration the differences in the scope of each subproject, at the sector level, auxiliary indicators were standardized to the extent possible. By doing this, the level of accuracy of the project's effect at both the subproject and sector levels was enhanced. However, there were some restrictions depending on the auxiliary indicator, such as availability of data at the township, district, and/or city level, or data was simply not to be publicized. Facing these limitations in setting auxiliary indicators, it was not possible to accurately and thoroughly measure the project's effect.

A Poverty Line³ was supposed to be used in order to assess one of the expected impacts of the project, namely the "improvement of the living and cultural standard of the poor". The poverty standard used in China is the "Poverty Line" established by the National Bureau of Statistics. However, there are on-going discussions even within the country, in terms of its accuracy and appropriateness. Especially, the fact that its definition is revised so often that a year-on-year comparison is not possible, made it difficult for this ex-post evaluation to use it as a poverty standard which is necessary in order to assess the project's impact. Therefore, in this ex-post evaluation, after

³ The definition of Poverty in China until 2007 was divided into two: "Population Living in Survival Conditions" who are the people living below the poverty line which was based on the minimum amount of calorie consumption, and the "Low Income Population" who were living just above the poverty line. However, after 2007, the poverty line was defined as "the income necessary to secure the least minimum necessary clothes, food and shelter" and taking into account the increase in consumer price index, it has been adjusted almost every year from 1,067 yuan in 2007 to 2,736 yuan in 2013. However, there is still a lot of debate regarding the definition and basis to establish what is the "least minimum necessary clothes, food and shelter", as well as the definition of urban and rural area in the population statistics, which is ambiguous. On the other hand, in some cases, the poverty line announced by the World Bank in 2008 (1.25 U.S. dollars per day) has been converted using 2005's Purchasing Power Parity and the result has been used as a poverty standard. But also, for purposes of public assistance programs, different poverty standards exist, resulting in a situation where there is a lack of a "Poverty Standard" that is "objective, logical and with publicness" (Source: based on interviews to the Executing Agency and experts, research papers (Li, Li "A study on the poverty line in the rural area and incidence of poverty – based on data from the National Statistical Bureau and Department of Public Welfare" *Research on Modern Economics* No. 8, 2012, and Cheng Yonghong, "Poverty Index estimation and analysis since China's economic reform" *Research on Contemporary Economy*, No.6, 2013).

discussions with the Executing Agency and JICA, instead of using the “Poverty Line” to assess the “improvement of the living and cultural standard of the poor”, the “Net average income per rural resident” is used although it does have limitations as an indicator that accurately assesses the effect of the project on poverty reduction.

3 Results of the Evaluation (Overall Rating: B⁴)

3.1 Relevance (Rating ③⁵)

3.1.1 Relevance to the Development Plan of China

The national poverty alleviation policy at the time of appraisal was the “China Rural Poverty Alleviation Program (2001-2010)” which focused on poverty alleviation of two groups: approximately 300 million people living below the poverty line (625 yuan in 2000) classified into “Population Living in Survival Conditions”, as well as approximately 6,000 to 7,000 people living barely above the poverty line classified as “Low Income Population”. The Program specifically set six main principles, among which the following are highly related with the project: (1) promoting the construction of rural infrastructure in poor areas; (2) promoting education, healthcare, culture, science and technology, especially in areas where ethnic minority groups live; (3) implementing poverty alleviation activities basically at the township, municipal and village levels even though the basic unit would be the county. The Wuling Mountain Area, which is the target area of this project, was one of the six regions in the country classified as “National Focal Development Regions for Poverty Alleviation” and it was a region where immediate measures were needed. The Hunan Province Government formulated the “Hunan Province Rural Poverty Alleviation Plan (2001-2010)” based on the National Program”, aiming to improve production and living environment as well as quality of life, in order to solve the basic problem of “clothes, food and shelter”. Specifically, it aimed to achieve elementary and middle school enrollment ratios of 99% and 95% respectively by 2010, and to improve the proportion of villages with health care centers to 90%, among other things.

The national poverty alleviation policy at the time of the ex-post evaluation is the “China Rural Poverty Alleviation and Development Program (2011-2020)”. The Program states that even though the problem of “clothes, food and shelter” improved, the income disparity in China is growing, and it emphasizes that the need to reduce relative

⁴ A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory.

⁵ ③: High, ② Fair, ① Low.

poverty is becoming apparent⁶. It defines the poverty line as “the per capita average annual income of less than 2,300 yuan”. It also establishes 14 poverty areas (total of 679 counties, among which 31 are in Hunan Province), and aims to continue taking actions for poverty alleviation. Based on this National Program, the Government of Hunan Province formulated the “Hunan Province Rural Poverty Alleviation Plan (2011-2020)”. The Plan indicates that there is still a big disparity in the development levels of the urban and rural areas, and that relative poverty is a serious problem. The Wuling Mountain Area continues to be considered as a poverty area, and it puts special emphasis in reducing the poverty of farmers (mostly ethnic minority groups) that live in this area. In order to solve the poverty problem, the said Plan aims to devote its resources to identify main industries and its sustainable development, as well as to continue constructing basic infrastructure such as education, health care, water supply, electricity, roads and small-scale irrigation. In addition, by 2015, it plans to attain 80% of water supply coverage, 100% of basic education attendance rate (nine years of elementary and middle school) and 95% in the proportion of villages with health care centers.

The above shows that both at the time of appraisal and the ex-post evaluation, the Wuling Mountain Area was and continues to be an important poverty area in both national and provincial development plans, and aims to develop infrastructure in order to alleviate poverty. In sum, this project is highly relevant to the development policies at the national and provincial levels; therefore its relevance is high.

3.1.2 Relevance to the Development Needs of China⁷

As mentioned above, the Wuling Mountain Area located in the northwest of Hunan Province is a mountainous area (more than 70% of the total area are mountains), and within Hunan Province, it is an area where the population living in poverty is concentrated. When the national average poverty rate was 3% in 2002, the rates were especially high reaching 34% in the Xiangxi Tujia and Miao Autonomous Prefecture, and 15% in Zhangjiajie Prefecture-level City. Because the Wuling Mountain Area has a Karst topography with low water retention soil, it is difficult to secure arable land, and because agricultural productivity was low, economic and household budget levels were low. In addition, due to the difficulty to access public services, health conditions, literacy rates, access to safe drinking water remained low; resulting in a vicious cycle where it became even more difficult to escape from poverty. From the above, it is clear

⁶ When it comes to poverty, there are the “absolute poverty” and “relative poverty. The former is a situation in which the least minimum necessary living standards are not fulfilled, whereas the latter is a situation, where relative to the majority of a certain regional society, people are poorer (Source: UNICEF). At the time of appraisal, “absolute poverty” where the least minimum necessary “clothes, food and shelter” was not fulfilled was a serious problem, whereas at the time of the ex-post evaluation, the issue is the “relative poverty”.

⁷ Based on documents provided by JICA.

that the development needs of the project were high at the time of appraisal.

The most recent statistics available at the time of ex-post evaluation were those from the year 2012. According to these data, the average annual income per farmer in the Wuling Mountain Area improved from 1,600 yuan in 2002 to 4,600 yuan in 2012. Access to public services has clearly improved when compared to the situation that existed in 2002, and especially elementary school attendance rate reached 99% in 2010. However, as, agriculture productivity continues to remain low, it is classified as a National Poverty Area. While the national average poverty rate⁸ in 2012 was 7%, the rates for Xiangxi Tujia and Miao Autonomous Prefecture and Zhangjiajie Prefecture-level City were still high at 36% and 18% respectively. Thus the development needs in terms of poverty reduction at the time of ex-post evaluation remain high.

3.1.3 Relevance to Japan's ODA Policy

Japan's assistance policies for China at the time of appraisal were the following three: namely, the "Economic Cooperation Plan for China (formulated in 2001)", the "Policy for Conducting Overseas Economic Cooperation Activities (2005-2008)" and the "Country-Specific Action Policy (2002-2005)".

The "Economic Cooperation Plan for China (formulated in 2001)" shifted its priority area from the traditional model which focused on the development of the coastal area, to the improvement of living conditions, social development, human resource development, institutional-building and technology transfer of the inland region, establishing six focus areas. Among those areas, this project contributes to the assistance for the eradication of poverty, i.e. the project is an economic and social development assistance project that aims to help reduce the gap in the per capita income between the coastal and inland areas, thus it is highly consistent with Japan's assistance policy. The "Policy for Conducting Overseas Economic Cooperation Activities (2005-2008)" establishes four focus areas, and the project coincides especially with (1) assistance for poverty reduction, and (2) development of a basis for sustainable development. On its part, the "Country-Specific Action Policy (2002-2005)", established environmental protection, human resource development and poverty alleviation as its focus areas, based on the fact that regional disparities were increasing, and problems related to environment and infectious diseases, etc., appeared as China experienced a sudden growth. It also establishes that it will consider cooperating in activities that contribute to the living conditions of the inland area. As it can be seen, the purpose of the project is consistent with all assistance policies for China.

⁸ As mentioned in footnote 3, due to the change in official poverty standard in 2007, it is not possible to simply compare the poverty rate indicated in the development needs at the time of appraisal in 2002, with the poverty rate at the time of ex-post evaluation.

In light of the above, this project has been highly relevant to China's development plan and development needs, as well as Japan's ODA policy. Therefore its relevance is high.

3.2 Efficiency⁹ (Rating ②)

3.2.1 Project Outputs

This project planned to develop a total of 56 major facilities in 18 townships belonging to 10 counties, covering four sectors: (1) development of educational facilities (extension and construction of elementary and middle school buildings, dorms and procurement of educational equipment), (2) development of health care facilities (extension and construction of hospitals and health centers, procurement of medical equipment), (3) development of rural markets (construction of rural markets, procurement of equipment such as refrigerators) and (4) development of water supply facilities (i.e. extension and construction of water purification plants and water distribution network). In addition to these, it was also planned to develop elementary schools, health centers, drinking water facilities in villages (total or 351 places), as secondary works. Compared to the plan, a total of 49 subprojects were actually conducted in 17 townships belonging to 10 counties, and secondary works were conducted as planned. The main reasons in output changes are as follows (see Annex 1 for township-level reasons for changes in output).



Education Subproject:
Jishou City No. 8 Elementary
School



Health Care Subproject:
Sangzhi County Ruitapu Township
Health Center

⁹ Efficiency is evaluated with the impact in mind.



Photo 1: Representative Subprojects per Sector

- (1) Lack of accuracy in the geological survey and cost estimation at the time of the feasibility study (F/S): As for the construction of a health care facility, it was found that there was a fault in the planned construction site once the civil works had started. As for the construction of rural markets, construction sites had to be changed as it was found that the geological features were more complex than expected, and additional foundation works had to be done. Also, in the case of water supply facilities, it became clear that water conduction from the water source would be difficult and expenses would run up, thus the petition of the subproject itself was cancelled. In addition, especially for rural market subprojects, it became clear that cost estimations at the time of the detailed design would be much higher than the county's budget, thus the number of markets had to be reduced, resulting in the development of only those markets with the biggest transaction volumes.
- (2) Changes due to the project delay: Because of the delays in the project, especially subprojects with high development needs, such as the case of health care facilities; these were constructed earlier than the project and were excluded from the project.
- (3) Repayment capacity of the beneficiary institution¹⁰: Although it was possible to transfer the yen loan funds of those subprojects whose applications were cancelled to other subprojects, the repayment capacity of the beneficiary institution was established as one of the selection conditions for this project. Due to the fact that institutions that could meet those standards were limited, the number of subprojects decreased.

¹⁰ Selection criteria for the subprojects were: (1) to be a County or City defined as national or provincial level poverty assistance/focal development area; (2) to be a remote township; (3), not to duplicate with projects of other donors; (4) to be an area of ethnic minority; (5) the beneficiary institution has to have repayment capacity. All subprojects into which funds were reallocated comply with all these conditions.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total planned project cost was 10,543 million yen, from which the Japanese ODA loan portion was 7,882 million yen, and 2,661 million yen was planned to be covered with domestic funds from the central government's subsidy for Hunan Province Poverty Reduction Projects, as well as provincial and city budgets. The total actual project cost was 8,222 million yen, which is lower than the planned amount, partially due to reduction in project output. The breakdown was 7,460 million yen for the Japanese ODA loan portion, and 762 million yen of domestic funds. The total project cost was 78% compared to the planned amount which was within the plan.

Table 1: Project Cost: Planned and Actual

(Unit: Million Yen)

Sector	Planned Value			Actual Value			Compared to Planned
	Japanese ODA Loan ¹	Local Currency	Total	Japanese ODA Loan ¹	Local Currency	Total	
Education	1,835	0	1,835	2,285	122	2,407	131%
Health Care	1,299	0	1,299	971	223	1,194	92%
Water Supply	2,141	0	2,141	1,773	301	2,074	97%
Rural Market	2,044	0	2,044	1,852	116	1,968	96%
Supplementary Projects ²	0	398	398				
Others	0	1,942	1,942	579	0	579	30%
Price Escalation	127	18	145				
Physical Contingency	436	142	578				
Interest During Construction	0	161	161				
Total	7,882	2,661	10,543	7,460	762	8,222	78%

Source: Planned amounts are based on documents provided by JICA. Actual amounts are based on information provided by the Executing Agency.

Planned amounts: Exchange rate was 1 US dollar = 121yen / 1 yuan = 15 yen / price escalation was 1.6% for the foreign currency portion, and 0.3% for the domestic currency portion / physical contingency rate: foreign currency portion 5.0%, domestic currency portion 6.0% / Base year used in cost estimation: September 2002

Actual amounts: exchange rate was 1 yuan=13.81yen (monthly average from January 2005 to July 2014).

1: The breakdown of the planned Japanese ODA loan amount was: 1,187 million yen of foreign currency and 6,695 million yen equivalent of local currency. Breakdown of actual amounts into foreign and local currency were not available.

2: Actual amounts of the secondary works are included in the amount of the main works.

The main reasons for the change in project cost are as follows:

- a. Education: The addition of the underground multistory parking lot of First Zhangjiajie Middle School's gymnasium, as well as the fact that some schools increased their scale and added secondary facilities as well, resulted in a cost that is 131% compared to plan.
- b. Health Care: As the location site of the Jishou health care subproject was changed, additional costs related to foundation works arose. On the other hand, the health care subproject in Baojin County was developed separately with funds from the

Public Health Administration Department, thus it was excluded from the project, resulting in a cost that is 92% compared to plan.

- c. Water Supply: It took more time than expected in order to assess water conduction methods from the water source, as well as coordination for land acquisition, thus, some water supply subprojects were excluded from the project and were developed separately. In addition, although it was possible to reallocate the Japanese ODA loan portion of the excluded subprojects to other subprojects, as mentioned in “3.2.1 Project Output”, there were subprojects that could not be executed because the fact that an essential selection criteria of the subprojects was “that the beneficiary institution must have repayment capacity”, and entities that could meet such condition could not be found. Thus the project cost was 97% compared to plan.
- d. Rural Market: In some townships, subprojects that were planned to be developed within this project were excluded due to project delays, and were developed separately with their own funds. In addition, due to the maximum limit of the Japanese ODA loan, measures such as narrowing down the subprojects to those with the highest priority had to be taken, leaving out some subprojects, which resulted in the project cost that is 96% compared to plan.

From the above, in the education sector where one subproject was added, the project cost was slightly higher than plan. However, for those sectors in which subprojects were cancelled such as health care (two cases out of 127 were cancelled), water supply (two cases out of 11 were cancelled) and rural markets (four cases out of 161 were cancelled), all project costs were within plan¹¹.

3.2.2.2 Project Period

The planned project period was from March 2003 to December 2006 (three years, total of 46 months). The actual project period was from March 2003 to July 2014 (11 years five months, total of 137 months) which resulted in 298% compared to plan, substantially exceeding the plan.

¹¹ However, since accurate information on the cost of those subprojects that experienced changes in their output could not be obtained, it was difficult to confirm whether the project cost is actually appropriate when compared to their respective increase/decrease in output.

Table 2: Project Period: Plan and Actual

Step	Planned	Actual	Compared to Planned	Delay of start
L/A Signing	March 31, 2003	March 31, 2003		
A. Education				
Design	July 2003 to February 2004 8 months	January 2004 to January 2009 61 months	763%	6 months
Tender/Procurement	January 2004 to January 2005 13 months	October 2004 to January 2010 64 months	492%	9 months
Civil works	January 2004 to January 2005 13 months	February 2005 to January 2011 72 months	554%	13 months
Installation of facilities and equipment, test run	February 2005 to December 2005 12 months	February 2010 to October 2012 33 months	275%	60 months
B. Health Care				
Design	July 2003 to February 2004 8 months	January 2004 to January 2009 61 months	763%	6 months
Tender/Procurement	January 2004 to January 2005 13 months	October 2004 to January 2010 64 months	492%	9 months
Civil works	January 2004 to January 2005 13 months	February 2005 to December 2013 107 months	823%	13 months
Installation of facilities and equipment, test run	February 2005 to December 2005 12 months	February 2010 to July 2014 54 months	450%	60 months
C. Water Supply				
Design	July 2003 to February 2004 8 months	January 2004 to January 2009 61 months	763%	6 months
Tender/Procurement	January 2004 to November 2004 11 months	October 2004 to January 2010 64 months	492%	9 months
Civil works	January 2004 to April 2006 28 months	February 2005 to January 2011 72 months	554%	13 months
Installation of facilities and equipment, test run	September 2004 to April 2006 20 months	February 2010 to February 2012 33 months	125%	65 months
D. Rural Market				
Design	July 2003 to February 2004 8 months	January 2004 to January 2009 61 months	763%	6 months
Tender/Procurement	January 2004 to January 2005 13 months	October 2004 to January 2010 64 months	492%	9 months
Civil works	January 2004 to January 2005 13 months	February 2005 to January 2011 72 months	554%	13 months
Installation of facilities and equipment, test run	February 2005 to December 2005 12 months	February 2010 to February 2011 13 months	108%	60 months
Project As a Whole	March 2003 to December 2006 46 months	March 2003 to July 2014 137 months	298%	

Source: Planned periods are from documents provided by JICA. Actual periods are from documents provided by the Executing Agency.

Note: Project completion was defined as the delivery of facilities and equipment of the whole project.

There were no major delays in starting the respective procedures of design, tender/procurement and civil works. However, because the period of the civil works substantially exceeded the planned period, the period for the installation of facilities and equipment, as well as test runs was delayed. The main reasons of the substantial delay in

the project period are as follows:

- a. Project as a whole: (1) since this was the first Japanese ODA loan project for the Executing Agency, it took time for them to get used to several procedures such as making requests to JICA for changes in subprojects, as well as procurement procedures according to Japanese ODA loan guidelines. (2) Because the project consisted of a large number of subprojects, it took more than expected to conduct and coordinate the various procedures in each process. As a result, the needs of each township changed, which meant having to change the content of the subprojects or cancel subprojects altogether.
- b. Subproject level: (1) for the health care subproject in Jishou, the geological study at the design stage was not sufficient, and a fault in the expected site location of the hospital was found once the civil works had already started. Due to this, the works had to be interrupted, and time was needed to conduct additional studies and designs. While the subproject was expected to be completed in 15 months, it took approximately four years and a half, ending in July 2014. Similar problems related to geological features were found as well in some water supply and rural market subprojects. Especially in the latter, it was necessary to reinforce the foundation works of some parking lots. In the case of some water supply subprojects, basic confirmation of facts such as securing the water source and assess water conduction methods were not sufficient, making it necessary to cancel the request. As can be see, the lack of proper studies in the F/S considerably affected the project period¹². (2) As the project experienced delays, the financial losses of contractors increased as market prices increased and exchange rates fluctuated, forcing some subprojects to interrupt their works.

3.2.3 Results of Calculations of Internal Rates of Return (Reference only)

As no Internal Rates of Returns (IRR) were calculated for this project at the time of appraisal, no IRR was calculated at the time of ex-post evaluation as well.

From the above, the total project cost was within the plan and it was appropriate when taking into consideration the increase/decrease in outputs. On the other hand, as for the project period, basic problems such as lack of proper geological studies resulted in a substantial delay of the Jishou health care subproject, which in turn resulted in the delay of the project period as a whole. From a general point of view, the project period exceeded the plan and was not appropriate when considering the actual output; therefore,

¹² The Executing Agency itself considered that there were flaws in the geological study in the F/S as well as in securing water sources etc., and that they should have improved the accuracy of these studies. They considered that these issues should be captured as lessons learned.

efficiency of the project is fair.

3.3 Effectiveness (Rating ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

In 2002, a base line survey was conducted for this project, and based on the survey; the baseline values of 2002 as well as the target values to be met two years after project completion were officially agreed on a sector-basis between JICA and the Executing Agency. In the ex-post evaluation, these were considered as basic indicators. However, for the additional education subproject, as well as all water supply subprojects, basic indicators were set separately, in order to assess more precisely their operation status and appearance of their effects.¹³ In addition, for the education sector, even if the indicators were not established as basic indicators, “enrollment ratio”, “intake rate” and “dropout rate” were set and collected as common auxiliary indicators. For subprojects in which student dormitories were constructed, the “dormitory utilization rate” was established as an indicator. In the ex-post evaluation, the auxiliary indicators were considered only as reference information. Also, the evaluation of the effectiveness for the project as a whole was done on a sector basis, as was done at the time of appraisal.

- a. Education (see Annex 2 for detailed indicators): All 21 schools met the target set for the basic indicators. Enrollment rates and intake rates are either improving or have reached almost 100% and the dropout rates are also low. As for the schools in which student dormitories were constructed, with the exception of the Jiaozhiya Township Nine-year School where students from the rural area are decreasing, all other dormitories’ utilization ratios were 100%. As for schools in which libraries were constructed, targets on the number of books per student have been met 100%. In addition, as for the Zhanjidai First Middle School’s gymnasium, which has a capacity to accommodate 2,000 persons; it is being used not only for the school’s

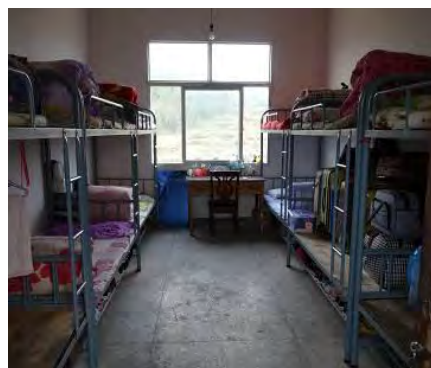


Photo 2: Fenghuang County Ala Township: Girls dormitory at Middle School No. 3.

¹³ A Base Line Survey of the project was conducted in 2002, and based on it, a base value and a target value to be met two years after project completion was set for each subproject, and officially agreed between JICA and the Executing Agency. However, for the subproject that was added in Yongding Zhangjiajie First Middle School, indicators were newly set as the content of the subproject was the construction of a gym and its multistory parking lot, and new indicators to assess their utilization condition were established (see Annex 2). As for water supply subprojects, only two out of nine subprojects had pre-established indicators, thus based on discussions with the Executing Agency as well as each water supply company, new indicators were set (see Annex 4).

own events, but also for events of other schools in the area, local government events, and especially, events of neighboring rural villages, which shows that a certain project effect can be recognized. As for the underground multistory parking lot of the gymnasium, repair works were being done at the moment of the ex-post evaluation, thus it was not being used, but the repair works are planned to be completed during 2015. From an overall point of view, the effect of the education subprojects can be fully recognized.

b. Health Care (see Annex 3 for detailed indicators): From the 11 subprojects, with the exception of Jishou City Wangrongjian Central Hospital, all the rest were completed from 2010 to 2011. Due to the improvement of medical services that were already provided in the existing facilities, as well as the execution of awareness programs on health and hygiene to the residents, the targets for infant mortality rate, cure rate of endemic diseases and maternal mortality rate were already met at the moment the project

was completed, and as they have continued to improve, the project's contribution can be recognized. As for the hospital in Jishou, even though there was a delay in civil works due to deficiencies in the topographical survey, as of December 2014, the hospital had already started activities by conducting health check-ups for the neighborhood residents. In

addition, since it is located in an area which is a development district, needs are expected to grow from now on, which will result in a higher capacity utilization rate of the hospital, which leads to expect that all indicators will meet their targets. As for Jiaoziya Township Health Center which was planned to be developed by the project, it was constructed ahead of the project with local funds from the Zhanjidae City government because the project was delayed. Although the request was cancelled, the funds were relocated to the construction of Yongding Central Hospital. The Jiaoziya Township Health Center is a branch hospital of the Yongding Central Hospital, and because of this, it receives patients of the said health center, which is in a rural area, on a preferential basis. In addition, the Yongding Central Hospital sends medical doctors to Jiaoziya Township Health Center, and receives medical doctors from Jiaoziya Township Health Center for training, thereby contributing fully to the health care of the regional community. Judging comprehensively, effects of the health care



Photo 3: Jishou City Wangrongjian Central Hospital: conducting a health check-up

subprojects can also be fully recognized.

- c. Water Supply (see Annex 4 for detailed indicators): In all subprojects, all the targets of the newly set indicators, namely, amount of water supply, population served, and water quality (mainly turbidity) were met more than 100% two years after project completion. As for the percentage of population served, two out of 11 subprojects (Longshan County and Huayuan County) met more than 80% of the target, and in only one subproject (Guzhang County) the target attainment rate was 50%. However, all subprojects are improving. In addition, water quality has achieved the National Standards for Drinking Water, and it has contributed to significantly improve the living environment of local residents. Since all water supply subprojects were newly-constructed, judging by the fact that indicators have almost met the targets since right after the project completion, it can be said that the project's effect is high.



Before the project, residents fetched water from the river

(Photo provided by the Water Supply Company Luxi County, Pushi Township)



After the project, water is pumped up from the river, and sent to each household after being purified in the plant

Photo 4: Luxi County, Pushi Township Water Supply Subproject

- d. Rural Market (see Annex 5 for detailed indicators): All markets have met the target for average annual income of neighborhood residents, and it is even on an upward trend. Indicator on new job opportunities has also met their targets. Rural markets existed before the project, by the roadside, or by closing the roads and opening the market every month on a pre-established frequency. However, because they were conducted in a disorderly manner, management was not sufficient, and problems such as traffic obstruction arose. However, even in such environment, the turnover in these rural markets grew as China's economy grew, and average annual income was also on an upward trend. Therefore, other reasons besides this project are behind the fact that indicators have met their targets. Nonetheless, land for rural markets were secured by this project, and general management, including health

and sanitation management, was enabled. As shown in Table 4, other commercial facilities have been constructed around these rural markets, and on the whole, the project's contribution to the average income of the neighbor residents and the increase in new job opportunities can be recognized.

In sum, as for the project's quantitative effects, all subproject indicators officially agreed between JICA and the Executing Agency have met their targets. In addition, the targets of the auxiliary indicators that were added at the time of the ex-post evaluation, have also either met their targets, or are improving, thus, realization of the effects of the project can be sufficiently recognized.

3.3.2 Qualitative Effects (Other Effects)

The qualitative effect expected from the project was "to improve the living and cultural standards of the poor". However, since this can be considered as an impact-level of project effect, it has been evaluated together under section "3.4 Impact".

3.4 Impacts

3.4.1 Intended Impacts

The project expected impacts were "to improve the living and cultural standards of the poor" and "socioeconomic stability of the target region". An attempt was made to obtain basic statistics by sector, but this was difficult due to the following reasons: (1) these statistics are outside the jurisdiction of the Executing Agency of the project; (2) statistics that can be published are limited; and (3) data by county that can be compared year by year cannot be gathered. Therefore, the manifestation of the impact "*to improve the living and cultural standards of the poor*", was assessed based on the "*per capita annual average net income of rural residents*", the beneficiary study, and interviews during the site survey.

- a. Per capita annual average net income of rural residents: since there are many debates on China's poverty standard (for details see footnote 3), in this ex-post evaluation, "the per capita annual average net income of rural residents" was used in order to assess the living standards of the poor. The fact that the project target area is classified as a National Poverty Area, and the fact that in all counties, the proportion of the rural population compared to the total population is high between 80% to 87%, thus an improvement in the per capita annual average net income of rural residents can be considered as a rough estimate of the improvement in poverty. As shown in Table 3, although the per capita annual average net income of rural residents is low compared to the average for the whole Province, it has been steadily improving in all counties since the project started in 2003. Although it

cannot be identified the extent of the project’s contribution, judging from the operation and effect indicators, the beneficiary study, and the impacts that could be confirmed through the site study, in overall terms, certain contribution can be recognized.

Table 3: Rural Residents: Average Net Annual Income Per Capita (Unit: Yuan/Year)


	2003 Starting of Project	2010	2011 Project Completion	2012 1 year after Project Completion	2013 2 years after Project Completion
Hunan Province	2,533	5,622	6,567	7,440	8,372
Fenghuang	1,354	3,460	4,012	4,681	5,733
Longshan County	1,465	3,077	3,628	4,164	5,466
Baojin County	1,267	3,228	3,705	4,191	5,482
Yongshun County	1,338	2,942	3,406	3,963	4,361
Huayan County	1,262	3,290	3,783	4,354	4,903
Jishou City	1,975	3,697	4,162	4,823	6,269
Guzhang County	1,234	2,620	3,086	3,596	4,127
Luxi County	1,246	3,413	3,647	4,089	4,707
Sangzhi County	1,223	2,642	3,020	3,406	4,226
Yongding District	1,715	4,236	4,593	4,961	6,054

Source: Documents provided by the Executing Agency.

- b. Beneficiary Survey: In order to assess the project’s impact, a beneficiary study to 100 beneficiaries was conducted (for details see Annex 6). In all sectors of education, health care, water supply and rural markets, the satisfaction level of the residents clearly improved comparing the situation before and after the project, and the satisfaction level was also high. It became clear that the level of education, health and sanitation conditions, ways to secure income sources, income, and job opportunities have all improved. It can be said that these are results that the project significantly contributes to both impacts, namely, “*to improve the living and cultural standards of the poor*” and “*socioeconomic stability of the target region*”.
- c. Impacts that could be recognized through the field study: In the site survey¹⁴ conducted at the time of the ex-post evaluation, the following impacts were recognized. These, together with the results of the above-mentioned Beneficiary Study, demonstrate that the effects of the project are clearly appearing.

¹⁴ Site surveys were conducted in all Counties. The details were Education (eight out of 21 subprojects), Health Care Centers (six out of 11 subprojects), Water Purification Plants (five out of nine subprojects) and Rural Markets (five out of eight subprojects).

Table 4: Impacts Confirmed During the Site Surveys

<p>【 Education 】</p> <ul style="list-style-type: none"> • In the middle schools where Science and Technology Buildings (laboratories, computer, art and music rooms) were constructed, students are now able to participate in the “ Science Innovation Contest”, to which up to now there were not able to participate, and in 2013, 10 students representing the Prefecture were able to advance to the Provincial-level Contest. • As a result of constructing art and music classrooms, places to teach traditional crafts (paper crafts, embroidery etc.) and folk dances of the Miao and Tujia ethnic minority groups living in the project area have been secured, contributing also to the protection of the cultural heritage of these ethnic minority groups. • The schools that were constructed by the project are now able to secure teachers with a higher level of training. Some schools have even become schools to prepare students to advance to higher education in their respective jurisdiction areas, as well as “Model Schools (base schools to train teachers for Hunan Province)”. 	 <p>Baojin County Baojin Ethnic School: Traditional Miao ethnic group embroidery made by student</p>
<p>【 Health Care 】</p> <ul style="list-style-type: none"> • As county-level facilities were able to be introduced in townships’ health centers and hospitals, (1) the distances to hospitals have been shortened, and utilization rates of hospitals have improved. (2) Since 2009, residents can take free medical check-ups in each township, making it possible to monitor resident’s health condition. As a result, it is now possible to put more efforts not only to “medical treatment” but also “prevention”. (3) Now they can provide medical services at home by making doctor rounds. • The facilities that were developed by the project have been recognized as training bases for medical doctors of even smaller health centers in their respective areas, contributing to the bottom-up of the whole region’s medical level. 	
<p>【 Water Supply 】</p> <ul style="list-style-type: none"> • All water purification plants mentioned that the greatest effect is that “water-fetching labor is no longer needed”. Before the project, people had to fetch water from wells or small rivers that took 30 minutes to one hour one-way walking distance in average. It was necessary to fetch water several times a day, in addition to that, since many people had to fetch water from the same well or river, so if the waiting time is included, one to two hours were used every time for this labor. Today, the water supply coverage rate is on average between 95% and 99%, and now that there is no need to fetch water, residents have started new businesses and/or have gone to the city to work. There were some cases in which resident’s income have increased because of this. In addition, now that water supply infrastructure has been developed, effects such as “washing machines can now be used” and “shower and flushing toilet could be constructed, significantly improving the hygienic environment” were recognized as well. • In the water supply subproject of Baojin County, purified water is now sold in five gallon bottles, resulting in annual sales of one million yuan. 	



Fenghuang County Ala Township Rural Market: Get-together of Miao ethnic minority

【 Rural Market 】

- Because roofs have been constructed in the markets, people are now able to do business even on rainy days which have resulted in an increase in sales. In addition, because each type of product has a designated sales section of the market, order has been secured and it has become easier to manage, including hygiene. Also barter trade has disappeared.
- After markets were developed, migrant workers have come back, becoming new business owners, and as their business increase, they are creating new jobs as well. Not only market transactions have increased, but also new businesses (hotels and restaurants) around the market have been created.
- Rural markets have traditionally been a place for ethnic minority groups to interact. Especially in the first half of the year, markets also play a role as places for meeting future husbands or wives, and the market administration authorities also provide a space to serve those purposes. New industries have emerged, as ethnic minority groups songs are now sold in CDs at the market, as well as their clothes, accessories, textiles, and dyed goods.

Source: Based on interviews conducted during the site surveys to the staff of each operating entity and residents.

3.4.2 Other Impacts

(1) Impacts on the Natural Environment

The report of the Environmental Impact Assessment of this project was approved in January 2003 by the Hunan Province Environmental Protection Department. From the planning stage, this project was elaborated as a one comprised by the development of small-scale infrastructure and the environmental impact was considered to be small. Also, because it was to be conducted outside any environmental protection area, it was estimated that the possibility to affect these areas would be small. At the time of the ex-post evaluation, it was reconfirmed through interviews to the Executing Agency, the beneficiary study and interviews to the residents, that there are no protection areas or habitats of valuable species in the project sites and their surroundings, and that problems that would jeopardize the natural environment have not occurred. As for the environmental monitoring during the construction period, each county and city-level executing agency monitored waste disposal, dust, turbid water and noise and they were conducted appropriately. In addition, as for environmental monitoring at the time of ex-post evaluation, water quality is monitored on a daily basis at the water purification

plants. Vibrations and noise are not monitored because these facilities are far from residential areas. Specialized entities are in charge of processing medical waste in accordance with the “Ordinance on the management of medical waste treatment”, and the Health Bureau monitors it on a regular basis. As for rural markets, each city and county’s Environmental Hygiene Department monitors and gives instructions on the hygienic conditions (waste disposal and cleaning) of each market, and no particular impact on the natural environment were recognized at the time of the ex-post evaluation as well.

(2) Land Acquisition and Resettlement

The land area that was planned to be acquired by the project was 59.14 ha in eight counties (741 persons who possess land-use rights), whereas, the actual area was 54.9 ha (93% compared to the plan / 708 persons who possess land-use rights, 96% compared to the plan), which was almost as planned¹⁵. No resettlement was planned, but a total of five households¹⁶ were actually resettled. Each was provided with housing and no particular problems were recognized. From the beneficiary study, it was also confirmed that both resettlement and land acquisition were completed without major problems. The main reason for this was that the residents understood that the content of this project was to directly contribute to the “improvement of the public welfare”.

From the above, regarding the project’s quantitative effects, all indicators that were officially agreed between JICA and the Executing Agency either met their targets or are steadily improving. As for the qualitative effects and impacts, the project’s contribution could be sufficiently recognized through the results of the beneficiary study and site surveys. There were also no negative impacts related to the natural environment or land acquisition and resettlement. Since this project has largely achieved its objectives, therefore effectiveness and impact of the project are high.

3.5 Sustainability (Rating ②)

3.5.1 Institutional Aspects of Operation and Maintenance

The operation and maintenance supervising institutions by sector are, the

¹⁵ Land acquisition process was conducted as follows in each county/city: (1) establish a land acquisition department in each county/city; (2) elaborate a guideline with specific procedures for land acquisition based on the “Hunan Government Land Acquisition Compensation Ordinance”; (3) issue publicity and explanatory material, and disseminate the policies and purpose of the project through discussions and exchange of opinions with the target residents; (4) Based on the law, issue the standards for compensation (compensation amount was paid based on the “Compensation Amount for Permanent Acquisition of Land” established in the “National Land Administration Law”); (5) prepare the annual fund plan for land acquisition, make the request and obtain approval from the County government, once approved, sign the Agreement for Land Acquisition and conclude the acquisition of the land.

¹⁶ The breakdown is as follows: two households (10 persons) in the Huayuan County rural market subproject, one household (number of persons unknown) in the Guzhang County education subproject, and two households (10 persons) in the Sangzhi Country education subproject.

Department of Education, the Department of Health, the Department of Water Resources, the Department of Market Administration and the Department of Industry and Commerce, and each operating entity is in charge of the actual operation and maintenance. In almost all counties and cities, a common operation and maintenance organization exist as shown in Table 5.

Table 5: Institutional Aspects of Operation and Maintenance

Education	<ul style="list-style-type: none"> • Organization: At the head of is the Principal, followed by the vice-principal, the administrative office, financial office, learning and education office, logistics administration office (in charge of maintenance and educational material), and student office. Depending on the school, there are offices that are in charge of the administration of cafeterias and student dorms. • In large-scale schools, there are from 150 to 200 teaching staff, and about 20 administrative staff. As the scale of the school gets bigger, there are no permanently stationed handymen, and maintenance is either outsourced or the manufacturer or electrician is asked to come as needed.
Health Care	<ul style="list-style-type: none"> • Organization: At the head is the hospital director, there are an administrative office, financial office, human resources department and a pharmacy. In each hospital or health center there are specialized departments. There is a specialized team in charge of the maintenance of machinery, but depending on the machinery or the content of the repair, it is often outsourced to the manufacturer. • Number of medical doctors, nurses and technicians vary depending on the scale of each facility, but in large-scale hospitals there are from 150 to 180 medical doctors, 200 nurses and 70 administrative staff. However, from the interviews, there were cases in the smallest health centers where operation was done in a small-scale, with 22 specialized medical doctors, 17 nurses, and three administrative staff. Especially, there were cases with lack of specialized medical doctors and nurses, the reason being that salaries and labor conditions are better in urban hospitals.
Water Supply	<ul style="list-style-type: none"> • Organization: At the head is the plant director, followed by the vice-plant director, the vice production director and the financial office. Below the vice-production director is the facility and equipment team (in charge of maintenance), the production team (in charge of the operation of the water purification plant and the pump stations), the laboratory (in charge of water quality inspection) and the water distribution team. Below the vice production director and the financial office there is the measurement office, monitoring office, meter-reader team, and the water fee collection team. The number of staff is on average 30 persons in a small-scale water purification plant and about 100 persons in a mid-size one.
Rural Markets	<ul style="list-style-type: none"> • Organization: In each county and city's market administration department, there is a service center for the market that was developed by the project, under which there are the "market section", the

	<p>“financial section” and the “administrative office”.</p> <ul style="list-style-type: none"> • Number of staff slightly varies depending on the scale of the market, but large-size markets have about 40 staff. These personnel are either sent from the county/city’s Industrial and Commerce Department or, in the case of jobs that require special certification such as electricians and real estate hygiene administrators, there are cases in which people are recruited separately. • Cleaning of markets are mostly done in turns by all the staff, but in relatively small-scale markets, there are cases in which only two persons are in charge of cleaning. • As for the operation and maintenance of garbage trucks, it has been outsourced to each country/city’s Environmental Hygiene Department.
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Source: Based on documents provided by the Executing Agency and interviews to the entities in charge of each service.

Institutional aspects of each sector’s operation and maintenance are established clearly. Organization charts and each section’s roles, as well as line of command are also well-managed. However, there is concern with respect to the operational organization of the smallest health centers. In addition to the fact that opportunities to increase income and progress in their carriers are very few, children’s education and other social infrastructure development are limited when compared to urban areas, which results in a low level of convenience of everyday life. This creates a trend for medical doctors and nurses to select working in more large-scale hospitals in urban areas, than to work in the smallest health centers in townships, which is the reason for the difficulties in securing medical doctors and nurses in these facilities. With regard to this problem, county/city governments are concerned as well, but the truth is that they have not been able to come up with effective measures, and improvements are desired.

3.5.2 Technical Aspects of Operation and Maintenance

a. Operation and Maintenance Technical Level

- Education: Teachers must have graduated from a three-year specialized vocational school, or must have obtained the National Teacher Certification; due to this system a certain level of technical level is secured. In addition, efforts to increase teachers’ skills are being introduced at the national level, and since 2015, it is mandatory for teachers to take an exam every five years and renew their certification. As for staff and personnel who do maintenance work, mostly these jobs are outsourced to outside certified personnel, so there are no particular problems.
- Health Care: Both medical doctors and nurses hold national certifications, thus technical levels are more or less secured. However, as the health care institution gets smaller and closer to the end of the organizational structure, the problem on

lack of medical doctors becomes more severe.

- Water Supply: Technical level is secured with the sufficient personnel with special certification, and experience, thus a certain technical level is secured.
 - Rural Markets: Personnel of the market administration department are either dispatched from the county/city's industry and commerce department, or recruited publicly. Personnel for the maintenance of water supply and sewage as well as electricity-related facilities are required to have a national certification and since only holders of such national certifications are hired, a certain technical level is secured.
- b. Preparation and utilization status of the operation and maintenance manuals and maintenance record keeping and their management status
- Education: As for equipment etc., (especially computers and the like) the operation and maintenance manuals are kept, used, and records are kept thoroughly according to the manual. Particularly for special equipment, is mandatory that a person with the necessary certification do the maintenance.
 - Health Care: Almost all hospitals and health care centers keep maintenance manuals and records of their facilities and medical equipment. However, in some health care centers, maintenance manuals could not be seen, thus were not used, and maintenance was done by their own rules, and no records were kept. Also, even if manuals are kept, their contents are not necessarily put into place thoroughly. During the site survey, it was found that the difference in the hospital director's awareness was reflected in the on-site maintenance gaps of the medical practice. Hospital directors with high awareness also put efforts to conduct equipment maintenance and staff training.
 - Water Supply: Each facility keeps their equipment and machinery's operation and maintenance manuals and maintenance records as well. In most of the water purification plants, the maintenance department reports the maintenance status at least once a month to the management, and they basically conduct preventive maintenance. In the water purification plants where site surveys were conducted, there have been no major breakdowns up to now, and unplanned water cut-offs have not occurred as well. There were no problems to obtain consumable goods and spare parts, and management of spare parts warehouses are done thoroughly. However, there were some cases such as in some pump stations where a section was used to store things, which made it difficult to affirm that manuals were followed completely with respect to cleanliness, tidiness and security management.

- Rural Markets: Detailed manuals that indicate the content and frequency of preventive maintenance, covering from steel frame structures, stainless sinks, fire extinguishers and fire hydrants are kept and maintenance records also exist. However, it is difficult to say that the manuals are applied thoroughly on the field. Warehouses where food was kept had problems with cleaning and an improvement in hygiene management awareness is required.



Jishou City, Wangrongjiang Township Rural Market: refrigerators with insufficient cleaning

- c. Development of training systems for the operation and maintenance personnel, status on investment and training for technical improvement.
 - Education: Teachers are sent to trainings to renew the National Teacher Certification, and based on an annual training program, teachers are sent to trainings on computer skills, Chinese language, and other special areas.
 - Health Care: A training program is prepared every year, and trainings are conducted to medical doctors, nurses and staff according to this program. Medical doctors and nurses go often to other hospitals for training.
 - Water Supply: Trainings inside the plants are done on a quarterly-basis, staff is sent to outside trainings once every half a year. It is mandatory for all the personnel to receive training on purification technology, installation of water distribution pipelines, standardization of water quality testing, etc.
 - Rural Markets: Personnel receive periodical training on real estate management and hygiene management. Training for managers/business owners is also conducted.

At the time of appraisal it was considered that there would be no particular technical problems related to the operation and maintenance of the entities that would be in charge of it. However, during the site surveys of the ex-post evaluation it was found that, even though the operation and maintenance manuals are kept and trainings are conducted, people who truly recognize the importance of the proper and thorough use of these on the job are only few, and as a result, maintenance is not done as the manuals indicate. On the whole, it necessary to be exhaustive in making sure the importance of basic maintenance, as well as increase proper attitude and awareness on maintenance, and improve basic awareness which is necessary even before the technical skills.

3.5.3 Financial Aspects of Operation and Maintenance

Although financial statements are not publicized, it was possible to obtain data on

each subprojects' operation and maintenance budget (labor costs and other operation and maintenance expenses) (see Annex 7). From these data and interviews to the operating entities it was possible to confirm that, with the exception of Sangzhi County's education subproject, all subprojects have secured a proper operation and maintenance budget. In addition, in recent years, especially schools and hospitals, have income sources other than the public budget, such as donations from NGOs and private individuals, which are used to cover operating expenses. As indicated in Annex 7, all subprojects are operating in the black¹⁷, and some water supply operating entities have started new businesses such as entering the drinking water market, reaching annual sales of 1 million yuan. As for rural markets, they have a rent income and in every case they are operating in the black. In addition, because these sectors are basic infrastructure and services, should they have any financial trouble, it is guaranteed that the county government will extend support; therefore no special problems on the operation and maintenance financial sustainability were found.

3.5.4 Current Status of Operation and Maintenance

At the time of the ex-post evaluation, the following were the status of operation and maintenance.

¹⁷ From the water supply subprojects, five out of nine in which site surveys were conducted, the quality of water from the original source is high, thus purifying procedure costs are possible to be kept low. In addition, the prime cost of those subprojects that are able to intake water and send it by gravity flow system are 2 yuan per ton on average, while water charges are 2.5 yuan per ton for domestic use, 4.5 yuan per ton for industrial use (mainly agriculture and commerce). Fee collection rates are as high as 95% on average, and from an overall point of view, the financial aspect of operation and maintenance is stable.

Table 6: Operation and Maintenance Status at the Time of Ex-Post Evaluation

Education	<ul style="list-style-type: none"> • Dormitories hygienic conditions: Cleaning of students' dormitories is done in turns by students and teachers. However, it stands out that rooms and common toilets and shower rooms are not cleaned thoroughly. • Building conditions: In several schools the corner of the stairs were worn down and chipped, and the walls had fissures. It is necessary to hurry with the repairs in order to secure the safety of students and teachers. • School kitchen: Although it is mandatory to wear masks and gloves when cooking, there were many people who were not wearing them. • Garbage collection: There were no specific buildings for garbage collection, and were gathered and left in a vacant land behind the schools. Although the land is part of the school, it stood out that garbage was just left as is. Although the garbage truck comes once a week, from the educational and hygiene aspects, it is a problem that must be improved. • In some elementary schools, repair of chairs and desks were not sufficient, and from the safety point of view of children, it is necessary to thoroughly repair them.
Health Care	<ul style="list-style-type: none"> • Building and equipment condition: As for health care centers and hospitals that have been completed approximately more than three years ago, walls had fissures, windows were broken, water leaked from the ceilings, corner of the stairs were worn down and chipped, etc., becoming a hazard and proving that maintenance had not been done thoroughly. Some hospitals were in the process of doing repairs, but it is necessary to make sure that daily and periodical maintenance is done as indicated in the manuals. As for equipment, it stood out that some of them are aging. Ambulances are also aging and it is time to renew some of them. Cleaning was also not enough in the interior of the ambulances. Although manuals are kept, the reality is that their contents are not thoroughly applied. • Maintenance records: Although maintenance manuals do exist, in many cases, records are not kept. In order to effectively use the equipment, it is necessary to thoroughly conduct maintenance including keeping maintenance records.
Water Supply	<ul style="list-style-type: none"> • Most of the water purification plants are clean, maintenance status is good, and management (tidiness and order) of spare parts warehouse is also good. However, in some pump stations, personal belongings were kept, meaning that manuals are not applied enough. In some cases, the water pipes inside the water purification plant were rusty, rain water had accumulated on top of the water storage tanks and even suspended particles could be seen. The understanding of the staff of this particular plant was that "it does not affect water quality", indicating that it is necessary to improve the awareness on the importance of maintenance.
Rural Markets	<ul style="list-style-type: none"> • Hygienic condition: Cleaning and hygienic management must be thoroughly conducted in all markets. Hygienic management of cold stores is especially bad, and there is a lot of room for improvement. It is also important to increase awareness of all beneficiaries such as not to throw garbage, use facilities in a careful manner, etc.

Source: Based on site surveys and interviews to the Executing Agency and operating entities.

As for the institutional organization to secure the sustainability of the project's effects, there are concerns regarding the fact that securing medical doctors and nurses on the smallest health care centers is difficult. In terms of the technical level, although manuals and training systems are more or less in place, awareness on the importance of maintenance is still low, and it is necessary to increase consciousness in all sectors. As for the financial situation, each subproject has a secured budget for operation and maintenance and no major problems were found. Regarding maintenance status, especially in some schools, health care centers and hospitals, insufficiency in matters that can affect the safety of children and patients, such as daily cleaning, preventive maintenance, and repairs were often found. Immediate measures in regard to markets' hygienic management and periodical cleaning of facilities such as cold stores are needed. On the whole, in order to make sure that the effect of the project is sustained, it is necessary not only to increase the awareness of entities in charge of the operation and maintenance of these facilities, but to also increase the awareness of residents who are the users of these facilities.

Some minor problems have been observed in terms of the institutional and technical aspects. Therefore sustainability of the project effects is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project aimed to improve the living conditions of the residents of the Wuling Mountain region located in the northwest part of Hunan Province, where the population living in poverty is concentrated, by constructing small to mid-sized infrastructure related to education, health, water supply, and rural markets.

This project has been highly relevant to both China and Hunan Province's development plans and development needs, as well as Japan's ODA policy, at the times of both appraisal and ex-post evaluation; therefore its relevance is high. In relation to operation and effect indicators, all subprojects on education, health, water supply and rural market sectors have achieved the goals of both the indicators set at the time of appraisal, as well as auxiliary indicators added at the time of ex-post evaluation. Satisfaction levels of the beneficiaries are also high, and on the whole, the expected effects from the project can be recognized, thus the effectiveness and impact are high. Project cost was within the plan, but the project period exceeded the plan, therefore, efficiency of the project is fair. As for operation and maintenance, although there is no major problem in the financial aspect, there are some concerns in the organizational aspect; especially the health centers located in small villages are facing difficulties in order to secure medical doctors and nurses. In the technical aspect, although manuals and

training systems are in place, the level of awareness when it comes to the importance of maintenance is still low, thus maintenance in the work place is not being fully implemented. Due to this, the maintenance status especially of schools and hospitals, need to be improved. In sum, some minor problems have been observed in the organizational, technical and current status of the operation and maintenance, therefore sustainability of the project effects is fair.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

All entities in charge of the operation and maintenance need to make sure to disseminate the contents of the maintenance manuals to the personnel in charge and improve maintenance. In order to secure the sustainability of the effects of the project, it is necessary to first strengthen the awareness regarding the importance of maintenance and then immediately make sure that the contents of these maintenance manuals are put thoroughly in practice on the sites. In addition, it is also necessary to work on increasing the awareness of not only the persons in charge of the operation and maintenance, but also the residents who are the users of each facility, so that the effects of the project appear in a sustainable way. Specifically, it is desirable to start with conducting awareness activities in each of the facilities. For example, in the case of schools, a “cleaning contest” can be introduced in order to promote the adequate use of classrooms and dormitory rooms. In the case of water supply subprojects, a tour of the water purification plant can be organized for local residents every year on March 22nd, which is the “World Water Day”.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

Proper setting of operation and effect indicators in mid-scale infrastructure development projects

As mentioned in “2.3 Constraints during the Evaluation Study”, almost all subprojects had operation and effect indicators and their targets set up in order to assess their effectiveness. However, depending on the sector, there were some problems that turned out to be obstacles to assess especially the quantitative effects, such as the case where indicators could only partially assess the effect, or even for subprojects that belong to the same sector, the indicators were not necessarily the same, or, even if the same indicators were set, definitions and formulae were not standardized. In projects

such as this, where many mid-scale infrastructure are developed in a wide area, when setting up operation and effect indicators, it is desirable to the extent possible, to try to set up common indicators by sector. It is necessary to clarify the definitions and formulae, and share them with all subprojects with no exception, and monitor the indicators of all subprojects. If deemed necessary, it is desirable to include a component such as a “capacity building on the monitoring of operation and effect indicators” to a project itself, or attach a technical assistance project for Japanese ODA loan projects, in order to secure a proper understanding of the indicators as well as their monitoring. In addition, if there are changes and/or additions in the indicators during project execution, it is also necessary to make sure that the Executing Agency and JICA officially agree on them. Moreover, as in the case of this project’s Zhangjiajie City First Middle School’s gymnasium and its underground multistory parking lot, if a subproject with a different scope from other subprojects in the same sector is added, it is desirable to clarify and set operation and effect indicators as well as their targets which are in line with the scope of the subproject, and officially agree on them during the procedures of request and approval.

END.

Annex 8. Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
<p>1. Project Outputs [County and Townships]</p> <p>1) Fenghuang County 2) Longshan County 3) Baojin County 4) Yongshun County 5) Huayan County 6) Jishou City 7) Guzhang County 8) Luxi County 9) Sangzhi County 10) Yongding District</p> <p>[Township level central infrastructure construction(total)]</p> <p>a. Education (Expansion and new construction of dormitories at elementary and middle schools, procurement of educational equipment)</p> <p>b. Health care: Expansion and new construction of hospitals, procurement of medical equipment</p> <p>c. Water Supply: Expansion and new construction of water purification plants, construction of water pipe network</p> <p>d. Rural Market: New construction, procurement of equipment such as freezing storage</p> <p>[Village level supplementary projects (total)]</p> <p>a. Education: elementary school b. Health care: health centers c. Water supply: Infrastructure for Drinking water</p>	<p>Shianjiang, Ala, Liaojiaqiao Liye Meihua, Yangchao, Fuxing Wangchun, Lingxizhen, Shidi Chadong, Dongmaku Wanrongxiang Luiyixi, Chengguan Pushi Ritapu Jiaoziya</p> <p>----- Total: 18 townships</p> <p>20 places</p> <p>13 places</p> <p>11 places</p> <p>12 places</p> <p>88 places</p> <p>114 places</p> <p>149 places</p>	<p>As planned As planned Yangchao: cancelled Lingxizhen: cancelled As planned As planned As planned As planned As planned Yongding metropolitan area: Added</p> <p>----- Tota: 17 townships</p> <p>21 places</p> <p>11places</p> <p>9 places</p> <p>8 places</p> <p>As planned As planned As planned</p>
<p>2. Project Period</p>	<p>March 2003 – December 2006</p>	<p>March 2003 – July 2014</p>

	(46 months)	(137 months)
3. Project Cost		
Amount paid in Foreign currency	1,187 million yen	7,460 million yen
Amount paid in Local currency	9,356 million yen	762 million yen
	(6,237 million yen)	(55 million yen)
Total	10,543 million yen	8,222 million yen
Japanese ODA loan portion	7,882 million yen	7,460 million yen
Exchange rate	1 yuan=15 yen (As of September 2002)	1 yuan=13.81 yen (Average monthly rate from January 2005 to July 2012)

Annex 1: Project Outputs: Planned and Actual Number of Subprojects and its contents

Prefecture /City	County /City /District	Township	Number of Subprojects (Plan)				Number of Subprojects (Actual)				Main changes in the content of subprojects and reasons for cancellation
			Education	Health Care	Water Supply	Rural Market	Education	Health Care	Water Supply	Rural Market	
Xiangxi Tujia and Miao Autonomous Prefecture	1. Fenghuang County	(1) Shianjiang	2	1	—	—	2	1	—	—	Education: There were slight changes in the site area and amount of equipment, but none of them are big changes.
		(2) Ala	2	1	1	1	2	1	1	1	
		(3) Liaojiqiao	2	1	1	—	2	1	1	—	
	2. Longshan County	(4) Liye	1	1	1	1	1	1	1	1	Education: due to the increase in needs, school building, laboratory building and dormitory were expanded.
	3. Baojin County	(5) Meihua	2	1	1	1	2	Request Cancelled	1	1	Healthcare: as repair plans by national health administration authorities could be executed before the project, the request was cancelled.
		(6) Yangchao	—	1	—	1	—	Request Cancelled	—	Request Cancelled	Healthcare: as repair plans by national health administration authorities could be executed before the project, the request was cancelled. Market: the planned site had complex geological features, and infrastructure construction surpassed the plan. Due to limited funds, it was decided to concentrate on Meihua Township.
		(7) Fuxing	1	—	—	—	1	—	—	—	Education: geological features were more difficult than expected, thus the design was changed which required more land than what was originally planned.
	4. Yongshun County	(8) Wangchun	1	1	1	1	1	1	1	1	Education: toilets were added. Healthcare: in order to save construction costs, the CT room was constructed inside the outpatient ward. One ambulance and two of

Zhangjiajie Prefecture-Level City		(9) Lingxizhen	—	—	—	1	—	—	—	Request Cancelled	equipment for anesthesia were added. Market: design changes arose in some markets, and since with the maximum limit of the Japanese ODA loan, it was impossible to construct all three markets, the Lingxizhen Township was cancelled because it had the least amount of transaction.
		(10) Shidi	1	—	—	1	1	—	—	1	Education: school building and gym were expanded.
	5. Huayan County	(11) Chadong	1	1	1	1	1	1	1	1	Market: due to a need increase, the country government allocated land and the areas of the general market section, and the livestock market section were expanded.
		(12) Dongmaku	1	—	1	—	1	—	1	—	As planned
	6. Jishou City	(13) Wanrongxiang	1	1	—	1	1	1	—	1	Healthcare: as a fault was found in the planned construction site of the hospital the location was changed.
		(14) Luyixi	1	1	1	1	1	1	1	1	Healthcare: according to the needs, the area for the cafeteria was reduced, and the areas of the hospital and diagnosis wards were expanded.
	7. Guzhang County	(15) Chengguan	1	—	—	—	1	—	—	—	As planned
		(16) Pushi	1	1	1	1	1	1	1	1	Request Cancelled
	8. Luxi County	(17) Ritapu	1	1	1	—	1	1	Request Cancelled	—	Water Supply: as constructing a water intake pipeline from the water source was too costly, the request was cancelled.

10. Yongding District	(18) Jiaoziya		1	1	1	1	1	Funds transferred to Yongding District Metropolitan area Health Care Subproject	Request Cancelled. Funds transferred to Yongding District Metropolitan area Education Subproject	Request Cancelled	Healthcare: the Jiaoziya Health Clinic was constructed with domestic funds, thus funds were allocated to new construction of the Yongding Central Hospital's hospitalization ward. Water Supply: an operating entity with repayment capacity could not be found, and because land acquisition was difficult the request was cancelled. Funds were allocated to the Yongding District Metropolitan Area education subproject (First Zhangjiajie Middle School) Market: part of the planned construction site was a "National Farmland Protection District" and construction permit could not be obtained, the request was cancelled. The market was later constructed with provincial government funds
	(19) Metropolitan area		—	—	—	—	—	Added with funds transferred from Jiaoziya Water Supply Subproject	Funds transferred from Jiaoziya County Health Care Subproject	—	—
Construction of central infrastructure at the Township level (conducted with Japanese ODA loan)			20 places	13 places	11 places	12 places	21 places	11 places	9 places	8 places	
Supplementary projects at the village level			88	114	—	149	88	114 places	—	149	

(conducted with Chinese counterpart funds)	places	places		places	places			places
Total	108 places	127 places	11 places	161 places	109 places (+1)	125 places (-2)	9 places (-2)	157 places (-4)

Source: Planned values based on documents provided by JICA, actual values based on documents provided by the Executing Agency.

Annex 2: Operation and Effect Indicators: Education

County	No.	Name of School	Indicator*	Base Year 2002	Target Value**	Project Completion					Target achievement/improvement trend***
						2010	2011	2012	2013	2014	
Fenghuang	1	Shanjiang Township Middle School	No. of students	---	---	503	552	521	486	504	---
			Intake Rate	95.2%	98.1%	100.0%	100.0%	100.0%	100.0%	100.0%	Achieved
			Dropout Rate	---	---	0.0%	0.0%	0.0%	0.0%	0.0%	Achieved
	2	Shanjiang Township Elementary School	Enrollment Ratio	---	---	100.0%	100.0%	100.0%	100.0%	100.0%	Achieved
			Utilization rate of student dorm	---	---	100.0%	100.0%	100.0%	100.0%	100.0%	Achieved
			No. of students	---	---	709	728	793	667	743	---
	3	Ala Township Middle School	Intake Rate	---	---	100.0%	100.0%	100.0%	100.0%	100.0%	Achieved
			Dropout Rate	---	---	0.0%	0.2%	0.0%	0.0%	0.0%	Achieved
			Enrollment Ratio	94.0%	99.2%	100.0%	99.8%	100.0%	100.0%	100.0%	Achieved
	4	Ala Township Elementary School	Utilization rate of student dorm	---	---	100.0%	100.0%	100.0%	100.0%	100.0%	Achieved
			No. of students	---	---	454	464	428	367	1,041	---
			Intake Rate	96.7%	98.5%	100.0%	100.0%	100.0%	99.7%	Achieved	
5	Liaoqiao Township Middle School	Dropout Rate	---	---	0.0%	0.0%	0.1%	0.0%	0.3%	Achieved	
		Enrollment Ratio	---	---	100.0%	100.0%	99.9%	100.0%	99.4%	Achieved	
		Utilization rate of student dorm	---	---	100.0%	100.0%	100.0%	91.8%	100.0%	---	
6	Liaoqiao Township Elementary School	No. of students	---	---	1,238	1,296	1,278	1,209	1,268	---	
		Intake Rate	---	---	99.3%	100.0%	100.0%	100.0%	100.0%	Achieved	
		Dropout Rate	---	---	0.0%	0.1%	0.0%	0.4%	0.2%	Achieved	
7	Liyu Township Ethnic Middle School	Enrollment Ratio	96.6%	99.8%	99.3%	99.9%	100.0%	99.6%	99.8%	Achieved	
		No. of students	---	---	704	618	553	530	504	---	
		Intake Rate	---	---	99.6%	100.0%	99.8%	99.6%	100.0%	Achieved	
8	Meihua Township Elementary School	Dropout Rate	---	---	0.2%	0.8%	0.1%	0.0%	0.1%	Achieved	
		Enrollment Ratio	---	---	99.4%	99.2%	99.7%	99.6%	99.9%	Achieved	
		Utilization rate of student dorm	---	---	100.0%	100.0%	100.0%	100.0%	100.0%	Achieved	
9	Meihua Township Middle School	No. of students	---	---	1,099	1,099	1,109	981	927	---	
		Intake Rate	---	---	100.0%	100.0%	99.6%	100.0%	100.0%	Achieved	
		Dropout Rate	1.4%	0.8%	0.2%	0.0%	0.1%	0.2%	0.1%	Achieved	
10	Fuxing Township Middle School	Enrollment Ratio	---	---	99.8%	100.0%	99.5%	99.8%	99.8%	Achieved	
		Utilization rate of student dorm	---	---	100.0%	100.0%	100.0%	100.0%	100.0%	Achieved	
		No. of students	---	---	958	958	987	1078	1142	---	
11	Wangxun Township Middle School	Intake Rate	---	---	100.0%	100.0%	100.0%	100.0%	100.0%	Achieved	
		Dropout Rate	0.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	Achieved	
		Enrollment Ratio	---	---	100.0%	100.0%	100.0%	100.0%	100.0%	Achieved	
12	Langxi Township Boarding Middle School	No. of books per student	---	---	20 books	25 books	26 books	26 books	26 books	Achieved	
		Utilization rate of student dorm	---	---	100%	100%	100%	100%	100%	Achieved	
		No. of students	---	---	3,285	3,522	3,688	4,245	4,483	---	
13	Chadong Township Nine-year school	Intake Rate	---	---	98.6%	98.6%	97.9%	99.4%	99.4%	Achieved	
		Dropout Rate	5.5%	2.5%	1.4%	1.4%	2.1%	0.6%	0.4%	Achieved	
		Enrollment Ratio	---	---	100.0%	100.0%	100.0%	100.0%	100.0%	Achieved	
14	Dongmaku Township Nine-year school	No. of books per student	11 books	30 books	32 books	32 books	30 books	30 books	Achieved		
		Utilization rate of student dorm	---	---	100%	100%	100%	100%	100%	Achieved	
		No. of students	---	---	794	785	785	870	882	---	
15	Wangrongguang Township Nine-year school	Intake Rate	---	---	97.30%	97.90%	97.90%	98.20%	98.20%	Achieved	
		Dropout Rate	5.5%	2.5%	2.1%	2.1%	1.8%	1.8%	1.8%	Achieved	
		Enrollment Ratio	---	---	100.0%	100.0%	100.0%	100.0%	100.0%	Achieved	
16	Laozi Township Nine-year school	No. of books per student	---	---	30 books	31 books	32 books	32 books	32 books	Improving	
		Utilization rate of student dorm	---	---	100.0%	100.0%	100.0%	100.0%	100.0%	Achieved	
		No. of students	613	---	777	698	688	692	737	---	
17	Chengguang Township Nine-year school	Intake Rate	92%	---	99.0%	99.0%	99.5%	99.0%	99.5%	Improving	
		Dropout Rate	2.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	Achieved	
		Enrollment Ratio	---	---	99.5%	100.0%	99.5%	100.0%	99.5%	Achieved	
18	Liyu Township Ethnic Middle School	No. of students	---	---	99.0%	99.0%	99.5%	99.0%	99.5%	Improving	
		Intake Rate	---	---	99.0%	99.0%	99.5%	99.0%	99.5%	Improving	
		Dropout Rate	2.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	Achieved	
19	Meihua Township Middle School	Enrollment Ratio	---	---	99.0%	99.0%	99.5%	99.0%	99.5%	Improving	
		Intake Rate	731	---	1,033	1,031	1,039	1,037	1,108	Improving	
		Dropout Rate	---	---	99.5%	100.0%	100.0%	99.5%	100.0%	Achieved	
20	Jaoziya Township Nine-year school	Intake Rate	95%	---	99.5%	100.0%	100.0%	99.5%	100.0%	Achieved	
		Dropout Rate	---	---	0.0%	0.0%	0.0%	0.0%	0.0%	Achieved	
		Enrollment Ratio	---	---	99.5%	100.0%	100.0%	99.5%	100.0%	Achieved	
21	Zhangjiacite City First Middle School+	No. of students	---	---	99.5%	100.0%	100.0%	99.5%	100.0%	Achieved	
		Intake Rate	---	---	99.5%	100.0%	100.0%	99.5%	100.0%	Achieved	
		Dropout Rate	2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	Achieved	

Source: Target values are based on documents provided by JICA. Actual values were provided by the Executing Agency.
 *: Indicators that have a target set are indicators officially agreed as basis operation and effect indicators of this Project in the M.D. The rest of the indicators are supplementary indicators. If the subproject includes the construction of a library, "No. of books per student" was added as indicator. If dorms were constructed by the Project, the "Utilization rate of student dorm" was added as indicator.
 **: Target value that has to be achieved two years after project completion.
 ***: In the case of basic indicators, targets considered as "Achieved" if the actual value was 80% or more of the target value. For supplementary indicators that have a base year value, it was indicated as "Improving" or "Decreasing" comparing the actual value to the base year value. If the supplementary indicator does not have a base year value, the actual value was compared to either its trend from 2010, or its ideal target value, and it was indicated as "Achieved" if the value achieved 80% or more of that value, or it is on an upward trend.
 +: Because Zhangjiacite City First Middle School's subproject scope was the construction of a gym and its underground parking lot, indicators to assess their utilization status were additionally established.

Annex 3: Operation and Effect Indicators: Health

Country	No.	Name of Health Center / Hospital	Indicator	Base Value	Target Value	Project Completion	One year after Project Completion	Two years after Project Completion			Achievement of Target Value Two Years after Project Completion
						Year					
						2010	2011	2012	2013	2014	
Fenghuang	1	Shianjiang Township Central Health Center	Infant Mortality Rate	4.40%	3%	2.3%	2.9%	1.8%	1.1%	0.9%	Achieved
			Cure Rate of Endemic Diseases	42%	80%	79.0%	86.0%	88.0%	84.0%	89.0%	Achieved
			Maternal Mortality Rate	0.20%	0.10%	0.1%	0.0%	0.0%	0.0%	0.0%	Achieved
	2	Ala Township Central Health Center	Infant Mortality Rate	4.35%	3%	1.8%	1.1%	0.5%	0.2%	0.1%	Achieved
			Cure Rate of Endemic Diseases	42%	80%	79.0%	81.0%	85.0%	89.0%	90.0%	Achieved
			Maternal Mortality Rate	0.20%	0.09%	0.0%	0.0%	0.0%	0.0%	0.0%	Achieved
	3	Liaojiaqiao Township Central Health Center	Infant Mortality Rate	4.50%	3%	1.4%	0.8%	0.5%	0.1%	0.0%	Achieved
			Cure Rate of Endemic Diseases	45%	80%	89.0%	95.0%	96.0%	98.0%	98.0%	Achieved
			Maternal Mortality Rate	0.20%	0.10%	0.1%	0.1%	0.0%	0.0%	0.0%	Achieved
Longshan	4	Liye Township Hospital	Infant Mortality Rate	2.30%	1.80%	0.2%	3.3%	1.6%	1.9%	0.4%	Achieved
			Cure Rate of Endemic Diseases	96%	99%	100%	100%	100%	100%	100%	Achieved
			Maternal Mortality Rate	0.20%	0.10%	0	0	0	0	0	Achieved
Yongshun	5	Wangcun Township Central Hospital	Infant Mortality Rate	3.20%	2.40%	1.1%	0.5%	0.6%	0.6%	NA	Achieved
			Cure Rate of Endemic Diseases	63.20%	82%	87%	85%	88%	90%	NA	Achieved
			Maternal Mortality Rate	0.10%	0.05%	0.03%	0.03%	0.03%	0.03%	NA	Achieved
Huayuan	6	Chadong Township Hospital	Infant Mortality Rate	1.57%	1.20%	0	0	0	0	0	Achieved
			Cure Rate of Endemic Diseases	75%	90%	92%	93%	92%	93%	92%	Achieved
			Maternal Mortality Rate	0.08%	0.06%	0	0	0	0	0	Achieved
Jishou	7	Wangrongjiang Township Central Hospital	Infant Mortality Rate	2.80%	1.20%	—	—	—	—	—	Not Achieved because it was completed in July 2014
			Maternal Mortality Rate	0.078	0.04%	—	—	—	—	—	
Guzhang	8	Luoyixi Township Central Hospital	Infant Mortality Rate	20.40%	8%	6.9%	7.4%	7.2%	6.1%	NA	Achieved
			Cure Rate of Endemic Diseases	83%	95%	95.6%	96.5%	96.2%	97.3%	NA	Achieved
			Maternal Mortality Rate	0.20%	0.10%	0	0	0	0	0	Achieved
Luxi	9	Pushi Township Central Hospital	Infant Mortality Rate	5.5%	83%	95%	95%	95%	95%	95%	Achieved
			Cure Rate of Endemic Diseases	55%	83%	95%	95%	95%	95%	95%	Achieved
			Maternal Mortality Rate	0.20%	0.10%	0	0	0	0	0	Achieved
Sangzhi	11	Ruitapu Township Central Hospital	Infant Mortality Rate	0.30%	0.20%	0	0	0	0	NA	Achieved
			Cure Rate of Endemic Diseases	78%	85%	90%	91%	91%	92%	NA	Achieved
			Maternal Mortality Rate	0.80%	0.08%	0	0	0	0	NA	Achieved

Source: Planned values based on documents provided by JICA, actual values based on documents provided by the Executing Agency.

Annex 4: Operation and Effect Indicators: Water Supply

County	No.	Name of Water Treatment Plant (WTP)	Indicator	Target Value	Project Completion	One Year After Project Completion	Two Years After Project Completion			Achievement of Target Value Two Years after Project Completion	
					Year						
					2010	2011	2012	2013	2014		
Fenghuang	1	Ala Township WTP	Amount of Water Supply (T/day)	To be on an upward trend	1,500	2,000	2,500	2,500	3,000	Achieved	
			Population Served (10 thousand persons)	To be on an upward trend	1.5	2	2.2	2.5	2.5	Achieved	
			Percentage of Population Served	90%	92%	92%	95%	95%	98%	Achieved	
	2	Liaojiaqiao Township WTP	Water Quality (turbidity)	< INTU	0.6	0.6	0.6	0.6	0.6	Achieved	
			Rate of Facility Utilization	80%	100%	100%	100%	100%	Achieved		
			Amount of Water Supply (T/day)	To be on an upward trend	800	800	1,000	1,500	2,000	Achieved	
	Longshan	3	Liye Township WTP	Population Served (10 thousand persons)	To be on an upward trend	0.8	1.2	1.2	1.2	1.5	Achieved
				Percentage of Population Served	90%	90%	92%	95%	95%	97%	Achieved
				Water Quality (turbidity)	< INTU	0.7	0.6	0.6	0.5	0.5	Achieved
4		Meihua Township WTP	Rate of Facility Utilization	80%	100%	100%	100%	100%	Achieved		
			Amount of Water Supply (T/day)	To be on an upward trend	7,452	7,780	8,274	8,438	8,657	Achieved	
			Population Served (10 thousand persons)	To be on an upward trend	5.9	5.9	6.0	6.1	6.1	Achieved	
Yongshun		5	Wangcun Township WTP	Percentage of Population Served	90%	98%	98%	99%	98%	98%	Achieved
				Water Quality (turbidity)	< INTU	< 1	< 1	< 1	< 1	< 1	Achieved
				Rate of Facility Utilization	80%	76%	78%	83%	85%	87%	Achieved
	6	Chadong Township WTP	Amount of Water Supply (T/day)	To be on an upward trend	10,800	10,900	11,200	11,250	NA	Achieved	
			Population Served (10 thousand persons)	To be on an upward trend	1.6	1.9	2.0	2.0	NA	Achieved	
			Percentage of Population Served	90%	91%	95%	95%	97%	NA	Achieved	
	Huayuan	7	Dongmaku Township WTP	Water Quality (turbidity)	< INTU	< 1	< 1	< 1	< 1	< 1	Achieved
				Rate of Facility Utilization	80%	100%	100%	100%	100%	Achieved	
				Amount of Water Supply (T/day)	To be on an upward trend	2,700	3,200	3,500	3,900	4,200	Achieved
8		Luoyixi Township WTP	Population Served (10 thousand persons)	To be on an upward trend	0.8	0.9	1.0	1.1	1.2	Achieved	
			Percentage of Population Served	90%	59%	72%	75%	86%	88%	More than 80% achieved	
			Water Quality (turbidity)	< INTU	0.9	0.8	0.8	0.8	0.8	Achieved	
9		Pushi Township WTP	Rate of Facility Utilization	80%	100%	100%	100%	100%	Achieved		
			Amount of Water Supply (T/day)	To be on an upward trend	8,200	8,760	9,040	9,315	9,580	Achieved	
			Population Served (10 thousand persons)	To be on an upward trend	0.6	0.6	0.6	0.7	0.8	Achieved	
Luxi	9	Pushi Township WTP	Percentage of Population Served	90%	57%	58%	60%	70%	80%	More than 50% achieved	
			Water Quality (turbidity)	< INTU	< 1	< 1	< 1	< 1	< 1	Achieved	
			Rate of Facility Utilization	80%	70	73	78	80	85	Achieved	
	10	Pushi Township WTP	Amount of Water Supply (T/day)	To be on an upward trend	1.1	1.1	1.1	1.4	1.4	Achieved	
			Population Served (10 thousand persons)	To be on an upward trend	3	3	3.2	3.6	3.6	Achieved	
			Percentage of Population Served	90%	82%	83%	90%	95%	95%	Achieved	
	11	Pushi Township WTP	Water Quality (turbidity)	< INTU	< 1	< 1	< 1	< 1	< 1	Achieved	
			Rate of Facility Utilization	80%	100%	100%	100%	100%	Achieved		

NTU: Nephelometric Turbidity Unit

Source: Planned values based on documents provided by JICA, actual values based on documents provided by the Executing Agency.

Annex 5: Operation and Effect Indicators: Rural Markets

County	No.	Name of Market	Indicator	Base Year	Target	Project Completion Year	One Year After Project Completion	Two Years After Project Completion			Target achievement status two years after project completion
						Year					
						2010	2011	2012	2013	2014	
Fenghuang	1	Ala Township Rural Market	Average annual income of neighborhood resident	717 Yuan	900 Yuan	1,540	1,860	2,120	2,461	2,580	Achieved
			New job opportunities	—	2000 persons	2,110	2,150	2,180	2,300	2,320	Achieved
Longshan	2	Liye Township Rural Market	Average annual income of neighborhood resident	924 Yuan	1814 Yuan	5,900	6,100	6,500	6,800	NA	Achieved
			New job opportunities	—	360 persons	397	423	469	498	586	Achieved
Baojin	3	Meihua Township Rural Market	Average annual income of neighborhood resident	1000 Yuan	1400 Yuan	4,215	4,420	4,664	4,851	5,482	Achieved
			New job opportunities	—	360 persons	370	370	370	370	400	Achieved
Yongshun	4	Wangcun Township Rural Market	Average annual income of neighborhood resident	1151 Yuan	1331 Yuan	3,226	3,571	3,951	4,389	NA	Achieved
			New job opportunities	—	639 persons	1,322	1,465	1,590	1,752	NA	Achieved
	5	Shiti Township Rural Market	Average annual income of neighborhood resident	1166 Yuan	1376 Yuan	3,132	3,396	3,387	4,115	NA	Achieved
			New job opportunities	—	377 persons	655	677	796	904	NA	Achieved
Huayuan	6	Chadong Township Rural Market	Average annual income of neighborhood resident	875 Yuan	1275 Yuan	4,100	3,750	3,800	3,800	NA	Achieved
			New job opportunities	—	1500 persons	1,600	1,610	1,625	1,638	NA	Achieved
Jishou	7	Qianzhou Township Rural Market	Average annual income of neighborhood resident	1000 Yuan	1175 Yuan	10,594	10,620	12,360	13,350	16,201	Achieved
			New job opportunities	—	1000 persons	4,009	3,216	3,814	3,679	3,950	Achieved
Guzhang	8	Luoyixi Township Rural Market	Average annual income of neighborhood resident	761 Yuan	1500 Yuan	2,620	3,002	3,596	4,127	NA	Achieved
			New job opportunities	—	1200 persons	445	692	945	1,206	NA	79% Achieved

* Target values of new job opportunities created are accumulated values.

Source: Planned values based on documents provided by JICA, actual values based on documents provided by the Executing Agency.

Annex 6: Results of the Beneficiary Study

Survey Period	December 8 to December 10, 2014
Area and Sample number	Longshan County Liye Township's 100 residents (Note: as a result of discussions with the Executing Agency, among the counties where subprojects of all four sectors were conducted, Longshan County was selected as it was where the most funds were invested).
Sampling method	With the cooperation of the County Poverty Alleviation Office, residents were requested to cooperate. The residents that gathered were asked to respond to a questionnaire. As a result, 100% of the samples were direct beneficiaries of the project. All of them were beneficiaries of the education, health care and rural market subprojects, and 96 persons were beneficiaries of the water supply subproject.
Sample Characteristics	<ul style="list-style-type: none"> • Number of samples: 100 persons (50 men and 50 women / proportion of ethnic minority: 97%, others: 3%). • Age distribution: 20 to 29 years old (14%), 30 to 39 years old (25%), 40 to 49 years old (28%), 50 to 59 years old (14%), over 60 years old (19%). • Final academic background: finished middle school (51%), finished elementary school (19%), dropped out from elementary school (14%), dropped out from middle school (8%), Others (8%). • Occupation: agriculture (55%), commerce (38%), fishery (2%), others (5%). • Annual income: less than 2,300 yuan (poverty, 21%), from 2,300 yuan to less than 5,000 yuan (32%), from 5,000 yuan to less than 10 thousand yuan (25%), more than 10 thousand yuan (22%). • Beneficiaries whose family member(s) are working in urban areas: 44%.
Results of the Survey	
<p>1. Education Subproject (Elementary school)</p> <ul style="list-style-type: none"> • Enrollment and graduation situation: While 50% of the residents recognized that before the project “almost all school-aged children are enrolled” or “everybody is enrolled”, 94% of the respondents answered that now “everybody is enrolled”, 16% answered that “almost everybody is enrolled” thus it can be recognized that enrollment has significantly improved. As for graduation rate most respondents answered that before the project “children dropped out of school because their parents became migrant workers”, however, now all respondents said that “100% graduate”. • Changes in the educational environment: respondents were asked to evaluate on a scale from 1 to 4 (1: not sufficient; 2: more or less not sufficient; 3: more or less sufficient; 4: sufficient) on the following aspects: “number of school compared to number of children in the area”; “number of teachers per class”, “number of classrooms”, “safety of classrooms”, “number of desks, chairs and textbooks”, “condition of educational facilities” and “condition of toilets”. Average points for conditions before the project was 2.7, while, the same was 3.7 now, showing that there was a clear improvement. • Comments most often made in the free comments section: (1) classrooms have more light and are more 	

<p>hygienic, each student have their own desk and chair which has increased children’s motivation to learn. (2) Number of teachers has improved and generally, quality of education has improved.</p>
<p>2. Health Care Subproject</p> <ul style="list-style-type: none"> • Changes in health conditions and access to health care services: 39% of beneficiaries said that “before the project I often got sick” or “I was prone to get sick”. However, now only 7% of beneficiaries had the same answer, while 93% said “I hardly get sick” or “I am completely healthy”. The reasons being that hospitals were developed in the neighborhood and that living conditions (water and hygienic conditions of housing etc.) have improved. • Changes in the medical environment: respondents were asked to evaluate on a scale from 1 to 4 (1: not sufficient; 2: more or less not sufficient”; 3: more or less sufficient; 4: sufficient) on the following aspects: “street and road and conditions to a medical facility”, “number of medical facilities”, “number of medical doctors and nurses compared to local population”, “number of times in which hospitalization was refused due to lack of beds”, “problems due to lack of medical equipment”, “price of medication”, “percentage in which a newborn lives up to seven years old”, “medical facilities awareness activities and provision of information to prevent sickness”. While total average points for conditions before the project was 2.6, the same clearly improved to 3.6 after the project. • Comments most often made in the free comments section: (1) hospitals were developed which is convenient since there is no need to go to hospitals that are far; (2) hospitalization is available in a near hospital which gives peace of mind; (3) technical levels of medical doctors and facilities improved and medical services as a whole were enhanced, (4) it is desirable to continue investing, introduce new equipment and strengthen preventive health, (5) it is a must to continue training of medical staff.
<p>3. Rural Market Subproject</p> <ul style="list-style-type: none"> • Changes in the way rural markets are utilized: 54% of residents responded that before the project they were “doing transactions directly in the market as producers”, while the same has decreased to 38% now after the project. On the other hand, residents that were selling merchandise purchased from producers were 25% before the project, while the same has increased to 45% now. And while 91% of producers, sellers and consumers were utilizing the market in one way or another before the project, the same has slightly increased to 95% now. (Note: although in small scale, but sellers are residents that are business owners, and includes residents that are employed by these business owners. • Changes in annual income: 28% of respondents’ annual income before the project was less than 2,300 yuan, which is the definition for poverty, but the same had decreased to 6% now. On the other hand, 61% of residents had an annual income before the project that was between 2,300 yuan to 10,000 yuan, while the same has decreased now to 47%. However, while residents whose annual income was more than 100,000 yuan before the project was only 9%, this has increased significantly now to 46%. Many residents mentioned that although markets existed since before the project, now they are being managed in an orderly manner, job opportunities have been created, resulting in an increase in farmer’s income. • Satisfaction level of markets: respondents were asked to evaluate on a scale from 1 to 4 (1: not sufficient; 2: more or less not sufficient”; 3: more or less sufficient; 4: sufficient) on the following eight aspects: “access”, “user-friendliness of facilities”, “hygienic conditions”, “merchandise assortment”, “freshness”, “price”, “job opportunities”, “place for the community’s interaction”. The overall grade for conditions before the project from the producers and sellers point of view was 2.3, and 2.4 from the consumers’ point of view. The same have improve respectively to 3.5 and 3.6. • Comments most often made in the free comments section: (1) market scale has increased and as the market place has been unified, selling places are ordered which has increased convenience to both sellers and buyers. (2) Markets are now cleaner, overall environment has improved, there is more variety of products, and fresh products are now available. (3) From now on, it is desirable to strengthen hygienic management of markets. (4) Prices are often not uniform, thus it is desirable to do a manage markets in a more rational way.
<p>4. Water Supply Subproject</p> <ul style="list-style-type: none"> • Access to water supply: Before the project, 42% of respondents used to fetch water from “wells and small rivers”, 18% from “communal water taps”, and 40% answered that they “already had water taps in their own house and there was no need to fetch water”. At the time of the ex-post evaluation, 1% of residents said that they “fetch water from wells”, 1% from “communal water taps, and 92% “have water taps in their own house”, showing a significant improvement. • Changes in water-fetching labor and time: the residents that used to fetch water from wells and small rivers, spent about 30 minutes/day (47%), from 30 minutes to one hour per day (15%) , more than one hour (8%). This shows that improving access to water in Liye Township was a considerably important development need. Through this project, almost all respondents said that they are now able to use tap-water at home from at any time, saying that they can “save time and it is very convenient”. In addition, before the project, 89% of residents answered that mainly adults from each household used to fetch water, but now, after the project, since each household have their own tap-water, adults are able to do other activities (agriculture, go to work in the city, etc.). • Changes in health condition: before the project, 64% of residents answered that they “often or sometimes got sicknesses caused by dirty water”, but now, this percentage has decreased to 18%, and residents that answered

that they “hardly get sickness caused by dirty water” increased from 21% to 59%, showing that as safe and clean water has been secured, at least the situation of sicknesses caused by dirty water have improved. Respondents were asked to evaluate on a scale from 1 to 4 (1: not sufficient; 2: more or less not sufficient”; 3: more or less sufficient; 4: sufficient) on the changes in the quality of water for domestic use. The overall average grade before the project was 2.4, while the number has now improved considerably to 3.7.

- On water supply services: residents evaluate highly the actual water supply services, and 95% said that “maintenance condition is good”, and 92% answered that “water charges are reasonable”.
- Comments most often made in the free comments section: (1) development of water supply infrastructure has made daily life more convenient and finally we are able to drink clean water without any worries. (2) Standard of living has improved. (3) For farmers, it is now more convenient to use water when doing farm work.

Annex 7. Budget and Expenditure of Subprojects by Sector (Unit: million yuan)

County	Item	2010	2011	2012	2013	2014	
Fenghuang	Education	Budget	127.2	167.7	225.1	242.2	256.7
		Expense	127.2	167.7	225.1	242.2	256.7
		Difference	0.0	0.0	0.0	0.0	0.0
	Health Care	Budget	0.4	0.4	0.4	0.4	0.4
		Expense	0.4	0.4	0.4	0.4	0.4
		Difference	0.0	0.0	0.0	0.0	0.0
	Water Supply	Budget	5.2	6.0	6.2	6.6	7.7
		Expense	5.2	6.0	6.2	6.6	7.7
		Difference	0.0	0.0	0.0	0.0	0.0
	Rural Market	Budget			0.6	0.8	0.9
		Expense	Construction Period		0.4	0.5	0.7
		Difference			0.2	0.3	0.3
Longshan	Education	Budget	0.4	0.5	0.5	0.5	0.6
		Expense	0.4	0.5	0.5	0.5	0.6
		Difference	0.0	0.0	0.0	0.0	0.0
	Health Care	Budget	4.3	4.8	5.9	9.0	11.3
		Expense	4.2	4.6	5.3	7.1	10.5
		Difference	0.1	0.2	0.6	1.9	0.8
	Water Supply	Budget	18.0	18.5	19.2	19.8	22.0
		Expense	17.0	17.8	18.2	18.5	20.0
		Difference	1.0	0.7	1.0	1.3	2.0
	Rural Market	Budget	1.9	2.0	2.1	2.4	2.7
		Expense	1.5	1.7	2.0	2.2	2.3
		Difference	0.4	0.3	0.1	0.2	0.4
Baojin	Education	Budget	2.4	1.8	0.6	1.2	1.9
		Expense	1.0	0.9	0.2	0.6	0.9
		Difference	1.4	0.9	0.4	0.6	1.0
	Water Supply	Budget	7.1	7.3	7.6	8.0	8.4
		Expense	1.3	3.1	3.5	3.6	3.7
		Difference	5.8	4.2	4.1	4.4	4.7
	Rural Market	Budget	1.0	1.1	1.2	1.3	1.4
		Expense	1.0	1.0	0.9	1.1	1.0
		Difference	0.1	0.1	0.3	0.2	0.4
Yongshun	Education	Budget	3.5	3.9	4.0	4.3	4.3
		Expense	2.6	2.8	2.9	2.9	2.8
		Difference	1.0	1.1	1.1	1.4	1.5
	Health Care	Budget	2.0	2.0	2.3	2.5	2.5
		Expense	1.7	1.9	2.1	2.4	2.2
		Difference	0.3	0.1	0.2	0.2	0.3
	Water Supply	Budget	1.8	3.0	2.7	2.7	2.8
		Expense	1.5	1.7	1.7	1.9	2.0
		Difference	0.3	1.3	1.0	0.8	0.8
Rural Market	Budget	2.6	2.9	2.9	3.0	2.9	
	Expense	2.2	2.3	2.6	2.6	2.5	
	Difference	0.4	0.6	0.4	0.4	0.4	
Huayuan	Education	Budget	9.2	11.5	11.9	13.4	15.5
		Expense	9.2	11.5	11.9	13.4	14.7
		Difference	0.0	0.0	0.0	0.0	0.8
	Health Care	Budget	1.1	2.3	5.1	7.2	7.5
		Expense	1.0	2.2	4.8	6.9	7.5
		Difference	0.1	0.0	0.3	0.4	0.0
	Water Supply	Budget	1.8	3.1	3.3	3.7	3.9
		Expense	1.7	2.9	3.1	3.5	3.7
		Difference	0.1	0.2	0.2	0.2	0.2
	Rural Market	Budget	0.5	0.5	0.5	0.5	0.5
		Expense	0.3	0.3	0.3	0.3	0.3
		Difference	0.2	0.2	0.1	0.1	0.2
Jishou	Education	Budget	0.1	0.1	0.2	0.3	0.4
		Expense	0.1	0.1	0.2	0.3	0.4
		Difference	0.0	0.0	0.0	0.0	0.0
	Rural Market	Budget	0.2	0.2	0.2	0.2	0.5
		Expense	0.2	0.2	0.2	0.2	0.5
		Difference	0.0	0.0	0.0	0.0	0.0
Guzhang	Education	Budget	7.3	9.7	9.7	12.5	11.9
		Expense	7.3	9.7	9.7	12.5	11.9
		Difference	0.0	0.0	0.0	0.0	0.0
	Health Care	Budget	0.1	0.1	0.1	0.1	0.1
		Expense	0.1	0.1	0.1	0.1	0.1
		Difference	0.0	0.0	0.0	0.0	0.0
	Water Supply	Budget	5.0	5.5	5.7	6.0	6.2
		Expense	4.8	5.2	5.3	5.5	5.5
		Difference	0.2	0.3	0.4	0.6	0.7
Rural Market	Budget	0.1	0.1	0.1	0.1	0.1	
	Expense	0.1	0.1	0.1	0.1	0.1	
	Difference	0.0	0.0	0.0	0.0	0.0	
Luxi	Education	Budget	0.0	0.0	0.0	0.4	0.4
		Expense	0.0	0.0	0.0	0.4	0.4
		Difference	0.0	0.0	0.0	0.0	0.0
	Health Care	Budget	9.5	15.2	20.0	18.4	12.9
		Expense	9.4	14.8	19.8	18.2	12.9
		Difference	0.1	0.5	0.2	0.2	0.0
Water Supply	Budget	4.0	4.1	5.8	7.5	8.3	
	Expense	3.7	3.8	5.3	6.8	7.8	
	Difference	0.3	0.3	0.5	0.7	0.5	
Sangzhi	Education	Budget	7.6	13.1	18.6	21.1	14.4
		Expense	8.5	13.9	19.1	21.1	14.9
		Difference	-1.0	-0.8	-0.5	-0.0	-0.5
	Health Care	Budget	4.5	4.9	6.4	6.8	4.6
		Expense	4.0	4.9	6.0	6.3	4.1
		Difference	0.5	0.0	0.4	0.5	0.5
	Water Supply	Budget	8.2	8.2	8.2	8.6	8.9
		Expense	1.0	1.0	1.0	1.0	1.0
		Difference	7.2	7.2	7.2	7.6	7.9
Health Care	Budget	52.0	65.0	89.0	103.0	145.0	
	Expense	41.6	52.0	71.2	82.4	101.5	
	Difference	10.4	13.0	17.8	20.6	43.5	

Source: Based on documents provided by the Executing Agency.

People’s Republic of China

Ex-Post Evaluation of Japanese ODA Loan
Eco-environmental Construction and General Treatment Project of
the Yangtze Upper Reaches in Sichuan Province
External Evaluators: Kenji Momota and Makiko Oleynikov, IC Net Limited

0. Summary

This project was carried out in 12 counties in Sichuan to provide afforestation and vegetation cover, and the construction of methane gas facilities to provide an alternative fuel in order to increase the forest area, decrease soil erosion, and ultimately achieve an improvement of the environment.

This project has been highly relevant because at the times of both the appraisal and the ex-post evaluation, it has been consistent with China’s development policy and needs at the state, provincial, and municipality levels, as well as Japan’s ODA policy for China. Since the completion of the project, forest growth has been in good condition, with increases in forest area and coverage, and consequent decreases in sediment discharge, as well as other positive effects produced in counties covered by this project. The construction of methane gas facilities has also produced results showing a reduction of firewood use, with some secondary effects of improved living conditions for farmers. The facilities have also been conducive as part of reconstruction work after the major earthquake in 2008. In terms of effectiveness and impact, this project can be evaluated as having almost achieved, or being highly likely to achieve, their criteria. Its efficiency has turned out to be fair, as although the project period was within the plan, the project cost exceeded the plan. The sustainability of the effects this project has produced is high, with no major problems found in its maintenance arrangements, or its technical and financial aspects.

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

1. Project Description



Project Location



Photo 1: A Forest Developed by the Project

1.1 Background

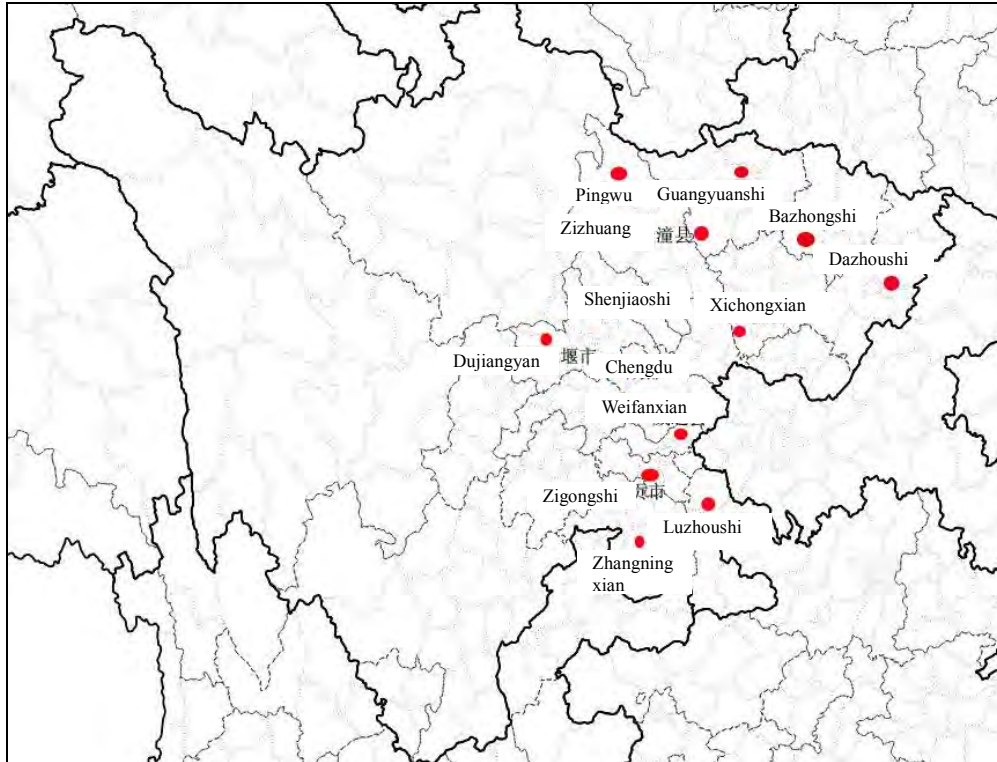
Since its founding in 1949, China has made national land afforestation as one of its basic policy programs, developing arrangements and carrying out large-scale afforestation projects. However, to satisfy demand for wood amid economic growth, the country has for a long time been cutting down

forests faster than a level where a certain forest coverage ratio can be maintained. Its coverage ratio of 8.6% immediately after the foundation of the state, increased by a mere 18.2 % (year 2004), leaving the country ranked 119th (year 2004) in the world for forest area per capita as of that year. Excessive deforestation and a consequent decrease in forest resources have caused natural disasters, seen typically in great floods along the Yangtze River, deterioration of natural environments such as deforestation and soil erosion, and a reduction in the productivity of farmland and pastureland, factors of impoverishment in rural areas.

Located along the upper Yangtze River and with a warm climate, Sichuan Province had a higher forest coverage ratio than China's national average. However, a lack of appropriate forest management has resulted in decreases in the forest stock volume and increases in the soil erosion area, causing floods and other disasters. In particular, floods that occurred along the Yangtze in 1998 and 2004 caused great damage with more than 200 fatalities. This has demonstrated the growing need for restoration of forest resources mainly as a way of controlling soil erosion.

1.2 Project Outline

The objective of this project is to carry out in 12 county-class administrative units in Sichuan Province (Bazhou District, Shenjiao City, Yuanba District, Xichong County, Zizhuang County, Dujiangyan City, Daan District, Pingwu County, Changning County, Tongchuan District, Weiyuan County, and Jiangu District), afforestation and vegetation cover, as well as construction of facilities that should supply methane as a substitute for forests being cut down for fuel which will help reduce deforestation for the purposes of increasing forest area, decreasing soil erosion, and thereby achieving an improvement of the eco-environment in areas covered by this project.



Source: Prepared by the external evaluators

Figure 1: Twelve Target Counties and Cities of the Project

This project includes programs for afforestation, vegetation cover, and construction of methane gas facilities for farmers as its main components. They have each produced outputs outlined below.

(1) Afforestation

In line with the categories set out in the Forest Law of China, the afforestation program has developed protection forests, mountain closures, and economic forests. They each have characteristics listed below.

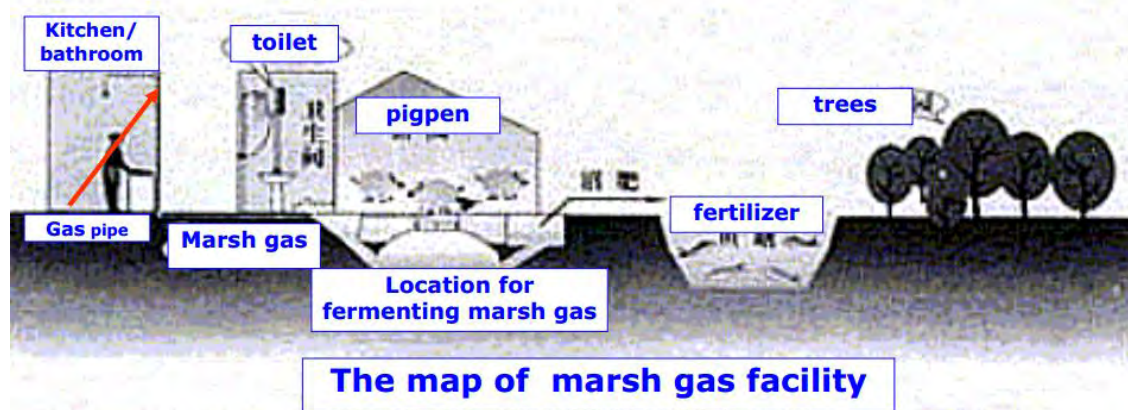
- 1) Protection forests: Intended mainly to conserve water and soil, protect water sources, and preserve farmland.
- 2) Mountain closures: Primeval forests where people are prohibited from entering in the hope that it will help trees and plants grow by themselves.
- 3) Economic forests: Intended to raise fruit trees and produce raw materials for industrial goods and pharmaceuticals.

(2) Vegetation cover

The vegetation cover program has been carried out in ways similar to afforestation for two categories of plants: protection vegetation, intended mainly to protect water sources; and economic vegetation, developed to produce marketable plants.

(3) Methane gas facilities

Methane gas facilities are designed to ferment excrement from hogs and other domestic animals and/or humans and produce methane as a substitute for the firewood that farmers have been using for fuel, thereby preventing their illegal logging. Their specific arrangements are shown below: a fermentation pool, connected to a livestock barn and/or a toilet, allows excrement to flow in and generate methane, which then goes through a pipe to a kitchen and a bathroom, where it is consumed.



Source: Materials provided by JICA

Figure 2: Overview of Methane Gas Facilities

Loan Approved Amount/Disbursed Amount	6,503 million yen / 6,401 million yen	
Exchange of Notes Date/Loan Agreement Signing Date	March 2005 / March 2005	
Terms and Conditions	Interest Rate Repayment Period (Grace Period) Conditions for Procurement:	0.75 % 40 years 10 years General untied
Borrower /Executing Agency(ies)	Government of the People's Republic of China / People's Government of Sichuan Province	
Final Disbursement Date	July 2012	
Main Contractor (Over 1 billion yen)	-	
Main Consultant (Over 100 million yen)	-	
Feasibility Studies, etc.	F/S: Sichuan Engineering Consulting and Research Institute (Sichuan Engineering Consulting Center); April 2004	
Related Projects	[Technical cooperation] • Model Afforestation Project in Sichuan I (2000) • Study on Reforestation in Anning Watershed in Sichuan Province (2000) • Sino-Japan Forestry Ecology Training Center Project	

	<p>(2004)</p> <p>[ODA Loan Project]</p> <ul style="list-style-type: none"> • Shaanxi Loess Plateau Afforestation Project (2000) • Shanxi Loess Plateau Afforestation Project (2000) • Inner-Mongolia Loess Plateau Afforestation Project (2000) • Gansu Water-Saving Irrigation Project (2000) • Xinjiang Water-Saving Irrigation Project (2000) • Ningxia Afforestation And Vegetation Cover Project (2001) • Gansu Afforestation and Vegetation Cover Project (2002) • Inner Mongolia Afforestation And Vegetation Cover Project (2002) • Hubei Afforestation Project (2003) • Jiangxi Afforestation Project (2003) <p>[Other international or aid organizations, etc.]</p> <p>World Bank</p> <ul style="list-style-type: none"> • National Afforestation Project (1990) • Project for Forestry Development in Poor Districts (1998) • Project for Sustainable Development of the Forestry Sector (2002) <p>KfW Development Bank (Germany)</p> <ul style="list-style-type: none"> • Natural Resources Preservation Project (1997) • Afforestation and Resources Preservation Project (1998) <p>EU</p> <ul style="list-style-type: none"> • Project for Sustainable Development of the Forestry Sector (2002)
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2. Outline of the Evaluation Study

2.1 External Evaluators

Kenji Momota, IC Net Limited

Makiko Oleynikov, IC Net Limited

2.2 Duration of Evaluation Study

This ex-post evaluation was carried out as follows.

Duration of the Study: August 2014 – November 2015

Duration of the Field Study: November 26 - December 11, 2014, and April 26 - May 9, 2015

2.3 Constraints during the Evaluation Study

For this project, a broad-area enterprise covering 12 county-class administrative units (hereinafter “counties”) in Sichuan, the External Evaluators found it impossible to visit all the counties for the field study and inspect the project sites there. Instead, they picked six of the 12 counties as samples that

they should visit for the field study.¹ Some of the data and analysis results are based on findings of the sample survey. When measuring the effectiveness of the project, some of the data for specific areas covered by the project, especially the forest coverage ratio and sediment loss hectares, were replaced with those for the entire county because of the unavailability of such data.

3. Results of the Evaluation (Overall Rating: A²)

3.1 Relevance (Rating: ③³)

3.1.1 Relevance to the Development Plan

1) Relevance to the Development Plan at the Time of the Appraisal

After the great flood of the Yangtze River that occurred in 1998, the Chinese government formulated and promulgated the National Plan for Ecological Construction in January 1999. Turning around from the government's conventional disregard for the eco-environment, the National Plan formed a nationwide framework for eco-environment protection over the next 50 years, covering four fields: forestry, water management, agriculture, and environmental protection. It set short-term, medium-term, and long-term numerical targets for environmental improvement, four areas the focus should be placed on going into 2010, and the priority challenges that needed to be addressed.

Table 1: Major Targets of the National Plan for Ecological Construction

Short-term targets (1998–2010)	<ul style="list-style-type: none"> • Preventing soil erosion (60 million ha) • Preventing desertification (22 million ha) • Increasing forest area (39 million ha) • Achieving a forest coverage ratio of 19 %
Medium-term targets (2011–2030)	<ul style="list-style-type: none"> • Preventing soil erosion (60 % of area where erosion is preventable) • Preventing desertification (40 million ha) • Increasing forest area (46 million ha) • Achieving a forest coverage ratio of 24 %
Long-term targets (2031–2050)	<ul style="list-style-type: none"> • Preventing soil erosion (entire area where erosion is preventable) • Completing afforestation over the entire area suitable for planting • Achieving a forest coverage ratio of 26 %

With regard to the Yangtze River, the National Plan stated that watershed protection forests should be secured along the middle and upper courses of the river by 2010. Specifically, its middle and upper basins, which include Sichuan Province, were designated as priority areas where precedence should be given to eco-environmental development. Accordingly, the 10th Five-Year Forest Plan (2001–2005)

¹ Samples were evenly selected from the counties the evaluators were able to visit during the evaluation study period in the province from each of the northern, southern, eastern and western parts. Some of the samples were picked out in areas affected by the Sichuan Great Earthquake.

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

³ ③: High, ②: Fair, ①: Low

referred to the protection of natural forests in the upper Yangtze basin and other areas, as well as the expansion of sediment loss prevention area by 25 million hectares among the targets that it set.

2) Relevance to the Development Plan at the Time of the Ex-post Evaluation

Among its medium-term targets, the “11th Five-Year Forest Plan” and the National Plan for Long- and Medium-Term Forestry Development, announced in 2006, stated that by 2020, a forest coverage ratio of 23 % or more should be reached, and that the western priority area should see a great improvement in its ecological conditions. The Enforcement Ordinance for the Forestry Act of China (2005) also positions carrying out protection forest projects on an ongoing basis to foster forest covers as a priority challenge. The 12th Five-Year Forest Plan (2011–2015), formulated under the medium and long-term vision, again refers to protection and restoration of forest covers, with recovery of the forest coverage ratio one of the aims of its development plan for the forestry sector. It emphasizes that in the “Three North Areas” (Northwest, North China, and Northeast areas), the Yangtze River basin, and the Pearl River basin, among others, protection forest projects should be continued to create greater forest vegetation, and that along the Three Rivers (Yangtze, Huang, and Lancang) forests and vegetation cover should be protected and restored to enhance their capacity to prevent soil erosion and preserve water sources. To materialize the concepts described above, the Sloping Land Conversion Program, one of the Six Major National Forestation Programs, has been underway since 2003. The greening program restores farmland developed in mountainous regions, on slopes with an incline of 25 degrees or more, to a forest or grassland, positioned in the Great Western Development Program, a national development project, as an important environmental conservation measure. During on-site consultation with the executing agency, it was confirmed that under the said national plan, eco-environmental protection projects, including this one, had been formulated and carried out, and it should be recognized that this project has been highly relevant to the development policy programs mentioned above.

3.1.2 Relevance to the Development Needs

1) Relevance to the Development Needs at the Time of the Appraisal

While Sichuan Province has a forest coverage ratio of around 20 %, higher than the national average, 18 %, it saw its forest stock volume declining because of poor forest management, with the functional versatility of forests being impaired. In addition, imprudent deforestation in the upper Yangtze River basin, which caused deteriorated soil erosion, ecological destruction, and sediment loss, helped cause the great floods along the middle and lower Yangtze in 1998, leaving extensive damage. Against such a background, the Sichuan government intended to expand afforestation, vegetation cover, and water-soil runoff prevention areas by 1.3, 1.15, and 4.5 million hectares, respectively, during the “10th Five-Year Forest Plan” period.

2) Relevance to the Development Needs at the time of the ex-post evaluation

The 10th Sichuan Five-Year Plan for Environmental Preservation (2005–2010), laying down the overall targets for the eco-environment, presented a program for protecting the Minjiang River, Tuo River, and Jialing River, all of which are tributaries of the Yangtze, as priority areas. The program has been inherited by the 12th Five-Year Plan (2011–2015), now underway, which again carries as one of its targets the restoration of forest resources as part of ecosystem protection, which demonstrates that it still maintains a position as one of the important development targets.

The needs for such initiatives became all the more evident after the Sichuan Great Earthquake, in 2008. The massive earthquake struck major habitats for pandas and other rare wild animals, as well as important water source areas in the upper Yangtze basin. After the earthquake, the Forestry Agency of Sichuan formulated the Plan for Recovery and Restoration of the Forestry Ecosystem after the Sichuan Great Earthquake. The Plan determines that over the entire area of damaged forests, vegetation must be ecologically restored in 300,000 hectares, among which 90,000 hectares should be left to recover naturally, while 180,000 hectares should be rehabilitated artificially, with the remaining 30,000 hectares restored through artificial sowing⁴.

As described above, improvement of the eco-environment in the western part of China through restoration of forest resources has turned out to be critical not only for the natural environment but in terms of disaster prevention and better living conditions. As a particularly important water source area, the upper Yangtze basin, which includes Sichuan, has growing needs for water resource development and management. In addition, on the way to recovery from the 2008 earthquake, greater effort is being expended to restore forest resources.

In light of the above, this project, which is highly consistent with the initiatives mentioned above, should be evaluated as relevant to their development needs.

3.1.3 Relevance to Japan's ODA Policy

At the time of the appraisal, major policies set out by Japan regarding its ODA for China were presented as the Economic Cooperation Program for China, laid down by the Ministry of Foreign Affairs in 2001, and the Guidelines for Economic Cooperation Service Overseas (1999–2002), set out by JICA.

Shifting from conventional infrastructure development for the coastal regions, the Economic Cooperation Program for China (2001) presented a policy of giving greater emphasis on preservation of the environment and ecosystem amid growing severity regarding pollution and destruction, improvement of public welfare and social development in the inland regions, human resource development, institution building, and technology transfer, among others, with these six issues set as priority areas: (1) cooperation for dealing with environment problems and other global-scale

⁴ Seeds are systematically sowed manually by people to achieve afforestation.

challenges; (2) support for reform and opening-up; (3) facilitation of mutual understanding; (4) support for overcoming poverty; (5) support for private-sector activities; and (6) promotion of bilateral cooperation. This program is relevant to Priority Area (1), where assistance should be given for measures to control water contamination and other pollution problems, and for the sustainable use of water resources. Under the Guidelines mentioned above, JICA has positioned “environmental preservation” and “human resource development” as two priority areas, with the western, northeastern, and central parts of China, as well as other inland areas, designated as priority regions. In the field of “environmental preservation,” the agency says that in inland rural areas particularly, where many low-income people live, they deal with problems related to the environment in a broad sense, which should also include the living environment, such as damage from floods resulting from soil erosion, damage done by wind-blown sand to farmland and worsening living conditions due to deterioration in the natural environment. This project turns out to be consistent with the Guidelines in many areas, such as the regions to be covered and priority areas. Thus the project is highly relevant to Japan’s ODA policy.

In light of the above, this project has been highly relevant to the country’s development plan and development needs, as well as Japan’s ODA policy. Therefore its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

This project includes programs for afforestation, vegetation cover, and construction of methane gas facilities for farmers as its main components. The sections below report the state of development by output.

(1) Afforestation

In line with the categories set out in the Forest Law of China, the afforestation program has developed protection forests, mountain closures, and economic forests. Below are the details showing the state of development by category, and the development results of any ancillary facilities.

Table 2: Outputs of This Project (Afforestation)

	Plan 2004	Actual 2014	Actual/Plan (%)
Afforestation (ha)	69,496	88,705	128 %
Protection forest	27,981	34,324	123 %
Mountain closure	30,480	41,863	137 %
Economic forest	10,900	12,378	114 %
Seedbed	135	140	104 %
Other civil engineering facilities	62,188	48,317	78 %
Reservoir (units)	11,398	8,332	78 %
U-shaped gutter (units)	4,780	2,933	61 %
Silt basin (units)	46,010	37,052	81 %

Source: (Plan) Data provided by JICA; (Actual) Data provided by JICA and responses of the executing agency to the questionnaire

The afforestation area exceeded the initial plan, while fewer civil engineering facilities have been completed than were planned. Viewed by county, all the districts have achieved the target figures set in the plan, except Tongchuan District, where protection forests have failed by a small margin to reach the level of hectares stated in the plan.

Dujiangyan City, Pingwu County, Shifang City, Zitong County, Yuanba District, and some other counties were severely hit by the Sichuan Great Earthquake. Protection forests, mountain closures, and economic forests which were developed there as part of this program were also damaged. In view of changes in the geographical features and restoration after the earthquake, the afforestation plan was reviewed in terms of afforestation hectares, and it was decided that trees should be planted over a larger area. As a result, more hectares have been afforested than the original target. Throughout the process, supplemental planting has also been carried out.

During the project period, material prices and labor costs rose by about 15 % from the time that the plan was formed, and in some buildings that had been completed were damaged by the earthquake and had to be restored. As a result, a smaller number of reservoirs, U-shaped gutters, silt basins, and other small-scale water management facilities have been constructed than were planned, with some adjustments made in their design, so that the overall functionality could be maintained.



Photo 2: Before Afforestation (Project Area in Xichong County)



Photo 3: After Afforestation (Project Area in Xichong County)



Photo 4: Reservoir in Changning County



Photo 5: Seed nursery in Changning County

(2) Vegetation cover

For this project, vegetation cover includes two types of plants: protection grass and economic grass.

Table 3: Outputs of This Project (Vegetation Cover)

	Plan (2004)	Actual (2014)	Actual/Plan (%)
Vegetation cover (ha)	22,510	18,792	83 %
Protection grass (ha)	15,048	12,795	85 %
Economic grass (ha)	7,461	5,997	80 %

Source: Data provided by the executing agency

Vegetation cover has only reached a little more than 80 % of the plan. The executing agency says that this was a result of adjustments made to modify the original plan after the earthquake by adding afforestation areas and building more methane gas facilities.

(3) Development of methane gas facilities

Two types of methane gas facilities have been developed: those for single-family farmhouses and multiple-family facilities for settlements. The results are shown in the table below.

Table 4: Outputs of This Project (Methane Gas Facilities)

	Plan	Actual (2014)	Actual/Plan (%)
Single-family	24,880	33,187	133 %
Settlement	15	15	100 %

Source: Data provided by the executing agency

After the original plan was modified after the earthquake, surpluses of funds for equipment and materials procurement, and training were appropriated to the methane gas facilities, and a much greater number of facilities have been constructed. Behind the increase lies the fact that these facilities have been adopted as part of the aid provided for people suffering from the disaster to provide them with greater benefits in their living conditions. As seen in Dujiangyan City, where an additional 1,500 houses were equipped with methane gas facilities, some of the counties that were not targeted by the original plan also saw methane gas facilities installed there.

(4) Training and technical guidance

In addition, a total of sixty people came to Japan to participate in training over five sessions. Originally, training seminars were to be held both in Japan and China, but it was decided that seminars should be given only in Japan, with a larger number of participants. This was because after the Sichuan Great Earthquake in 2008, a special training course on earthquake-related issues was set up.

3.2.2 Project Inputs

3.2.2.1 Project Cost

At the time of the appraisal, the project cost was estimated at 10,615 million yen, of which foreign and local procurement was expected to amount to 6,503 million yen and 309 million yuan, respectively. The actual cost of the project was 12,138 million yen, of which foreign and local procurement amounted to 6,401 million yen and 392 million yuan, respectively, larger than planned, at 114 % of the plan.

Table 5: Comparison of Planned and Actual Project Cost

(Unit: million yen)

Item	Plan		Actual		Actual/Plan
	Total	ODA loan	Total	ODA loan	
Afforestation	5,949	4,173	8,414	4,560	141 %
Vegetation cover	1,203	840	1,145	570	95 %
Methane gas facilities	1,336	976	2,112	1,180	158 %
Equipment and materials	443	443	132	71	30 %
Others (incl. training)	742	6	336	20	45 %
Reserves	942	65			
Total	10,615	6,503	12,138	6,401	114 %

Source: (Plan) Data provided by JICA; (Results) Data provided by the executing agency;

*1: (Exchange rate at time of planning) RMB = ¥13.3

*2: (Exchange rate) RMB = ¥14.63 (Average from 2005 to 2013; this rate was used by the provincial Project Management Office for conversion.)

The project cost increased because of the factors listed below, the same as mentioned above in the section of project outputs.

- (1) Adjustment for changes in the scope (increased afforestation and methane gas facilities, and decreased vegetation cover)
- (2) Restoration after damage by the Sichuan Great Earthquake in 2008 (damaged afforestation, vegetation cover, methane and water management facilities, etc.)
- (3) Changes in the exchange rate, and increased material and labor expenses (Increases were seen especially in the unit cost for development of infrastructure that required civil engineering work, such as reservoirs.)
- (4) Afforestation, carried out mainly with labor provided in kind by farmers, saw little increase in development cost per hectare, although expenses increased in proportion to the extended afforestation area.

Increases in the project cost are attributable in part to increased outputs, especially in afforestation and methane gas facilities. However, taking into account the narrowed scope of vegetation cover and decreased water management facilities (60 to 80 % of the plan), partial incompleteness of training, canceling procurement of equipment (about 380 million yen), and higher material expenses⁵, it is fair to say that the actual cost was higher than planned.

3.2.2.2 Project Period

At the time of the appraisal, the project period was planned to be 66 months from July 2005 through December 2010. The project started in July 2005 and was completed in December 2010 (duration of 66 months), exactly as planned.

Table 6: Project Period: Plan and Result

Outputs	Plan	Result*	Result/ Plan
1. Afforestation	July 2005 - December 2010 (66 months)	As planned	100 %
2. Vegetation cover	August 2005 - December 2007 (29 months)	August 2005 - December 2010 (65 months)	224 %
3. Methane	October 2005 - December 2009 (51 months)	October 2005 - December 2010 (63 months)	124 %

Source: (Plan) Provided by JICA; (Actual) Data provided by the executing agency

*: Project completion is defined as the time of construction and/or development for all the sub-projects having been finished, with final inspections performed.

Viewed by output, completion was delayed for vegetation coverage and methane gas facilities. Below are the major factors that had significant impact on the progress.

⁵ For instance, afforestation expanded to 128 % of the plan on an output basis, with an increase to 141 % on a project cost basis, more than 10 percentage points higher.

- (1) Suspension of construction work after the earthquake, and readjustment of the project plan. Despite differences in severity of damage from the earthquake, Dujiangyan City, Pingwu County, Shifang City, Zitong County, Yuanba District, and some other counties particularly suffered many infrastructure damages such as reservoirs, U-shaped gutter, etc.
- (2) A major delay in vegetation cover was caused by a longer lead time before grass seeds had been delivered, and planting depending on seasonal factors, which hindered vegetation cover work from going on as planned.

However, because these outputs were originally planned to be completed in a shorter period than afforestation, the entire project, including afforestation, was finished as planned.

As seen above, the project period was as planned.

3.2.3 Results of Calculations of Internal Rates of Return (Reference Only)

At the time of the appraisal, only the economic internal rate of return (EIRR) was calculated, which turned out to be 12 %. At the time of the ex-post evaluation, it was concluded that recalculating the rate would be difficult because of the following reasons.

- (1) It was not possible to identify the original calculation formula, based on which calculation should be performed.
- (2) Reliable data were unavailable as none of the local forestry agencies or other organizations had recorded accurate landslide and other sediment related disaster data, and estimations were difficult.
- (3) With project forests still in the process of growth, it was too early to say whether they were evidently effective to prevent disasters, and any recalculation at that point in time would have produced nothing more than provisional estimates, which are of no use for effective analysis.

In light of the above, although the project period was within the plan, the project cost exceeded the plan. Therefore, the efficiency of the project is fair.

3.3 Effectiveness⁶ (Rating:③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

This project includes programs for afforestation, vegetation cover, and construction of methane gas facilities for farmers as its main components. They were separately evaluated with regard to outputs they had produced. Below are the major viewpoints for evaluation.

- (1) Afforestation and vegetation cover: The External Evaluators examined how many hectares of forest were added, and as a result, how well the loss of soil was controlled. Among specific indicators to be examined were afforestation area, forest coverage ratio, survival rate of afforestation area, and loss of soil. However, at the time of the ex-post evaluation, it was likely to be too early to examine expansion of the forest area, decrease of soil erosion, and other effects. Accordingly, evaluation was performed at that point in time only to estimate how much effect

⁶ Sub-rating for Effectiveness is to be put with consideration of Impact.

might be produced in the future. The evaluation referred to data from the entire province or county, instead of those from the specific districts covered by the project, because of the unavailability of such data.

- (2) Methane gas facilities: The External Evaluators assessed how much firewood consumption was reduced, and with the introduction of the new facilities, what changed in the farmers' living environment.

(1) Operation and effect indicators

Below is a summary of the major indicators for this project.

Table 7: Major Indicators of the Afforestation Program

Indicator	Baseline 2003	Target 2010	Actual 2010	Actual 2011	Actual 2012	Actual 2013
	Baseline year	Completion year	Completion year	1 year after completion	2 years after completion	3 years after completion
Total afforestation area in 12 counties (10,000 ha)	78	88	92	93	94	95
Afforestation area under this project (10,000 ha)	-	-	-	-	-	8.9
Coverage ratio (%)	33.7	43.6	51	51	52	53
Stock volume (m ³ /ha)*1	73	81	78	78	82	83
Survival rate (%)	-	85	91	91	89	87
Reduced firewood consumption (ton)*2	-	12,211	14,454	14,454	14,454	14,454
Soil loss (ha)*3	821,287	-	690,403	595,007	525,557	459,171
Soil loss (ton/ha)*3	45.2	-	34.4	31.9	29.1	24.7

Source: Data provided by JICA, and questionnaire responses from the executing agency

*1 The results are an average of nine counties because of data deficiencies.

*2 For firewood consumption, one unit of methane gas facilities is supposed to supply annual 350 m³ of gas, which is converted to firewood consumption, using conversion factors for methane, firewood, and standard coal (methane: 0.714 kgce/m³; firewood: 0.57 kgce/kg), which then gives a unit of savings for calculation purposes, 438 kilograms.

*3 For soil loss, both in hectares and tons per hectare, data for the entire counties are adopted only for reference because of the unavailability of data solely for the districts covered by this project.

The project has produced the effects outlined below.

- 1) In the counties covered by this project as a whole, the afforestation area started growing before the start of the project, of which the area that came under this project accounts for almost 10 %.
- 2) The coverage ratio has increased above the target value of 43 % and reached 53 % (which includes effects produced irrespective of this project).
- 3) Regarding the survival rate, the counties vary in the level of completeness of data, leaving accurate averages between them unavailable. However, the current survival rate is maintained above 85 %.
- 4) With methane gas facilities coming into wide use, annual reduction of firewood consumption has gone above the initial target of 12,000 tons reaching 14,000 tons.
- 5) Soil loss in hectares, based on data for the entire counties, has declined by about 44 % since 2003, the time of the appraisal, showing an evident trend of improvement.

All the indicators for the afforestation program have reached, or almost reached, their expected level. The coverage ratio, soil loss in hectares, and some other indicators are based on province or county-level data, rather than any effects this project has produced by itself. They seem to be a reflection of multiple factors, including aid provided by the World Bank and the EU at the same time as this project. Carried out as part of these initiatives, this project should be evaluated as having made a contribution to higher coverage ratios. Behind the generally satisfactory state of growth lies the fact that Sichuan, compared to inland provinces, has favorable natural conditions, such as stable precipitation, that seems to produce these consequences.⁷

(2) State of project implementation by county

Below is a summary of the state in five sample counties visited for the field study.

⁷ As some districts selected a single type of tree for afforestation, such as Changning County, which picked bamboo, the field study examined what is generally called fragility of simple forest. The Forestry Bureau, stating that they had selected a certain type of tree for afforestation based on primeval forests and geographical features observed in an area where the program would be carried out, presented the view that there should be a little concern that afforestation using a single type of tree might cause any fragility. In addition, Sichuan is blessed with favorable conditions for afforestation. Therefore, there should be no significant problem.

Table 8: State of Afforestation Implementation by County

County	Overview of tree types adopted, state of growth, etc.
Weiyuan County	<ul style="list-style-type: none"> • Eucalyptus (cross-bred) is adopted as the main type of tree for afforestation. Forestation areas are managed by local large-scale farmers (operators), under lease from farmers who own the actual forest titles. Some operators manage about 5,000 <i>mu</i>.⁸ • The type of tree was recommended based on breeding tests performed by the Chinese Academy of Forestry, a governmental institute. Its survival rate is high at around 95 %, with a three-year preservation rate of 99 %. The stock volume for the county stands at 120 m³/ha. • Thinning is carried out every six years, at an appropriate point in time based on the state of growth. Eucalyptuses are thinned when they reach 15 centimeters in diameter at breast height, and/or 20 meters in height. • Maintenance is fully transferred to operators from the third year onwards, with the Forestry Bureau remaining in charge of technical assistance. Maintenance consists mainly of disease and pest control and fire prevention. The most common pest is termites. Insecticide has been sprayed to control them. • Thinning must be performed after filing an application with the Forestry Agency. An application must be submitted by the operator, together with a detailed work plan, which is then examined to consider whether to grant permission. However, an annual threshold of thinning is set for the entire county, and operators are restricted by this.
Zizhuang County	<ul style="list-style-type: none"> • The average survival rate is 90 % or more. • For mountain closures (state forests), Chinese red pines and oaks have been picked out for their suitability to climate conditions there. There is a forest manager who has been working full-time in the mountain for 36 years, with six other forest managers stationed for day-to-day work. • For protection forests, poplars have been selected for their quick growth and suitability to climate conditions there. As giant timber bamboos, planted on a trial basis, failed to survive the winter, Caluzajiao bamboos have been planted, and 250 kilograms per <i>mu</i> of edible bamboo sprouts have been harvested since 2011. The choice was made independently by the county. • Some large-scale operators were found to have taken advantage of the project to clear and operate farmland for Sichuan pepper.
Shifang City	<ul style="list-style-type: none"> • The average survival rate is 95 %. The survival rate is calculated based on samples picked out by the forestry bureau, who examines the survival rate of trees on-site. • Parts of privately-owned forests designated as protection forest are managed by farmers. Many of the trees planted there are cedars, species commonly found in primeval forests. They were procured from seedling farms developed with ODA loans provided by Japan, or other seedling sites nearby, with no burden imposed on farmers. Cedars can be used as timber. They must be grown for 15 years before being thinned. (Based on interviews with people of Bingchuanzhenxingong and Wuma villages, which the evaluators visited).
Pingwu County	<ul style="list-style-type: none"> • The average survival rate is 85 %. • Economic forests are developed, with Amur cork trees, Du zhong (hardy rubber tree), or other medicinal trees planted and raised there. 500 grams of fresh Amur cork trunks sell for four yuan, as does the same weight of dried trunks for four to five yuan, though the price has recently been falling. • For protection forests, Chinese red pines and cedars are grown, with water brought in by farmers at their own expense. Walnut and other trees are also grown there.
Changning County	<ul style="list-style-type: none"> • The average survival rate is 80 %. • Among the varieties of bamboo, timber bamboos, types that sell at rather high prices, are planted more broadly than others, and most of them are grown in wasteland or deserted mountains leased by large-scale farmers or landowners for large-scale afforestation which have reached 67 hectares. • However, prices of bamboo materials, which were low in the first place, fluctuate, between 200 and 300 yuan per ton, and many farmers position them merely as a supplementary source of income. The deputy governor of the county said they need to promote secondary processing of bamboo materials to add more value.

Source: Produced by the External Evaluators based on interviews with the forestry bureau and beneficiaries at the field survey.

⁸ The *mu* is a traditional unit of land area in China equivalent to 666.7 m² (approx. 200 *tsubo*)

The sampling survey has found trends listed below.

- 1) In all the counties, the survival rate stays at a satisfactory level, with no major problem observed in the forests' state of growth.
- 2) Protection forests are planted with different species of trees between counties. Some, such as Changning County, mainly adopt bamboos, while others for instance pick out poplars. Which species of tree should be planted is decided by the counties after consulting with farmers and operators who manage the forests. In many protection forests, trees raised there are also used for timber and other economic purposes.
- 3) Many of the residents managing the forests use forest resources, such as timber, as a supplementary source of income. In some cases, forests are managed and maintained by the title holders themselves, while in others, forests are leased to larger-scale farmers to share between them profits that they obtain from forest resources.
- 4) Economic forests of different species generate income from produce on different cycles, and some counties have yet to gain any income. Even species that grow faster, such as bamboo, have some challenges as they sell only at a lower unit price, leaving them less profitable. To make them more profitable, greater effort must be exerted to add more value.

In general, the counties that the evaluators visited have a higher survival rate, with a stable state of growth. The state of project implementation observed through the field study supports the improvements stated above in terms of forest area and coverage ratio at the level of the entire province.



Photo 6: Protection Forest in Changning County



Photo 7: Protection Forest in Weiyuan County

3.3.2 Quantitative Effects

(1) Effects of methane gas facilities

As part of the field study, the evaluators visited farmhouses equipped with methane gas facilities in each county to hold interviews. The findings are outlined below:

- 1) The facilities have been kept in use by farmers that the evaluators visited mainly for cooking appliances, such as rice cookers and stoves.

- 2) The facilities, quite simple as a system, have had few problems with their main components, requiring little more than roughly annual cleaning of their fermentation rooms to keep them functional.
- 3) The effects of these facilities on improving the farmers' living conditions include better sanitary conditions and reduced firewood consumption. At the household level, they are free from firewood smoke, with the indoor environment also improved, plus excrement from domestic animals is made available for reuse, producing sanitary effects (For more details, see "3.4 Impact.")
- 4) In addition, there are several cases of livestock breeders operating methane gas facilities for settlements engaged in recycling on a commercial basis (Dujiangyan City).



Photo 8: Methane-Fueled Stove



Photo 9: Methane Reservoir

Visiting the field study farmers who had methane gas facilities installed in their house, the evaluators confirmed that they kept the facilities in use, which demonstrated the effects they produced as part of the local residents' livelihood infrastructure. Reduction in firewood consumption should be evaluated as producing a great effect mainly in its contribution to the conservation of forest resources. The facilities are easy to maintain, and they rarely break down, which is one of the factors that enable farmers to keep using them.

(2) Contribution of training participants to project operation

Training seminars held as part of this project were attended by those related to the counties, whose experience is now reflected in the current project management. Below are two examples of testimonies obtained through the interviews.

- 1) "I learned new techniques that are not taught in China, such as how to use contours for planting trees on a slope." (Senior engineer, Zi Zhuang County)
- 2) "Thanks to this project, I had the opportunity to visit Hiroshima and learn about afforestation and the philosophy of resource management. Now I am working to help people relocate when constructing a dam, and sharing with local residents the ideals I learned in Japan about the effective use of resources." (Deputy Director of the Agriculture Department, Shifang City)

3.4 Impact

3.4.1 Intended Impacts

Below are the major impacts this project was intended to produce.

- (1) Conservation of ecosystems as a result of restoring forest resources
- (2) Increased cash income for participants from the sale of economic forest trees and grass
- (3) Reduced timber-felling after construction of methane gas facilities

- (1) Conservation of ecosystems as a result of restoration of forest resources

In terms of restoration of forest resources for conservation of ecosystems, no evident effect can be confirmed because it is only a short time since the project was finished and forests are still in the process of growth. However, as stated in the effectiveness section, stable survival rates of forests and growing afforestation areas and forest coverage ratios for the entire province indicate a great likelihood that forests will grow well, producing long-term effects including the improvement of ecosystems.

- (2) Increased cash income for participants from the sale of economic forest trees and grass

Effects were examined through a survey of beneficiaries conducted among people related to the project and local residents. Below is a summary of the findings.⁹

- 1) Satisfaction rate: Almost all the respondents expressed a certain level of satisfaction. Among them, 83% said that they were very satisfied. Behind the positive response lie increased opportunities of employment, and effective use of the forest that led to increased income, which many of them pointed out. Many of the forests have so far yet to produce any income, but the respondents seem to maintain great expectation for forestry as a source of income.
- 2) Income and expenditure: In terms of income from forestation programs, the survey failed to obtain sufficient responses as the thinning cycle had yet to be established in many counties. Based only on a limited number of samples, it turned out that at that point in time, an average income of about 40,000 RMB had been earned with an expenditure of about 54,000 RMB; thus the programs were still in deficit. Income is expected to increase in seven or eight years or later, when the thinning cycle should be established.

Mainly for lack of any established cycles of income generation at the moment, any increase in income, or other effect, has been observed only to a limited degree. However, many of the respondents maintain some expectation for profitability in the future, meaning that their satisfaction with afforestation programs is at present staying generally high. Among them, expectation for economic returns in the future seems to be a stabilizer for the current maintenance and management arrangements.

⁹ This survey of beneficiaries was conducted among local 112 residents in Yibin City, Da xi City, Dujiangyan City, and Mianyang City who took part in tree and grass planting programs. The self-employed, agricultural cooperatives, and enterprises, who accounted for nearly 40 %, nearly 40 %, and 20 %, respectively, planted trees and grass over 1,178 hectares. The survey period was in mid-February 2015.

(3) Reduced timber-felling after construction of methane gas facilities;

As stated in the section on effectiveness, methane gas facilities came with success in the reduction of firewood consumption. To confirm the data by examining the realities of how the farmers use the facilities, a questionnaire survey was conducted among users of 30 methane plants (almost all of whom were farmers) in Tongchuan District, Dujiangyan City, and Zitong County. Below is a summary of the findings.

- 1) For a conventional fuel source, around 70 % of the respondents mentioned firewood (average daily consumption of 17 kilograms);
- 2) Main use of methane gas facilities, and frequency of use: Facilities are mainly used for cooking (stove, etc.), with some employed for heating and lighting. Some 90 % of the respondents said they usually use methane appliances around three times every day, while the frequency falls to twice a day in winter because of lower fermentation efficiency;
- 3) Satisfaction rate: Great satisfaction was expressed by 87 % of the users of the installed facilities. Behind the high satisfaction rate lies an improvement in living conditions (shorter time needed to spend building a fire, no smoke that causes pain in the eyes and/or throat when using firewood, etc.) that they pointed out;
- 4) Economic effects: With the installation of methane gas facilities, they save the cost of firewood they would otherwise consume. Cost-savings amount to between 400 and 2,000 RMB, or an annual 1,245 RMB on average; and
- 5) Other effects: Together with installation of methane gas facilities, all the respondents except one are carrying out renovations of their toilets and/or other improvements of housing conditions.

The beneficiaries' survey demonstrates that many of the respondents view the installation of methane gas facilities together with positive effects, such as cost savings, and reduced smoke and/or other improvements in the housing environment. In general, the present methane gas facilities cause no significant trouble for maintenance, with no problems observed by users, which indicates, in addition to the conservation of forest resources by reducing firewood consumption, one of the primary purposes of the project, the installation of methane gas facilities has produced secondary effects in the form of an improved living environment for the beneficiaries. Some of the counties covered by this project were damaged by the 2008 Sichuan Great Earthquake, and this project should be evaluated as having made some contribution from the standpoint of livelihood support after the earthquake.

3.4.2 Other Impacts

(1) Impacts on the Natural Environment

At the time of the appraisal, this project was rated as Category B according to the environmental guidelines for ODA loan projects, and no major negative impact on the natural environment was assumed. The project was designed to plant native varieties of trees and grass over woodlands with a low density of vegetation and improve the environment there, with no specific negative impact

expected on the natural environment. Project outputs have been achieved almost as planned, and no problems have been observed.

(2) Land Acquisition and Resettlement

This project was carried out in forest areas whose use rights were held by the implementation bodies themselves, and no land acquisition or resettlement was needed. The project was completed with no resettlement or land acquisition, just as assumed in the plan.

(3) Other impacts

For this project, the need for monitoring during construction of methane gas facilities was pointed out to keep track of dust, noise, and other problems that may occur. When asked about these issues, the executing agency responded that the facilities had been installed behind farmhouses, and that reservoirs had been built with no large-scale construction work because of their structural simplicity, which helped avoid significant problems in terms of dust and noise during construction.

This project has largely achieved its objectives. Therefore the effectiveness and impact of the project are high.

3.5 Sustainability (Rating:③)

3.5.1 Institutional Aspects of Operation and Maintenance

(1) Operation and Maintenance Systems during Implementation of the Project

The major agencies that implemented this project were established for each of the administrative units in China as listed below.

1. Provincial level: Provincial Affairs Office of the Sichuan Province Development and Reform Commission
2. County level: County Affairs Office in each county
3. Township and town level: Township and Town Affairs Office of each township and town

The executing agency at each level consisted of members of the Development and Reform Commission, which was established for each administrative unit, as well as of the Finance Agency, the Agriculture Agency, the Forestry Agency, the Environmental Protection Bureau, and the Agricultural Energy Affairs Office. After the project was completed, plans called for groups of farmers who participated in the project to take main responsibility for its operation and maintenance, with the province's Forestry Agency and each county's Forestry Bureau to provide guidance and support as required.

At each agency, the specific duties of the project are undertaken by the following people.

1. Tree and grass planting: Farmers and personnel from state-owned forest farms are responsible for tree and grass planting under the guidance of the Forestry Agency and each county’s Forestry Bureau.
2. Civil engineering facilities such as water reservoirs: Farmers and personnel of state-owned forest farms are responsible for such facilities under guidance of the County, Township, and Town Affairs Offices.
3. Methane gas facilities: These facilities are constructed by methane gas facility companies under the direction of the Provincial, County, Township, and Town Affairs Offices as well as the Agricultural Energy Affairs Office. After they are completed, plans call for farmers to take responsibility for their maintenance, with the methane gas construction companies and the Agricultural Energy Affairs Office to perform duties such as periodic inspections.

(2) Operation and Maintenance Systems after the Completion of the Project

1. Operation and Maintenance Systems at Supervisory Agencies

The makeup of the executing agencies remained the same as initially planned. The project is currently in the maintenance phase and all county-level practical maintenance duties are supervised by the Agriculture and Forestry Bureau in each county. At the township and town levels, tree and grass planting is undertaken by the Forestry Bureau under the supervision of the county’s Forestry Bureau. The Agricultural Energy Affairs Office is responsible for methane gas facilities at the working level under the control of the Agriculture Bureau. The county’s Forestry Bureau, which is responsible for the core maintenance duties, is divided into technical and administrative personnel and installs forest guards at the village level. In many counties, the ratio of technical to administrative personnel is 3:1, and in some cases, local residents also serve as forest guards. The table below shows the situation of the counties visited during the field survey for sampling.

Table 9: Operation and Maintenance System per each County

County	Structure of the Forestry Bureau
Zizhuang County	The County’s Forestry Bureau has 43 personnel of which 16 are administrative officers and 27 are forestry engineers. The engineering staff includes 4 senior and 11 general engineers. The Bureau installs forest guards in 329 villages.
Pingwu County	The County’s Forestry Bureau has 120 personnel and installs 40 officers at 25 local bureau offices. It has 1,073 forest guards.
Shifang City	The City invests 25 million yuan (400-500 million yen) in forestry annually. The City’s Forestry Bureau has 180 personnel of which 20 work at the Bureau.

Source: Interviews conducted during the field survey.

The Agricultural Energy Affairs Office, which is responsible for methane gas facilities, installs two or three officers in each township and town. These officers include methane gas engineers who receive agricultural training and hold technical qualifications. These engineers provide services such as tank cleaning and gas stove repair.

The interviewees responded that the current personnel assignment did not cause particular labor shortages or hinder the performance of their duties. Nor were there any replies to questionnaires from any of the 12 counties that indicated personnel-related problems. Judging from these facts, the basic personnel assignment system can be evaluated as being maintained appropriately.



Photo 10: Consultations with Stakeholders of Changning County’s Forestry Bureau



Photo 11: Consultations between Officials of Xichong County’s Agricultural Energy Bureau and Farmers

2. Support System for Tree and Grass Planting Participants (Farmers)

The actual maintenance work of the project is classified into the categories described below according to how forests and equipment are owned. The following is a summary of the maintenance system and its operation.

Table 10: Maintenance Support System and Its Implementation

Category	Maintenance system and its actual operation
Economic forests	If forests such as economic forests are owned by farmers or business owners, the owners are responsible for maintaining the forests and actually operating them with the support of the Forestry Bureau. There are two cases of operation of economic forests: one in which large farmers or owners operates the forests and one in which individual farmers do so with the assistance of the township or town. The method to select the operator of economic forests is decided by each county according to local circumstances. For example, among the 12 counties, most of the economic forests in Bazhou District, Xichong County, and Shifang City use the latter (township and town) model.
Protection forests and mountain closure	The daily operation and maintenance of state-owned forests are outsourced to neighborhood farmers by offering them incentives ¹⁰ . Forest village committees consisting of farmers are responsible for patrolling, inspecting, maintaining, and otherwise taking care of some of the state-owned forests, thus preventing them from being damaged by rabbits, rats, and other animals. Farmers thin out these forests as required, prohibit grazing, and prevent forest fires.
Irrigation facilities such as rainwater reservoirs	Farmers are responsible for irrigation facilities under guidance of the County, Township, and Town Affairs Offices. Normal operation of small water-use facilities is ensured by conducting both daily maintenance and inspections, and periodic intensive maintenance and inspections under the overall maintenance system. Farmers and related organizations participate in these maintenance and inspections.
Methane gas facilities	Officials from the Agricultural Energy Affairs Office, which is set up in each county, township, and town, visit the target farmers periodically as planned to provide supervision and guidance. For daily use, farmers can handle these facilities by themselves, and the burden of maintenance on users is relatively small. Officials from the Agricultural Energy Affairs Office maintain and inspect these facilities and provide technical guidance quarterly, and in addition, they clean the tanks about once every year.

Source: Replies to questionnaires for executing agencies and interviews conducted during the field survey.

¹⁰ In Xichong County, residents of the neighborhood undertake management of these forests and receive payment of 145 yuan per *mu* in annual management fees. Their main duties include periodic patrols (several times per month) and prevention of forest fires.

The results of sampling indicated that the supervisory and support agencies continued to monitor the beneficiaries and participants, suggesting that they had obtained a detailed understanding of the conditions in each area and the progress of project implementation. As described above, the Forestry Bureau replied that it had a sufficient personnel structure, and the results confirmed the situation that supported that reply.

3.5.2 Technical Aspects of Operation and Maintenance

1) Specialization of operation and maintenance

1. Executing agency at the county level

The Forestry Bureau in each county has a track record of similar tree-planting projects. It also has technical staff members and annual training programs. In particular, senior engineers with an academic background as a forestry expert and other qualifications are assigned to the Bureau, then mainly through participation in training in Japan as mentioned above, they have enhanced their ability as supervisors.

The interviews conducted during the field survey confirmed that the principal personnel of the Forestry Bureau had a clear understanding of the basic rules for management and supervision based on the Forest Law, personnel assignment, management plans and so forth, and that periodic cooperation and other systems together with the forestry bureaus of the townships and towns had been established.

The Forestry Bureau has established rules to confirm basic items such as the cycles of timber thinning and confirmation of blight. These rules are shared by all counties and considered as appropriate.

2. Tree and grass planting participants (farmers)

At each stage, the Forestry Agency, the Forestry Bureau, forestry bureaus at the township and town levels, and other agencies were supposed to provide technical guidance and training for tree and grass planting to farmers who implemented the project.

With respect to the methane gas facilities, the provincial and the county Agricultural Energy Affairs Office was supposed to provide guidance to project participants. The field survey confirmed that as planned during the project, farmers who carried out the project and contract farmers who were responsible for maintenance performed their duties while keeping close contact with those persons in charge at the Forestry Bureau. Interviews on basic management points and questionnaires to confirm communication and other systems at the sample counties visited during the field survey showed almost all the same replies concerning the duties performed and the systems used, suggesting that monitoring by the Forestry Bureau was working well.

Some of the analyses mentioned above are based on a limited number of samples, but there was no grave concern about the technical abilities of the Forestry Bureau. In particular, firm supervisory and communication systems have been established between those persons concerned with the project and

its beneficiaries at the township and town levels. They have the ability to perform their duties according to the established chain of command and can be evaluated favorably. The current management and supervisory systems have been established in accordance with the Forest Law, and at the moment, there is no plan for any major changes to forest and forestry management policy. Therefore, in technical terms, the current management capabilities will be maintained without problems for the time being.

3.5.3 Financial Aspects of Operation and Maintenance

(1) Executing Agencies (Executing Agencies of the Provincial Government and Each County)

The actual Forestry Agency budgets from each provincial government and each county as well as their breakdowns were not disclosed. As an alternative, summarized below are the fiscal expenditures in the agriculture and fisheries sectors at the city level, including the target counties.

Table 11: Changes in Fiscal Expenditure in the Sectors of Agriculture and Fisheries in the Cities to Which the 12 Target Counties Belong
(Units: 10,000 yuan)

City	2011	2012	2013	2014
Chengdu City (Dujiangyan City)	372,615	567,110	536,991	759,105
Zigong City (Da an District)	88,258	132,579	165,402	181,130
Luzhou City (Jiangyang District)	159,429	252,943	310,751	367,877
Deyang City (Shifang City)	114,886	145,448	177,028	258,954
Mianyang City (Zitong County, Pingwu County)	150,064	215,945	316,939	388,423
Guangyuan City (Yuanba District)	141,453	204,422	218,981	280,726
Neijiang City (Weiyu County)	115,397	159,668	186,913	227,637
Nanchong City (Xichong County)	207,158	307,933	400,781	464,005
Yibin City (Changning County)	167,597	225,301	293,707	357,472
Dazhou City (Tonghuan District)	212,158	272,493	347,825	375,442
Bazhong City (Bazhou District)	138,053	187,920	256,371	249,104

Source: Statistical Yearbook of Sichuan (2011–2014)

During the past four years, the fiscal expenditures of the 12 cities have grown by about 28 % on average, indicating that the cities have made fiscal outlays in a stable manner during that period. A reply from the Sichuan provincial government showed that it had obtained an annual budget of about 80 million yuan (1.6 billion yen) for the entire project, but specific changes in the annual amount of

budget were not revealed. A sample survey of the annual budget of each county confirmed that the allotment of budgets did not have any particular adverse effects on the operation of the project.

Fiscal expenditures could not be examined closely because detailed fiscal data was not obtainable, but replies confirmed the following: the Sichuan provincial government viewed recovery of forest resources as one of its priorities (see 3.1.2 “Relevance to the Development Needs”); fiscal expenditures for agriculture and forestry at the provincial and municipal levels had grown in a stable manner as the primary industries originally accounted for a large percentage of the province’s total; and the provincial government had appropriated a budget for the project and interviews with officials from the county’s Forestry Bureau during the field survey indicated that the Bureau had made the outlays required for project maintenance. Therefore, there seems to be no grave concern about the financial condition of the project.

(2) Tree and Grass Planting Participants (Support System Mainly for Farmers)

1) Financial Management System at the Time of the Appraisal

1. Because no profit other than that from timber thinning was expected from protection forests and grass, an agreement had been made for the County-level Affairs Office to provide participants with the necessary materials and equipment such as saplings and to pay them their wages.
2. Because sufficient profits were expected from products of economic forests and grass, participants were supposed to borrow money from the province or the county Finance Bureau and work unpaid for economic forests and grass.
3. Plans called for participants to pay expenses for methane gas facilities based on their income.

2) Financial Management System at the Time of the Ex-Post Evaluation

1. As planned, when the project was carried out, wages were paid to farmers who participated in planting trees for protection forests and mountains which were closed to facilitate forestation. Subsequent daily maintenance was outsourced to neighborhood residents making the most of the subsidies mentioned above and other funds. Almost all the residents who undertook such maintenance work were also engaged in agriculture, and these wages were strictly a subsidiary source of income. During interviews with farmers responsible for maintenance, they replied that they currently did not have any major dissatisfaction with maintenance duties because their frequency was low.
2. For economic forests, maintenance work was performed as planned by participants who borrowed money based on the assumption that they would earn income from products. The results of the survey of beneficiaries (112 samples), as mentioned in 3.4 “Impact,” indicated that they had repaid the loans as follows:
 - About 54 % of those surveyed had repaid the loans punctually, and 9 % continued to repay though they were delayed. 16 % temporarily stopped repayments, and 21 % failed to repay the loans.

Because the loan system is structured so that if beneficiaries fail to repay, the county involved settles the debt on their behalf, there is no direct problem.

- Many of the reasons for delayed repayment were attributed to the fact that the felling of trees and their subsequent economic use have not yet begun. Opinions expressed by some of the beneficiaries indicated that profitability of the products was low.

Information obtained during the field survey supported the opinions of beneficiaries as described below. The profitability of products currently varies depending on the growth of forests and the scale of their operation. One major type of production is the cycle of selling bamboo materials that has already been established in areas like Changning County where the main species is fast-growing bamboos. In these areas, a management and maintenance system based on economic return has taken root to a certain extent. Like those areas in Zizhuang County where Sichuan pepper is grown, forests that are completely industrialized by businesses are operated as a stable and profitable enterprise. By contrast, a cycle of profitable operations has not yet been established in those areas where, as with *Cryptomeria fortune* in Shifang City, trees have a long harvesting cycle (15 years). If the beneficiaries responsible for maintenance are enterprises with a certain size of business or larger, there are cases where they can continue maintenance work over a long period of time until they generate profits, but in the case of forests whose maintenance is mainly undertaken by smaller farmers, the challenge is whether they can maintain their business financially during this period. As described above, these small farmers' main source of income is agriculture and working far away from home, and so forest maintenance currently depends on these incomes. The majority of farmers visited or interviewed did not cite any major problems with the stability of these incomes. They still hope they will be able to collect returns from the forests in the future and are highly likely to continue to maintain the forests in a stable manner unless any major problems with these incomes arise.

As described in 3.4 "Impact," the financial profitability of economic forests was not confirmed in many counties because the collection of returns such as timber thinning had not yet begun. Thus it is currently difficult to make a firm projection for the financial sustainability of forest maintenance at the beneficiary level. However, based on responses from beneficiaries who have already earned income, and information on profitable businesses from forest products in various other counties, it is highly likely that the beneficiaries will earn income in the medium and long term if the forests grow steadily as they do now. In the future, it will become important how the incentives for participants should be maintained until a profitability cycle is established. The following is a summary of income forecasts that have been made based on a survey in a sample county.

Reference: Forestry income forecasts for Xinchangxiangzhen, Weiyuan County

In Xinchangxiangzhen, Weiyuan County, eucalyptuses have been planted, and income from timber thinning is expected in the future. Forecasts of income and expenditure calculated based on information confirmed during the field survey and their assumptions are described below. In Xinchangxiangzhen, forest operation is outsourced to business operators.

- The planting of eucalyptuses began in 2007 and was completed in 2009. The afforestation covers an area of about 60,000 *mu* across the entire protection forests.
- The main species planted is eucalyptuses. The forest is operated by local large farmers (business operators) who lease forest land from the farmers who own it. Some business operators manage around 5,000 *mu* of forest land.
- The trees are thinned out in a cycle of every six years, and the timing for thinning out is determined by checking the growth of the trees. In the case of eucalyptuses, the guideline is to thin them out when the diameter of their trunk becomes 15 cm and their height becomes 20 m.
- Initial investments total 1,000 yuan per *mu* of which 200 yuan is covered by an ODA loan project. The ODA loan was used mainly for materials and equipment, saplings, and fertilizers.
- The trees generate an income of 600 yuan per ton with an average of 12-15 tons of timber per *mu* expected from forest thinning.
- Forest thinning requires applications to the Forestry Agency. At the time of application, business operators submit detailed work plans, and examinations are conducted based on these plans. However, the amount of timber that can be thinned out is restricted by the annual upper limit set for each county. Actual forest thinning and timber transport require permission.

Under the conditions described above, net income from 20 years of forestry will be 12,600 yuan per *mu*. In Xinchangxiangzhen, plans call for land owners to receive 30 % of the net income, and forest owners (beneficiaries) are expected to earn a net income of 3,780 yuan per *mu*.

3.5.4 Current Status of Operation and Maintenance

(1) Condition of Afforestation

As mentioned in the effectiveness section, the average forest survival rate for the 12 counties has been maintained at 80 % or more in the past, indicating that the forests are basically kept in a favorable condition. In the six counties visited during the field survey, there has so far been no extensive damage such as forest fires or disease or insect pests. In terms of maintenance, the problems confirmed during the field survey are as follows:

- At some sites, the forests and infrastructure, particularly water reservoirs and U-shaped ditches, had been left damaged since they were hit by the earthquake (Xichong County).
- There were sites where the vegetation was not appropriately managed for access roads to water reservoirs (Xichong and Weiyuan Counties).

In both cases above, however, the problems had no adverse effects on the functions of the planted trees. Thus the overall maintenance condition can be evaluated as favorable.



Photo 12: Inspection by Forestry Bureau Stakeholders



Photo 13: Confirmation of Tree Growth

Sichuan Province is intrinsically blessed with favorable natural conditions such as the climate and is suitable for the growth of forests. As described above, the province also has stable operation and maintenance organizations and technology. In fact, the growth of planted trees is stable. If these and other factors are taken into consideration, the province's forests can be evaluated as being highly likely to grow in a stable manner in the years to come.

(2) Methane gas facilities

The survey results are limited because they are based only on information obtained from the sites visited during the field survey and those obtained from the sampling of beneficiaries (30 cases). However, most of the methane gas facilities have so far been used without any problems. Methane gas facilities do not require precision machinery, and simple, easy-to-maintain equipment was selected on the assumption that it was to be used in agricultural villages, and this was also probably effective in ensuring the smooth operation of such facilities.

As described above, there is no problem with the system, technology, and project maintenance finances, and the effects brought by the project are highly sustainable.

4. Conclusion, Recommendations, and Lessons Learned

4.1 Conclusion

This project was carried out in 12 counties in Sichuan to provide afforestation and vegetation cover, and the construction of methane gas facilities that are intended to supply fuel as a substitute for firewood in order to increase the forest area, decrease soil erosion, and ultimately achieve an improvement of the eco-environment in areas covered by this project.

This project has been highly relevant because, at the times of both the appraisal and the ex-post evaluation, it has been consistent with China's development policy and needs at the state, provincial, and municipality levels, as well as Japan's ODA policy for China. Since the completion of the project, forest growth has been in good condition, with increases in forest area and coverage, and consequent

decreases in sediment discharge, as well as other positive effects produced in counties covered by this project. The construction of methane gas facilities has also produced results showing a reduction of firewood use, with some secondary effects of improved living conditions for farmers. The facilities have also been conducive as part of reconstruction work after the major earthquake in 2008. With regard to effectiveness and impact, this project can be evaluated as having almost achieved, or being highly likely to achieve, its criteria. Its efficiency has turned out to be fair, as although the project period was within the plan, the project cost exceeded the plan. Sustainability of the effects this project has produced is high, with no major problems found in its maintenance arrangements, or its technical and financial affairs.

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

4.2 Recommendations

4.2.1 Recommendations to the executing agencies

None

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

(1) Sustainable forest management by stable institutional arrangement

In general, it takes five to ten years before the cycle of afforestation to timber felling begins and income starts to be generated. For this reason, to ensure sustainable operation of economic forests, it is important to establish an operation system supported by an appropriate financial foundation, and it is particularly difficult to take advantage of economies of scale when managing forests on an individual basis. As observed in some of the project counties, it would be effective to outsource the management of forests with a long cycle of timber felling to organizations such as agricultural cooperatives so that they can be maintained making the best use of a stable financial foundation.

(2) Increasing added value through the enhancement of entire value chain

Depending on factors such as species of tree and the cycle of timber felling, sufficient economic benefits may not be obtained from afforestation if beneficiaries handle timber with a low unit price and other primary products alone. When considering a system to implement afforestation projects on the assumption that participants will operate forests independently based on the income earned from there, it will be more effective for the county’s Forestry Bureau to position forestry development as part of the local industrial development strategy, such as increasing added value through enhanced secondary processing, not just in its sales of timber, but keeping the entire value chain¹¹ in mind.

¹¹ A value chain refers to a system that increases value added during each stage of a project or industry such as procurement, production, logistics, and sales as well as activities incidental to it.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Output		
Afforestation	69,496 ha	88,705 ha
Protection forest	27,981 ha	34,324 ha
Mountain closure	30,480 ha	41,863 ha
Economic forest	10,900 ha	12,378 ha
Seedbed	135 ha	140 ha
Civil engineering facilities		
Reservoir (units)	11,398	8,332
U-shaped gutter(units)	4,780	2,933
Silt basin(units)	46,010	37,052
Vegetation cover (ha)	22,510 ha	18,792 ha
Protection grass (ha)	15,048 ha	12,795 ha
Economic grass (ha)	7,461 ha	5,997 ha
Methane Gas Facilities		
Single-family	24,880	33,187
Settlement	15	as planned
2. Project Period	July 2005~December 2010 (66 months)	as planned
3. Project Cost		
Foreign currency	6,503 million yen	6,401 million yen
Domestic currency	4,112 million yen (309 million yuan)	5,737 million yen (392 million yuan)
Total	10,615 million yen	12,138 million yen
Japanese ODA loan portion	6,503 million yen 1 yuan = 13.3 yen	6,401 million yen 1 yuan = 14.63 yen
Exchange rate	September 2004	Average rate from 2005~2010

End

People’s Republic of China

Ex-Post Evaluation of Japanese ODA Loan Project
“Water Supply and Quality Environment Project in Changsha City”

External Evaluator: Hiromi Suzuki S., IC Net Limited



0. Summary

The purpose of this project is to address water contamination problems in the Xiangjiang River and to improve the living environment of citizens by constructing water and sewage facilities in Changsha City, Hunan Province.

The project is highly relevant, because at the time of the appraisal and the ex-post evaluation, it meets the development policies and needs indicated by the governments of China, Hunan Province, and Changsha City as well as the Japanese aid policies. Concerning the operation and effect indicators of the resulting waterworks, the goal achievement ratio is about half the plan. However, the effect is sufficient in consideration of the project role in the citywide water supply system confirmed during the ex-post evaluation. In the resultant sewage works, all the indicators have reached their goals defined at the time of the appraisal—both the effectiveness and impact of the project are recognized as high because of the improvement of contaminated rivers including the Xiangjiang River, which run through the City, and of the living environment of residents. Both the project cost and the project period exceed the planned ones significantly, resulting in low efficiency. The systems, technologies, and financial condition of operation and maintenance are good, so the effect resulting from the project is highly sustainable.

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

1. Project Description

 <p>Project Location</p>	 <p>Photo 1: Pipeline from Zhushuqiao Dam Reservoir</p>
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1.1 Background¹

Changsha City, the capital of Hunan Province, is located in central China. It has about 1.96 million people in the urban area as of 2003, and has grown rapidly as the center of the provincial politics, economy, and finance. However, compared with the development of the economy and population, the construction of water and sewage facilities is lagging—the water supply and sewerage treatment coverage ratios are 70% and 37%, respectively. The City receives 100% of its water from the Xiangjiang River, while domestic and industrial wastewater flows in the large river. In about five successive years from the 1990s, the Xiangjiang River, the City's only water source, encountered an extreme drought for about three months in winter, so it was very difficult to supply high-quality drinking water to the citizens. In the meantime, raw domestic and industrial wastewater discharged into the city rivers, branches of the Xiangjiang River, contaminated the main river seriously and degraded the living environment of citizens as the flow rate decreased, which also caused water pollution in Dongting Lake and the Yangtze in the downstream part.

1.2 Project Outline

The objective of this project is to improve Changsha City's ability to supply drinking water and to treat wastewater by constructing water intake and conveyance facilities, water purification plants, and sewage works, thereby contributing to the improvement of the water quality of the Xiangjiang River and the sanitation condition of the City.



¹ This is based on documents created at the time of the appraisal and provided by the executing agency.

Loan Approved Amount/ Disbursed Amount	19,964 million yen / 19,803 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 29, 2005 / March 30, 2005
Terms and Conditions	Interest rate: 1.5% for waterworks; 0.75% for sewage works and training Repayment period (grace period): 30 years (10) for waterworks; 40 years (10) for sewage works and training Conditions for procurement: General untied
Borrower/ Executing Agency(ies)	Government of the People's Republic of China / Government of Changsha City
Final Disbursement Date	July 26, 2012
Main Contractors	Hubei International Trade Investment & Development Co. Ltd. (China) and China Textile Industrial Corporation for Foreign Economic and Technical Cooperation (China) / Hunan Technical Import & Export Corporation (China) (JV)
Contract with Consultant(s)	None
Feasibility Studies, etc.	F/S: North China Municipal Engineering Design & Research Institute (conducted the study in March 2003)
Related Projects	Japanese ODA loan: Changsha City Waterworks Construction Project (L/A signed in March 2001) World Bank: Hunan Urban Development Project (from September 2004 to October 2012)

2. Outline of the Evaluation Study

2.1 External Evaluator

Hiroimi Suzuki S., IC Net Limited

2.2 Duration of the Evaluation Study

The following shows the studies conducted during ex-post evaluation.

Duration of the study: August 2014–November 2015

Duration of the field study: November 18–26, 2014 and March 30–April 5, 2015

2.3 Constraints during the Evaluation Study

The impact of this project is to improve the water environment quality of the Xiangjiang River and the sanitation condition of Changsha City. The former goal was expected to be attained by (1) reducing the amount of water taken from the Xiangjiang River and (2) promoting the treatment of wastewater discharged directly or indirectly into the Xiangjiang River. The intake reduction shown in (1) decreases the contaminant concentration but does not result in the fundamental improvement of water quality. Moreover, the extent to which the intake should be reduced to realize the impact was not shown clearly at the time of the appraisal. Accordingly, it seems that there was a limit in setting the intake reduction amount as

a way to improve the water quality of the Xiangjiang River. In the wastewater treatment indicated in (2), the main cause of contaminating the Xiangjiang River having more than 2,000 branches is the discharge of raw wastewater from industrial companies (heavy metal industry) in the upstream part. That is to say, the industrial wastewater degrades the water quality of the downstream part of the Xiangjiang River, and external factors have a significant effect on the evaluation of the extent to which wastewater treatment plants constructed in the project contribute to the improvement of the Xiangjiang River's water quality. The effect of the wastewater treatment plant and data on the water quality of the Xiangjiang River were used to evaluate the impact of the project during ex-post evaluation, but the constraints above made precise measurement difficult.

3. Results of the Evaluation (Overall Rating: B²)

3.1 Relevance (Rating: ③³)

3.1.1 Relevance to the Development Plan

At the time of the appraisal, the “10th Five-Year Plan (2001–2005)” based on the Chinese development policy aimed to build waterworks and sewage works to improve the efficiency of water source development in all the cities and use as well as to promote measures against contaminated water sources. As a concrete action for achieving both goals, the “10th Five-Year National Environmental Protection Plan (2001–2005)” was drawn up. The key objectives of the plan were to keep water sources in middle- to large-scale cities suffering from serious water shortage and to construct water supply infrastructures in local cities. In addition, to improve the quality of contaminated water, the plan aimed to reduce the total emission of key contaminants, to strengthen sewage works projects, and to promote the introduction of market mechanisms, such as building up a system for collecting contamination costs, modifying the sewage charge, and putting private investments into the environment industry. To keep water sources in the cities, the Chinese government issued a notice⁴ in 2000 in order to let them have multiple water sources, rather than a single one, and to optimize the distribution of water sources. In response, Changsha City drew up the “Changsha City Mid-to-Long-Term Development Plan (2002–2020)” as a mid- to long-term policy to develop the Liuyang Zhushuqiao Dam meeting Type II⁵ of the national water

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

³ ③: High, ②: Fair, ①: Low

⁴ The national government issued the document initiated by the State Council as Notice No. 36 on November 7, 2000.

⁵ Environmental Quality Standards for Surface Water issued by the National General Bureau of Environmental Protection on April 28, 2002: Type I: Water source and national wildlife sanctuary; Type II: Class 1 sanctuary having centralized surface water source for drinking, rare aquatic life zone, fish/shellfish spawning ground, and fry feeding ground; Type III: Class 2 sanctuary having centralized surface water source for drinking, fish/shellfish wintering area, migration route, fisheries waters (e.g. fish farm), and bathing area; Type IV: General industrial waters and entertaining waters without direct contact with humans; Type V: Irrigation and landscape waters

standards as the second source for drinking water. The dam would reduce the amount of water taken from the Xiangjiang River, resulting in a reduction in contaminant concentration and making the water quality at least Type III, which is suitable for drinking water. Moreover, the City aimed at a water supply ratio of 100% by enlarging the existing water purification plants and constructing new plants to increase the water supply scale of the six plants in total. Concerning the sewage works, this project aimed to construct two new wastewater treatment plants to attain a sewerage treatment coverage ratio of 80% by 2015. Another purpose was to improve the City's water environment, particularly the water quality of the Xiangjiang River into which wastewater and treated water flowed, by constructing a sewer network.

At the time of the ex-post evaluation, the Chinese government drew up two kinds of plans: one was the "12th Five-Year National Environmental Protection Plan (2011–2015)" and the other was the "12th Five-Year Overall Action Plan for Energy Saving and Emission Reduction (2011–2015)." The purpose of the former was to strive to improve the water quality by 2015 by ensuring the environmental safety of drinking water sources in urban and rural areas, while that of the latter was to attain a sewerage treatment coverage ratio of 85% in urban areas by 2015. According to the national plans, Hunan Province and Changsha City separately made the "12th Five-Year Plan for Developing the Nation's Economy and Society (2011–2015)." The city plan for waterworks shows the rational development and use of water sources and the strict protection of drinking water sources. In addition, the City plans to increase the water supply capacity per day to 2.2 million m³ in the urban area by 2015 by constructing new water purification plants, enlarging the existing ones, and establishing a city water supply network. Concerning sewage works, the municipal government aims to increase the city sewerage treatment coverage ratio to 95% by constructing new wastewater treatment plants (8 in total), expanding the existing ones, and installing a new 4 km-long sewer network. The plan also includes the promotion of fast sludge treatment and recycled water use programs.

In addition to the plans above, the State Council announced the "Action Plan for Water Contamination Prevention (Ten Water Articles) (No. 17 State Affair [2015])" on April 16, 2015. The plan shows that measures against water pollution will be taken from ten aspects; for example, suppressing the emission of all contaminants, strengthening water saving and water source protection, making legal enforcement and supervision stricter, enhancing water environment control, and strengthening the local government's responsibility. It also sets up concrete goals by 2020 for the seven river basins including the Yangtze and the Huang, such as the achievement of at least Type III of the national water standards and a sewerage treatment coverage ratio of 95% in the urban area.

The above shows that at the time of both the appraisal and the ex-post evaluation, the national, provincial, and municipal governments draw up their own development plans separately in order to establish the infrastructures of waterworks and sewage works as well as

to improve the water quality (drinking water and treated wastewater)—the water supply and wastewater treatment fields are kept important. This project is highly relevant to the development policy shown by the Chinese government. Therefore, its relevance is high.

3.1.2 Relevance to the Development Needs

- a. Waterworks: Changsha City had 1.96 million people in the urban area at the time of the appraisal (2003). As the population increased and the economy grew, the maximum demand would reach 1.73 million m³/day in 2010, while the supply capacity was up to 1.43 million m³/day, so the shortage was expected to be 0.3 million m³/day. At that time, the Xiangjiang River was the single water source for the City and encountered an extreme drought for about three months in winter in about five successive years, which accelerated water pollution in the basin and made it difficult to maintain high-quality drinking water. To overcome such conditions, the municipal government drew up some plans, including this project, to increase the water supply capacity to 2.2 million m³/day by 2015 by giving priority to the construction of pipelines, water purification plants, and a water supply network all over the City.

At the time of the ex-post evaluation (2014), the City had 3.71 million people, which was about 89% higher than that at the time of the appraisal. It planned to achieve a water supply coverage ratio of 100% and a water supply capacity of 2.2 million m³/day by 2015, and the latter was already 2.31 million m³/day at the time of the ex-post evaluation. However, the latest mid-to-long-term plan of Changsha City shows that continuous and rapid city development will increase the population of the urban area to 6.29 million people by 2020. According to the plan, the City will increase the water supply capacity to 4.0 million m³/day by 2020 by constructing the Liuyang Zhushuqiao and Dahu Dams as water sources other than the Xiangjiang River as well as preparing 13 water supply facilities in the urban area. Note that the Liaojia Citang Water Purification Plant constructed in this project connects with No. 1, No. 3, No. 5, No. 8, and Shongyahe Water Purification Plants via pipelines, so even if the demand increases or a certain plant pauses for maintenance, water can be inter-exchanged between from the service areas. This system plays a key role as part of the water supply system in the urban area of Changsha City.⁶

⁶ For example, when the City suddenly faced a difficulty in keeping the drinking water quality in 2014 because of a problem in the facilities of the Shongyahe Water Purification Plant, the Liaojia Citang Water Purification Plant constructed in this project supplied high-quality drinking water to the residents in the service area in question.

Table 1: Changsha City's Water Purification Capacity (10,000 m³/day)

Plant name	Water source	At the time of the appraisal	At the time of the ex-post evaluation
No. 1 WPP	Xiangjiang River and Dahu Dam	20	20
No. 2 WPP	Xiangjiang River	5	10
No. 3 WPP	Xiangjiang River	30	30
No. 4 WPP	Xiangjiang River	20	40
No. 5 WPP	Xiangjiang River and Zhushuqiao Dam	30	30
No. 8 WPP	Xiangjiang River	50	50
Wangcheng WPP	Xiangjiang River	5	15
Shongyahe WPP	Laodao River (branch of Xiangjiang River)	6	6
Liaojia Citang WPP (this project)	Zhushuqiao Dam	—	30
Total		166	231

Source: Documents provided by the executing agency
WPP: Water Purification Plant

b. Sewage works: In 2003, the sewerage treatment coverage ratio of Changsha City was as low as about 37%, because the City could not catch up a rapid population rise and economic development. Such a low ratio contaminated the Xiangjiang River and its branches in the City seriously and degraded the water quality of Dongting Lake and the Yangtze in the downstream basin. The City's mid- to long-term plan showed the construction of two new wastewater treatment plants in this project to aim at a sewerage treatment coverage ratio of 70% by 2010, so needs for developing sewage works were high. At the time of the ex-post evaluation, as mentioned before, a further population rise and city development would increase the treatment demand to 2.83 million m³/day in 2020. To meet it, the municipal government plans to increase the number of wastewater treatment plants to 14 and the treatment capacity from 1.28 million m³/day during ex-post evaluation to 3.53 million. Therefore, needs for developing sewage works are continuously high.⁷

Table 2: Changsha City's Wastewater Treatment Capacity (10,000 m³/day)

Facility name	At the time of the appraisal	At the time of the ex-post evaluation
No. 1 WTP	18	18
No. 2 WTP	14	14
Yuelu WTP	—	30
Xinkaipu WTP (this project)	—	10
Huaqiao WTP (this project)	—	16
Changshan Yuan WTP	—	16
Kaifu WTP	—	20
Pingtang WTP	—	4
Total	32	128

Source: Documents provided by the executing agency
WTP: Wastewater Treatment Plant

⁷ A drought problem in the Xiangjiang River was addressed by constructing a dam (completed in 2011) in the upstream part. Although the flow rate was stable, the Xiang Jiang's flow ability reduced, resulting in a fall in the Xiangjiang River's self-purification function. In addition, a rise in the number of cargo ships running along the Xiangjiang River increases the need for improving the water quality of the river.

3.1.3 Relevance to Japan's ODA Policy

At the time of the appraisal, Japan's assistance policies for China included the "Economic Cooperation Plan for China (made in 2001)," the "Policy for Conducting Overseas Economic Cooperation Activities (2005–2008)," and the "Country-Specific Action Policy (2002–2005)," all of which focused on environmental preservation. The third one gives priority to public projects requiring a government's role, such as support to the construction of water and sewage facilities, and promotes efforts to improve the environment administration ability by strengthening cooperation with local governments and transferring Japanese know-how to provide software aid. Accordingly, this project is highly consistent with Japan's support policy.

In light of the above, this project has been highly relevant to China's development plan and development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2 Efficiency⁸ (Rating:①)

3.2.1 Project Outputs

This project consists of three pillars: waterworks, sewage works, and training (for more information, see the table titled "Comparison of the Original and Actual Scope of the Project"). This subsection describes differences between the plans and results as well as their reasons.

3.2.1.1 Waterworks

a. Water intake and conveyance

- The capacity of the intake facility from the Liuyang Zhushuqiao Dam was changed from 0.95 million m³/day to 0.65 million (68% of the planned). The reason was that the city government made a decision to divide the facility construction plan into two phases (by 2015 and 2020) according to the development plan by 2020. Therefore, this project would attain 0.65 million m³/day and the Chinese side would complete the remainder with its own expenses. The output change has been reasonable from an efficiency point of view, because it was based on the City government's plan for running the first-phase project to meet the needs by 2015 and completing the second-phase project by 2020.
- Installation of pipelines: The planned pipeline was 76 km long, but the resulting length was 98 km (129% of the planned one) because after the project started, the City government made a request for laying an additional pipeline 22 km long to the No. 5 Water Purification Plant, an existing facility, in order to supply water meeting Type II from the Liuyang Zhushuqiao Dam to the plant and to improve the living environment

⁸ The efficiency is evaluated with the impact in mind.

of citizens. The output change has been reasonable because it improves the living environment of more citizens in the City.

- Construction of the Liaojia Citang Water Purification Plant: As planned, the facility having a capacity of 0.3 million m³/day has been completed.
- b. Construction of a water distribution network: The plan showed that the resulting length would be 553 km in total (new: 412 km and repair: 141 km). This project has completed a new network 23.23 km long, and the remainder has been constructed in different projects out of the scope.⁹ Of the new distribution network, a section 1.37 km long was under construction during ex-post evaluation but the remainder (387.40 km) and the pipeline (141 km) to be repaired were completed in the different project (for more information about the water distribution network, see “3.2.2.2 Project Period”). The output change and its reason have been proper, because it is reasonable to lay not only distribution pipes but also sewers and electric wires simultaneously with road construction to increase efficiency, including project cost reduction, from a city infrastructure building point of view.

3.2.1.2 Sewage works

- a. Construction of the Xinkaipu Wastewater Treatment Plant: Almost as planned, a facility having a capacity of 107 thousand m³/day (107% of the planned capacity) and featuring the A2O process¹⁰ has been completed.
- b. Construction of the Huaqiao Wastewater Treatment Plant: Almost as planned, a facility having a capacity of 168.6 thousand m³/day (105% of the planned capacity) and featuring the A2O process has been completed.
- c. Construction of a sewer network: Almost as planned, the network has been completed (plan: 116.60 km and result: 119.51 km).
- d. Construction of pump stations: The plan showed the construction of nine pump stations, but rationalizing the city and sewer network plans cancelled three sites. As a result, six pump stations have been completed.¹¹ The output change has been proper, because it has no effect on the operation and effectiveness of the resulting sewage works.
- e. Training: The plan showed that about 57 trainees would learn the operation and maintenance of a wastewater treatment plant, water purification plant, sewer network, and pump station as well as the chemical analysis and monitoring of the water quality.

⁹ The water distribution network has been completed with expenses paid by Xingsha Water Supply Corporation and ward-by-ward water supply companies, both buying purified water from Changsha Water Diversion and Water Quality Company Co. Ltd.

¹⁰ The A2O method (anaerobic, anoxia, and aerobic processes) is an advanced wastewater treatment type. Reaction tanks consist of anaerobic, anoxia, and aerobic ones to get rid of nitrogen and phosphorus together.

¹¹ The cancelled facilities were the Mayang Qiao Wastewater, Caijia Submerged, and Guitang Xiang Jiang Pump Stations. The planned wastewater tank of the third station was integrated into that of the Laodonglu Wastewater Pump Station—the latter capacity increased.

The resulting number of trainees has been 54, which is almost as planned.¹²

3.2.2 Project Inputs

3.2.2.1 Project Cost

The planned project cost was 46,963 million yen consisting of 19,964 million yen (paid in foreign currency) and 26,999 million yen (paid in local currency). The former was the Japanese ODA loan portion. The actual cost was 71,547 million yen (including the Japanese ODA loan portion of 19,803 million yen), which was significantly higher than planned (152% of the planned).

Table 3: Planned and Actual Project Costs (Unit: million yen)

Item	Planned costs			Actual costs			Ratio to the plan
	Japanese ODA loan	Amount paid in local currency	Total	Japanese ODA loan	Amount paid in local currency	Total	
Construction of pipelines and water purification plants (incl. distribution network)	10,185	13,367	23,552	12,918	26,595	39,513	168%
Construction of Xinkaipu Wastewater Treatment Plant (incl. related sewer network and pump stations)	3,024	3,365	6,389	3,225	8,194	11,418	179%
Construction of Huaqiao Wastewater Treatment Plant (incl. related sewer network and pump stations)	6,068	6,663	12,731	3,648	10,904	14,553	114%
Training	30	0	30	12	0	12	40%
Price escalation	657	199	856	0	0	0	0%
Reserve	0	2,181	2,181	0	80	80	4%
Interest during project	0	1,224	1,224	0	5,971	5,971	488%
Total	19,964	26,999	46,963	19,803	51,744	71,547	152%

Source: The planned and actual costs are provided by JICA and the executing agency, respectively.

Planned cost: Calculated at 1 dollar = 110 yen, 1 dollar = 8.28 yuan, 1 yuan = 13.3 yen, Annual price escalation rate = 1.4% for foreign currency and 0.4% for local currency, and Physical reserve rate = 5.0% for foreign and local currencies in September 2004.

Actual cost: Found at the average exchange rate (1 yen = 0.0732 yuan) from 2005 to 2012 because no annual cost in yuan was available.

There were three major reasons why the actual project cost was significantly higher than planned despite the output reductions in the water supply works, that is, the capacity of the water intake facility and the total length of the water supply pipeline network of the water supply, as well as in the sewage works, that is the number of pump stations: (1) the existence of topographical features and faults that were not identified in the geological survey of the

¹² The Kagoshima and Fukuoka City Waterworks Bureaus received the trainees. The training period was January 5–19, 2011 in the first phase and February 13–27, 2012 in the second phase.

feasibility study (F/S)¹³ increased the costs for constructing pipelines, the water distribution network, wastewater treatment plants, and the sewer network; (2) the material and equipment prices increased; and (3) the project cost consisted of a Japanese ODA loan and financial aid from domestic commercial banks, and a rise in the latter and the associated interest and the prolonged project period raised the interest during the project tremendously. Particularly in reason (1), geological problems were found in all components, so large-scale foundation works were added as a result.

3.2.2.2 Project Period

The planned period was from March 2005 to December 2008 (3 years and 10 months = 46 months in total), while the actual period was from March 2005 to August 2012 (7 years and 6 months = 90 months in total). The latter was significantly longer than the former (196% of the planned).¹⁴

¹³ Based on the interviews to the Executing Agency, the standard procedure in China is that, the level of accuracy in which geological surveys are conducted during the F/S are in line with what is established in the national standards, and more detailed surveys are conducted at the time of the detailed design if deemed necessary. The F/S of this project was approved by the National Development and Reform Commission in March 2004, thus it is possible to say that the geological survey at the time of the F/S was in line with the national standards, and from the point of view that it was approved at the national level, no additional surveys with a higher level of accuracy were conducted at the moment of the detailed design. However, if the fact that several problems related to the lack of accuracy in the geological survey appeared once the project started is taken into consideration, it is possible to infer that a higher level of accuracy of the geological survey at the time of the F/S and the detailed design could have resulted in a more efficient execution of the project. The Executing Agency commented that “the F/S geological survey should have been conducted more meticulously”.

¹⁴ The project is regarded as complete when all the operations are inspected and a test run is completed.

Table 4: Planned and Actual Project Periods

Process		Planned date/period	Actual date/period	Ratio to the plan*
L/A signing date		March 31, 2005	March 31, 2005	—
Preparation for bidding		Mar. 2005 to Dec. 2006 22 months	Mar. 2005 to Dec. 2006 22 months	On schedule
Bidding for earthwork		May 2005 to Dec. 2006 20 months	May 2005 to Mar. 2009 47 months	235%
Bidding for equipment and material		Aug. 2005 to Dec. 2006 17 months	Aug. 2005 to Aug. 2010 61 months	359%
Preparation for earthwork		Apr. 2005 to May 2006 14 months	Apr. 2005 to May 2006 14 months	On schedule
Earthwork and construction	Intake and conveyance facilities	Jan. 2006 to Dec. 2007 24 months	Feb. 2006 to Aug. 2010 55 months	229% Delay in start: 1 mo.
	Liaojia Citang Water Purification Plant	Jan. 2006 to Sept. 2007 21 months	Oct. 2005 to Oct. 2009 49 months	233%
	Water distribution network	Jan. 2006 to Dec. 2007 24 months	Nov. 2010 to Apr. 2012 18 months	75% Delay in start: 58 mos.
	Xinkaipu Wastewater Treatment Plant	Jan. 2006 to Sept. 2007 21 months	Sept. 2006 to June 2009 34 months	162% Delay in start: 8 mos.
	Huaqiao Wastewater Treatment Plant	Jan. 2006 to Sept. 2007 21 months	Nov. 2005 to Mar. 2009 41 months	195%
	Sewer network	Jan. 2006 to Dec. 2007 24 months	Sept. 2005 to May 2011 69 months	287%
Procurement, installation, test, and operation of equipment		Jan. 2006 to Dec. 2008 36 months	Jan. 2006 to Aug. 2012 80 months	222%
Training		Jan. 2006 to Dec. 2008	Jan. 2011 to Feb. 2012	—

Source: The planned and actual data are provided by JICA and the executing agency, respectively.

The project is regarded as complete when all the operations are inspected and a test run is completed.

Here are the three reasons for a long delay in the project period.

- a. Bidding procedures: As will be mentioned in “c. Water distribution network,” the main cause of a long delay was that it took a long time for the City government to define the policy for laying distribution pipes. Moreover, passing the pipeline through many prefectures required time to have talks with the prefectural governments, which caused a further delay in bidding procedures for earthwork. The delay also let bidding for equipment and material be behind the plan. Another reason for the delay was that the executing agency was not familiar with bidding and approving procedures for the Japanese ODA loan project.
- b. Accuracy of geological survey: The existence of topographical features and faults that could not be foreseen in the geological survey of the F/S became apparent, which led to a landslide during the underground laying work of intake and conveyance facilities. As a result, it was necessary to change the whole work and to conduct recovery work after the laying process. The construction of the Liaojia Citang Water Purification Plant, the Xinkaipu Wastewater Treatment Plant, and the Huaqiao Wastewater Treatment Plant faced similar problems; for example, unexpected geographical features were found and the geological conditions were worse than expected. Therefore, an increase in foundation improvement work made the project period

longer.

- c. Water distribution network: The plan showed that the network construction would start in January 2006, but the actual start date was November 2010. That was because the internal organizations of Changsha City did not agree to the water distribution network design of the city’s urban area¹⁵ and made a decision to lay pipes with road work in the section (1.37 km) where the pipeline would run along the road from an efficiency point of view. During the ex-post evaluation, the section was under construction because of a delay in the road work.¹⁶ In the remaining network, sections measuring 23.23 and 387.40 km long were completed in this and different projects, respectively.

3.2.3 Results of Calculation of Internal Rates of Return (Reference only)

At the time of the appraisal, only the financial internal rate of return (FIRR) was calculated, so during ex-post evaluation, the FIRR was recalculated under the same condition as at the time of the appraisal to a possible extent. The resulting return was negative in the construction of the intake and conveyance facilities and the Liaoqia Citang Water Purification Plant, because the cost was significantly higher than planned. Concerning the Xinkaipu and Huaqiao Wastewater Treatment Plants, the rates of return were 1.16% and 3.21%, respectively, because of a rise in income thanks to change in charge in 2014.

Table 5: Internal Rates of Return at Appraisal and Ex-Post Evaluation

At the time of the appraisal	At the time of the ex-post evaluation
<ul style="list-style-type: none"> • Intake and conveyance facilities and Liaoqia Citang WPP: 6.22% • Xinkaipu WTP: 4.30% • Huaqiao WTP: 4.23% 	<ul style="list-style-type: none"> • Intake and conveyance facilities and Liaoqia Citang WPP: -3.98% • Xinkaipu WTP: 1.16% • Huaqiao WTP: 3.21%
Expenses: Project, operation, and maintenance costs Profit: Charges Project life: 20 years	Expenses: Project, operation, and maintenance costs Profit: Charges Project life: 20 years

Source: The rates at the time of the appraisal are given by JICA, while the evaluator finds the rates during ex-post evaluation according to information from the executing agency.

In light of the above, both the project cost and project period significantly exceeded the plan. Therefore, the efficiency of the project is low.

¹⁵ Experts discussed whether the pipeline should be single or double and made no decision until July 2010. Some experts recommended the double type because two types of water could be supplied: one was quality water that would be supplied from the Liuyang Zhushuqiao Dam to residents as drinking water, while the other was water taken from the Xiang Jiang, which would be used for industrial purposes. The opponents stated that the double pipeline was not efficient from a long-term point of view, so the single type should be adopted as planned. In the end, the single type was employed in consideration of costs and long-term maintenance.

¹⁶ The pipeline, which runs along Hongqilu under construction, will be completed in 2015. This area is a developing zone near the station of a rapid transit railroad, so the population is expected to increase.

3.3 Effectiveness (Rating:③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

a. Waterworks: Assessing the quantitative effects of constructing the waterworks during the ex-post evaluation required that three points be taken into consideration. The first point is that the water supply ratio is nearly 100% in the areas (Xingsha, Xinshijidiq, and north of Wuyilu) that receive water from the Liaojia Citang Water Purification Plant—the effect is very good. The second point is that the Liaojia Citang Water Purification Plant belongs to the



Photo 2: Liaojia Citang Water Purification Plant

whole water supply system of Changsha City and has a sufficient capacity to fulfill the role of complimenting other plants when the demand increases, an emergency event occurs, or maintenance is necessary in a certain area—the plant contributes to the stable and safe water supply system. The third point is that although the development of the area receiving water from the Liaojia Citang Water Purification Plant is delayed, its progress is firm, so the demand is expected to increase as the population rises in the future.

Table 6 shows the operation and effect indicators of the Liaojia Citang Water Purification Plant defined at the time of the appraisal. Concerning the former, the basic indicators¹⁷ were evaluated, while the latter was assessed according to the achievement degree of the water supply ratio because of only one indicator. The basic operation indicators were evaluated in consideration of two points. The first point is that the population of the area receiving water from the Liaojia Citang Water Purification Plant does not increase as expected because the city development is lagging behind the plan. The second point is that it is not clear whether the goal is set up at the time of the appraisal in consideration of the whole water supply system of Changsha City after this project's role is clarified in the system.¹⁸ As shown in Table 6, none of the indicator has reached its goal after two years of the project completion, but the rating should not be so low if both points are taken into consideration. The first reason is that a delay in the city plan is an external factor to this project, so if the water supply population is 37% (258,000 people) of the goal (700,000 people) in 2012, it is natural to fail to attain the

¹⁷ The basic indicators consist of the water supply population, daily maximum water supply, daily average water supply, peak facility usage ratio, average facility usage ratio, and unaccounted-for water rate.

¹⁸ At the time of the appraisal, the goals of the peak and average facility usage ratios were set at 100% and 80% respectively, but ensuring stable water supply to the whole City requires letting the whole system have a certain reserve capacity. As mentioned in the text, at the time of the appraisal, there was no in-depth description of what role the Liaojia Citang Water Purification Plant should play in the whole system of Changsha City. Therefore, the goal might be specified solely for the plant rather than from the viewpoint of the plant belonging to the water supply system.

flow rate and facility usage ratio as planned at the time of the appraisal. Accordingly, failure to achieve the goal at 100% does not reduce the effect of this project. Note that the goal achievement ratio of the basic operation indicators was 100% for the unaccounted-for water rate and ranged from 37 to 52% for the other indicators two years after the completion of the project. As the population increases three years after the completion, all the achievement ratios are beyond 50%, which shows a tendency of improvement. After progress in the development of the service area in question and completion of the water distribution network 1.37 km long constructed with Hongqilu by the end of 2015, the daily water supply of the plant will increase to about 200,000 m³ and the average facility usage ratio will rise to 81%, so the latter will reach the goal in the near future.¹⁹ The second reason is that the average facility usage ratio of the water purification plants belonging to the system excepting the Liaojia Citang Water Purification Plant is 75% as of 2014, which is enough to supply water to the whole City stably and meets area-by-area demands. For example, the average facility usage ratios of No. 3 and No. 8 Water Purification Plants having densely populated areas are 100 and 89% respectively, while that of No. 5 Plant is 66% although it has almost the same population and purification capacity as this project. This example suggests that the average facility usage ratio (about 60%) of the Liaojia Citang Water Purification Plant is reasonable because it has a service area where city development will progress in the future. In addition, as mentioned in “3.1.2 Relevance to the Development Needs,” this project also plays the role of complementing other plants as part of the water supply system of Changsha City, so it is indispensable to operate the plant with a certain margin for the safe and stable supply of the whole system.

The effect indicator, which is the water supply ratio, is nearly 100% at the time of the ex-post evaluation because the water distribution network of the supply area of Liaojia Citang Water Purification Plant has been completed with the exception of a 1.37 km long section mentioned before.²⁰ Moreover, the field survey shows that the quality of water treated in the Liaojia Citang Water Purification Plant, although not an indicator, meets the “National Sanitation Standards for Drinking Water.” Therefore, the plant is recognized as effective.

¹⁹ This is a forecast presented by Changsha Water Group Co. Ltd., the parent company of the executing agency. The company may think that the service area in question will be developed firmly because Changsha City plans to start the second-phase plant construction work by 2020 to increase the purification capacity.

²⁰ Changsha Water Supply Co. Ltd. buys water from the (Liaojia Citang Water Purification Plant) and supplies it. The water supply to the area in question (given by this project) accounts for 10% of the whole City.

Table 6: Liaojia Citang Water Purification Plant: Operation and Effect Indicators

		Goal*	Actual				
			2010 Project completion	2011 1 year after completion	2012 (target) 2 years after completion	2013	2014
[Operation indicators]					Goal achievement ratio (%)		
Basic indicators	1. Water supply population (10,000 people, at year end)	70	2.2	10.2	25.8 (37%)	39.2 (56%)	39.2 (56%)
	2. Daily maximum water supply (10,000 m ³ /day)	30	0.82	3.81	15.5 (52%)	18.2 (61%)	16.95 (57%)
	3. Daily average water supply (10,000 m ³ /day)	24.6	0.79	3.6	9.1 (37%)	13.8 (56%)	13.97 (57%)
	4. Peak facility usage ratio (%)	100	2.7	12.7	51.7 (52%)	60.7 (61%)	56.5 (57%)
	5. Average facility usage ratio (%)	82	2.6	12	30.3 (37%)	46 (56%)	46.56 (57%)
	6. Unaccounted-for water rate (annual average in %)	18	16.32	15.31	14.86 Achieved	13.69 Achieved	13.88 Achieved
Auxiliary indicators	7. Accounted-for water rate (annual average in %)	82	83.68	84.69	85.14 Achieved	86.31 Achieved	86.12 Achieved
	8. Leakage rate (annual average in %)	13	16.32	15.31	14.86 (87%)	13.69 (95%)	8.28 Achieved
	9. Maximum intake (m ³ /s)	3.76	0.1	0.45	1.84 (49%)	2.15 (57%)	1.99 (53%)
	10. Average intake (m ³ /s)	3.08	0.1	0.42	1.08 (35%)	1.63 (53%)	1.64 (53%)
[Effect indicators]							
	11. Water supply ratio (%)	Nearly 100%	Nearly 100%	Nearly 100%	Nearly 100% Achieved	Nearly 100% Achieved	Nearly 100% Achieved

Source: The goals and results are provided by JICA and the executing agency, respectively.

*: The goal is a value two years after the completion of the project.

b. Sewage works: Table 7 shows the operation and effect indicators of the Xinkaipu and Huaqiao Wastewater Treatment Plants constructed newly in this project. In the former plant, all the water-related indicators reached or exceeded their goals in 2011 which is two years after project completion. The wastewater treatment rate, wastewater treatment population, and facility usage ratio reduced a little in 2012, but they improved in 2013 and reached 100% in 2014. All the indicators exceed 100% in 2014, which means that the Xinkaipu Wastewater Treatment Plant is effective in improving the living environment of the neighborhood residents and the water quality of the Guitang River into which the said plant directly discharges its treated water. The Huaqiao Wastewater Treatment Plant also achieved the goals of all the water-related indicators except the inlet SS concentration in 2011. The wastewater treatment rate, wastewater treatment population, and facility usage ratio were nearly 100%. After 2013, all the indicators reach or exceed 100%, which means that like the Xinkaipu Wastewater Treatment Plant, the Huaqiao Wastewater Treatment Plant is effective in improving the living environment of the neighborhood residents and the water quality of Liuyang River into which the said plant directly discharges its treated water. The reason for a reduction in inlet SS concentration after 2011 is increasing wastewater from the continuous construction of infrastructures through city development. The wastewater treatment rate of the plant is a little beyond the design load range, so expanding work for an additional 200,000 tons/day is carried on during the ex-post evaluation and will be completed in 2015.



Photo 3: Guitang River into which the Xinkaipu Wastewater Treatment Plant discharges its treated water

Table 7: Operation and Effect Indicators of the Wastewater Treatment Plants

	2002	Goal ¹	Actual (Achievement ratios)					
			2009 Project completion	2010 1 year after completion	2011 (target) 2 years after completion	2012	2013	2014
Xinkaipu Wastewater Treatment Plant								
Operation indicators								
1. Wastewater treatment rate (m ³ /day)	0	10	5.81	6.87	8.16 (82%)	7.2 (72%)	9.33 (93%)	10.7 Achieved
2. Wastewater treatment population (10,000 people, at year end)	0	16.28	9.52	11.26	13.37 (82%)	11.8 (72%)	15.29 (94%)	17.41 Achieved
3. Facility usage ratio (annual average in %)	0	100	58.1	68.7	81.6 (82%)	72 (72%)	93.3 (93%)	100 Achieved
4. Inlet BOD concentration ² (monthly average in mg/L)	100	100	85.11	88.36	81.45	86.47	84.29	88.79
5. Outlet BOD concentration (monthly average in mg/L)	100	20	8.25	8.34	8.78 Achieved	9.02 Achieved	8.51 Achieved	8.92 Achieved
6. BOD reduction ratio (%)	0	80	91	91	90 Achieved	90 Achieved	90 Achieved	90 Achieved
7. BOD emission rate (tons/year)	3,650	730	91.1	209.1	261.5 Achieved	237 Achieved	289.8 Achieved	344.1 Achieved
Inlet SS concentration ² (monthly average in mg/L)	90-110	150	104.4	109.5	113.5	114.3	106.7	119.1
9. Outlet SS concentration (monthly average in mg/L)	90-110	20	11	10	11 Achieved	11 Achieved	10 Achieved	11 Achieved
10. SS emission rate (tons/year)	3,285- 4,015	730	121.4	250.7	327.6 Achieved	289.1 Achieved	340.5 Achieved	424.3 Achieved
Effect indicators								
11. Ward sewerage treatment coverage ratio (annual average in %)	0	100	65	77	92 (92%)	81 (81%)	100 Achieved	100 Achieved
Huaqiao Wastewater Treatment Plant								
Operation indicators								
1. Wastewater treatment rate (m ³ /day)	0	16	6.59	10.07	15.87 (99%)	15.67 (98%)	16.11 Achieved	16.86 Achieved
2. Wastewater treatment population (10,000 people, at year end)	0	47.47	19.5	29.8	46.97 (99%)	46.38 (98%)	47.68 Achieved	49.98 Achieved
3. Facility usage ratio (annual average in %)	0	100	41.2	62.9	99.2 (99%)	97.9 (98%)	100 Achieved	100 Achieved
4. Inlet BOD concentration ² (monthly average in mg/L)	100	100	95.63	93.92	82.99	78.33	88.25	86.67
5. Outlet BOD concentration (monthly average in mg/L)	100	20	12.21	10.88	10.44 Achieved	9.77 Achieved	10.25 Achieved	12.00 Achieved
6. BOD reduction ratio (%)	0	80	87	89	87 Achieved	88 Achieved	88 Achieved	90 Achieved
7. BOD emission rate (tons/year)	5,840	1,168	293.7	388.8	764.7 Achieved	710.5 Achieved	602.7 Achieved	739.5 Achieved
8. Inlet SS concentration ² (monthly average in mg/L)	90-110	150	97	132	153	153	272	252
9. Outlet SS concentration (monthly average in mg/L)	90-110	20	12	11	11 Achieved	11 Achieved	13 Achieved	14 Achieved
10. SS emission rate (tons/year)	5,256- 6,424	1,168	305.2	404.3	637.2 Achieved	629.1 Achieved	764.4 Achieved	852.5 Achieved
Effect indicators								
11. Ward sewerage treatment coverage ratio (annual average in %)	0	61.5	25	39	62 Achieved	61 (99%)	62 Achieved	62 Achieved

Source: The goals and results are provided by JICA and the executing agency, respectively.

1: The goal is a value two years after the completion of the project.

2: BOD (Biochemical Oxygen Demand) refers to the amount of oxygen required for microorganisms to decompose organic contaminants in water. The larger the value, the greater the water pollution (Source: Website of the Ministry of the Environment (MOE) of Japan).

SS (Suspended Solids) refers to insoluble substances which are suspended in water and whose diameter is not more than 2 mm. They make water turbid, cut sunlight, and sometimes kill fishes by clogging their gills if the concentration is high (Source: Website of MOE).

In summary, concerning the effect indicators of the waterworks constructed, the water supply ratio is nearly 100% in the area receiving water from the Liaojia Citang Water Purification Plant, and the drinking water quality meets the “National Sanitation Standards for Drinking Water.” Therefore, this project is highly effective. Regarding the operation indicators, the goal achievement ratio does not reach 100%, because the development of the area in question is delayed and the population growth is sluggish, but the results are not so bad in consideration of the purification plant’s role in the whole water supply system of Changsha City—they are recognized as reasonable from the viewpoint of ensuring stable water supply to the City. Moreover, the ongoing development of the area in question is confirmed during the ex-post evaluation, and, simultaneously, the population is increasing, so there is the high possibility of raising the operation indicators in the future. The waterworks constructed run properly during the ex-post evaluation, so the effect is satisfactory as a whole. In the same manner, as for the sewage works, the operation and effect indicators of the two wastewater treatment plants reach 100%, and the water quality meets Class I-B set forth in the “Standard for Waste from City Wastewater Treatment Plants.” Wastewater, which was not processed before this project, is treated properly in this project, and the effect of this is very high. Therefore, this project for constructing water and sewage facilities is highly effective in improving the living environment of citizens in Changsha City and the quality of water flowing into the Xiangjiang River and its branches.

3.3.2 Qualitative Effects (Others)

The qualitative effects expected in this project were “Improving the sanitary environment of residents in the Xiangjiang River basin” and “Preserving the ecosystem environment of the basin by reducing the flow rate of water taken from the Xiangjiang River.” The evaluation of them was integrated into “3.4 Impact,” because the resulting effect was equivalent to the impact of this project.

3.4 Impact

3.4.1 Intended Impacts

The intended impacts of this project were “Improving the water quality of the Xiangjiang River” and “Improving the sanitation condition of Changsha City.” The results are shown below.

- a. Improving the water quality of the Xiangjiang River: This impact was expected to be attained by taking two measures: (1) Reducing water taken from the Xiangjiang River to suppress the contaminant concentration and (2) Treating wastewater discharged directly or indirectly into the Xiangjiang River. Note that as mentioned in “2.3 Constraints during the Evaluation Study,” there were many external factors having an effect on the measurement of the impact. Therefore, this ex-post evaluation was made according to data on the water quality of the Xiangjiang River announced by the

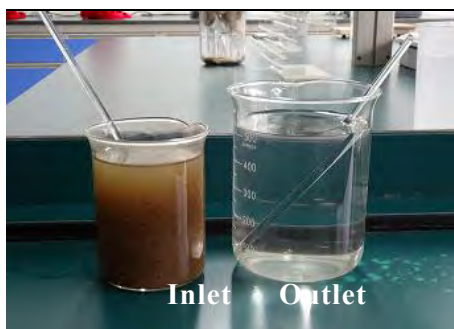


Photo 4: Huaqiao Wastewater Treatment Plant: Water before and after treatment

government of Hunan Province and the contaminant concentration reduced by the wastewater treatment plants constructed in this project. According to the “Environmental Condition Report” and environment-related press releases issued by Hunan Province, the water quality of the Xiangjiang River was improved in 2005, 2011, and 2012 as shown in Table 8. In 2011, the water quality was at least Type IV of the quality standards for surface water environment at all monitoring points, and in 2012, it met Class III at 88% of the monitoring points. However, it is impossible to precisely identify the extent to which the project has contributed to the water quality improvement indicated in Table 8. As mentioned in “3.3 Effectiveness,” the quality of water flowing from the two treatment plants in question to the Guitang and Liuyang Rivers is improved, because the BOD, SS, and main contaminant concentration are significantly lower than the national standards, and both plants treat wastewater properly and discharge it at about 280,000 m³/day, which means that the amount of contaminants flowing into the rivers reduces compared with when no wastewater was treated. Both the Guitang and Liuyang Rivers are branches of the Xiangjiang River, so the wastewater treatment plants in question have a certain effect on stopping degradation in the water quality of the main river.²¹

Table 8: Changes in the Water Quality of the Xiangjiang River

National water standards	Ratio of monitoring points		
	2005	2011	2012
Types I to III	84.8%	87.5%	88.0%
Type IV	3.2%	12.5%	12.0%
Type V	3.2%	—	—
Type VI or over	9.6%	—	—
Number of points	31	40	42

Source: The data in 2005 and 2011 are given by the “Environmental Condition Report” issued by the government of Hunan Province, while that in 2012 are shown in the “Press Release on the 2013 World Environment Day in Hunan Province.”

Note: The contaminants measured include colon bacilli, ammonia, COD, total phosphorus, arsenic, and cadmium, but no concrete values are shown.

- b. Improving the sanitation condition of Changsha City: This impact was assessed according to the results of taking a survey of people receiving benefit (for more information about the survey, see the appendix). Most of the answerers think that the

²¹ A survey of people receiving benefit shows that many people say, “The water quality of rivers is improved,” while the number of people stating, “The water pollution of rivers is still serious” is not so small. Some of the latter emphasize the necessity of strictly controlling wastewater from companies and waste disposal.

project goal has been achieved, and 80% of them are satisfied with the resulting water and sewage facilities. Therefore, it is obvious for the citizens to actually recognize the improvement of river water and sanitary environment thanks to the ability to use tap water with ease and the treatment of wastewater.

As mentioned before, The Chinese State Council announced the “Action Plan for Water Pollution Prevention” in April 2015 to show water improvement goals to be achieved by 2020, and to enforce new laws to give a penalty to companies committing a violation, such as a production stop or shutdown. Such measures are expected to be taken thoroughly (for more information, see “3.1.1 Relevance to the Development Plan”).

3.4.2 Other Impacts

(1) Impacts on the natural environment

This project issued an environmental impact assessment (EIA) report to the National General Bureau of Environmental Protection, which approved it in September 2003. At the time of the ex-post evaluation, it was confirmed that the area in question and its surrounding place included neither sanctuaries nor valuable species living zones. Good measures were taken against environmental pollution during project operation, including the construction of a water purification plant and two wastewater treatment plants.²² At the time of the ex-post evaluation, turbid water generated in the treatment plant was processed or reused in it, and noise was reduced by a noise suppressor, so their impacts on the residents were kept low. The wastewater treatment plant generated a loud noise, but it was not problematic during the field survey, by virtue of noise insulation measures. It was also confirmed that sludge generated in both wastewater treatment plants was properly combusted and landfilled at an existing final waste disposal site (Hunan Province legally bans the reuse of sludge).

The impact of the Liuyang Zhushuqiao Dam constructed in this project on the natural environment and ecosystem, which was a matter of concern at the time of the appraisal, was not negative. The annual average water level has been 164 meters since 2010 during which this project started an intake, so it was kept higher than 161 meters from 2005 to 2009 before the project. To maintain the water quality of the dam, Liuyang Zhushuqiao Dam Management Authority conducts real-time monitoring of eight indicators around the clock. As a result, the water quality has conformed to Type II of the national water standards from 2005 to ex-post evaluation. Therefore, this project has no negative impact.

(2) Land acquisition and resettlement

This project planned to move 81 residents (20 households). Actually, 80 people (21

²² The following shows the concrete measures. Exhaust gas: Introduction of machines meeting the national standards. Waste: Delivering it to a waste treatment center by special truck. Dust: Suppressing it by sprinkling water over the construction site. Turbid water: Discharging turbid water generated at the site in question into the sewer network under city control. Noise: Introducing a noise suppressor to minimize its level. Vibration: Avoiding blasting to a possible extent and employing methods involving little vibration.

households) moved, almost as planned. The plan showed that the area of land to be acquired would be 32.44 km², and the resulting area was 34.07 km². The executing agency constructed temporary dwellings and then permanent houses in the final place, and paid movement expenses in accordance with the “Changsha City Law of Land Acquisition and Resettlement.” All the residents in question moved before the construction started, and no problem has arisen.²³

In summary, concerning the waterworks, the water supply ratio is nearly 100%, drinking water meets the national standards, and the water purification plant plays a role expected as part of the water supply system of Changsha City, so this project contributes to stable water supply to the City. Regarding the sewage works, almost all the operation and effect indicators have reached their goals, and the quality of treated water meets the national standards. The people receiving benefit express a deep satisfaction to both the water and sewage facilities, and the evaluation results, which had some constraints, show that the plants contribute to improving the water quality of the Xiangjiang River and the sanitation condition of the City. Therefore, the effectiveness and impact of this project are high, because the effect appears almost as planned.

3.5 Sustainability (Rating:③)

3.5.1 Institutional Aspects of Operation and Maintenance

Changsha Water Diversion and Water Quality Company Co. Ltd, the facility operator of this project is a subsidiary company of Changsha Water Group Co. Ltd., together with Changsha Water Supply Co. Ltd. and Changsha Municipal Drainage Co. Ltd. The operator started in November 2003 as an organization that should fulfill the project goal and that was 100%-owned by the City government. Its duties include taking water from the Liuyang Zhushuqiao Dam constructed in this project, operating and maintaining the water purification plant and part of the distribution pipeline, and operating and maintaining the wastewater treatment plants and sewer network. Figure 2 shows the organization as well as operating and maintaining members. All the facilities employ a shift system consisting of four groups and three shifts.

²³ The detailed compensations include money proportional to the site area (land compensation), money depending on farm product income gained at the site (resettlement compensation), money for buildings at the site (ground attachment compensation), and money for farm products cultivated and not harvested at the site (seedling compensation). According to interviews to three residents who moved to permanent houses, they were highly satisfied with it because the city government held a meeting to describe the project, the compensations were reasonable, and the new living and sanitary environments were better than those before movement.

Changsha Water Diversion and Water Quality Company Co. Ltd.			
<u>Water Pipeline Management Center</u> (taking water from Zhushuqiao Dam and supplying it) Engineers: 29 Office workers: 7	<u>Liaojia Citang Water Purification Plant</u> Engineers: 50 Office workers: 9	<u>Xinkaipu Wastewater Treatment Plant</u> Engineers: 48 Office workers: 9	<u>Huaqiao Wastewater Treatment Plant</u> Engineers: 49 Office workers: 9
			Sewer network: Engineers: 49; Office workers: 9 Pump station: Engineers: 22

Source: Information provided by the executing agency

Figure2: Organization as well as operation and maintenance system of the facility operator

The Liuyang Zhushuqiao Dam Management Authority, which is owned by the electric power company that operates hydraulic power stations in the area, operates and maintains the Liuyang Zhushuqiao Dam. To ensure safety and protect the natural environment, the Authority makes strict control and commissions the parent company to maintain the crane used to open and close the intake gate, while the Water Pipeline Management Center always monitors the pipeline with cameras. Moreover, the operator forms an inspection team having six to seven members to maintain the sewer network with the City government. The organization and system are sufficient for sustainable operation and maintenance, and cooperation with the Authority is suitable from the viewpoint of maintaining the water source quality. In addition, for efficient operation and maintenance, the operator makes efforts to commission external companies to clean and guard the facilities. Therefore, the system is kept in a good condition as a whole.

3.5.2 Technical Aspects of Operation and Maintenance

a. Staff's technical level of operation and maintenance: The operator sets a high human resource employment level to preferentially adopt those who have certain experience and expertise in the water and sewage fields. Wastewater treatment engineers, water purification workers, pump operators, and chemical inspectors shall pass a technical test given by the Province. The operator employs such authorized people positively or encourages its employees to gain a qualification. In the meantime, those who handle a 10-kW unit, bridge crane, or pressure vessel shall have a certificate of designated work issued by the Province, and electric engineers shall obtain a national qualification. The engineers shown in Figure 5 already have such a qualification. In addition, the operator employs senior experts having plentiful experience as site supervisors and gives importance to the education of young employees. Changsha Water Diversion and Water Quality Company Co. Ltd, which is 100%-owned by the City government, is a very popular company, despite a personnel change in the same corporate group, because the

workplaces are stable and the welfare is very good. Moreover, the low job turnover allows the employees to accumulate knowledge and experience.²⁴ This is proven by there being no major problem in the operation and maintenance of the facilities.

- b. Operation and maintenance manuals as well as records and control of using and maintaining activities: The operator has operation and maintenance manuals for all the facilities and conducts daily inspection and preventive maintenance. Particularly in the operation and maintenance processes, poster-sized panels are put on the wall of each facility to allow the workers to always know what to do. Maintenance records show handover tasks to members working the next shift, and in some facilities, a whiteboard is used in addition to the records.
- c. Training system for the people in charge of operation and maintenance as well as investments and training for improving skills: New employees take training in the Changsha City Wastewater Treatment Training Center for three months after joining the Company, then receive OJT for six months, and finally go to the department in charge of operation or maintenance. Those who treat wastewater, analyze the water quality, or operate the pump station shall pass a qualification test given by the, Hunan Province's Department of Labor after having certain experience. The operator draws up and implements a training plan for the personnel after determining needs; for example, what knowledge and skills are insufficient or should be improved. Some training is delivered internally, but most of it is given at the Hunan Province Education and Training School or the Changsha Training School.²⁵

In light of the above, no major problems have been observed in the operator's ability to operate and maintain the facilities. The company has and uses manuals, makes a record of operation and maintenance, and draws up and implements a training plan in response to needs. Therefore, no major problems have been observed in the technical aspects of operation and maintenance.

²⁴ In many countries, the operator of sewage works faces difficulty in keeping human resources and the job turnover is high, so it has a problem of failing to accumulate knowledge and experience. After a hearing was given to the staff members of the operator of this project, it was proven that they were deeply satisfied with their workplaces. Accordingly, the operator accumulates expertise and skills gained through external training and OJT.

²⁵ Hunan Province and Changsha City make active contact with Japanese local governments, such as those of Fukuoka City, Kagoshima Prefecture, Shiga Prefecture, and Kobe City; therefore, many training and exchange projects take place every year in Japan. In March 2013, they started to run a 3-year training project with Shiga Prefecture and the facility operator sends five trainees to attend the "Training Course for Controlling Wastewater Treatment Plants" for 15 days every year. After going back to the country, all the trainees still work for the operator and use knowledge and experience in their workplaces. For example, the operator introduces daily maintenance such as 5S (sorting, organizing, keeping clean, cleaning, and discipline) and advanced topics such as energy saving technology for wastewater treatment plants. Concerning the latter, the technology the Associate Director has learned in the training held in Shiga Prefecture will be introduced to the second phase of the Huaqiao Wastewater Treatment Plant under construction. The operator takes full advantage of such continuous training from a mid- to long-term point of view.

3.5.3 Financial Aspects of Operation and Maintenance

No financial statements are disclosed, but the operation is in deficit if its cost includes money for expanding the Huaqiao Wastewater Treatment Plant currently and depreciation expenses. The operation and maintenance costs for the facilities constructed in this project are covered through the water and sewage charges (except for 2010).

Table 9: Water and Sewage Charges versus Operation and Maintenance Costs
(Unit: thousand yuan)

	2009	2010	2011	2012	2013	2014
Total water and sewage charges (A)	13,740	14,474	35,344	104,518	146,463	337,131*
Total operation and maintenance costs (B)	12,235	15,845	28,421	77,813	55,004	68,523
Labor cost included**	2,701	3,143	6,701	10,370	10,548	14,979
Other expenses***	9,534	12,702	21,719	67,443	44,456	53,545
Gross profit = (A) – (B)	1,504	-1,371	6,923	26,704	91,458	268,607

Source: Documents provided by the executing agency

*: In 2014, the income showed a year-on-year rise of 230% thanks to change in water and sewage charges.

** : The labor cost is paid to workers involved in the operation and maintenance of the wastewater treatment and water purification plants.

***: The other expenses include the operation and maintenance costs other than the labor cost.

The reason for deficit operation in 2010 is that no water charge was obtained for about three months because the pipeline broke twice, and required an inspection and repair with water supply stopped.

The operation and maintenance costs are covered through the water and sewage charges. Changsha City's Price Bureau sets up the charge and the facility operator can make a request to the Bureau for changing it if necessary. Because the expansion work of the Huaqiao Wastewater Treatment Plant lagged behind the plan, the labor, material, and equipment costs increased, the governmental funds were not enough, the loan interest rose, and the plan and design had been changed or reviewed. As a result, the operator made a request for revising the water charge for home use, which was approved in 2014 as shown in Table 10.

Table 10: Trends in Water and Sewage Charges

	2005	2011	2014
Water charge	1.02 yuan/m ²	Home: 1.21 yuan/m ² Industry: 1.38 yuan/m ²	Home: 1.61 yuan/m ² Industry: 2.47 yuan/m ²
Sewage charge	0.4 yuan/m ²	Home: 0.65 yuan/m ² Industry: 0.70 yuan/m ²	Home: 0.75 yuan/m ² Industry: 1.05 yuan/m ²

Source: Documents provided by the executing agency

In summary, no major problems have been observed in financial sustainability, because the operation and maintenance costs for the facilities constructed in this project are covered through the water and sewage charges from 2011, change in charge system in 2014 produces a return on the maintenance cost and investment, and if the funds are short, the Changsha City government is obliged to give financial support to the waterworks and sewage works, the lifelines of citizens.

3.5.4 Current Status of Operation and Maintenance

This subsection describes the status of operation and maintenance confirmed during the ex-post evaluation.

No major problem has arisen in the waterworks including the operation and maintenance of the pipeline and purification plant, and the procurement of spare parts. However, construction of the distribution pipe running along Hongqilu is under way and will be completed by the middle of June 2015. It is desired to keep striving to carry on the work on schedule while strengthening cooperation with the City government.

A problem in the sewage works identified during ex-post evaluation is that an overload is put on the Huaqiao Wastewater Treatment Plant because the flow rate of wastewater exceeds the design value slightly. Notwithstanding quick expansion work, it is hoped that the maintenance of the existing equipment will be reinforced. No major problem has arisen in the plant so far, but strong and thorough maintenance will be necessary in the future because the combined sewer carries lots of garbage, which puts a heavy load on the inlet and wears the screen at a rate higher than expected. The Xinkaipu Wastewater Treatment Plant faces no major problem, but there is a concern: if the blower fails to work, it is necessary to call the supplier from South Korea, which requires a high cost. Therefore, it is recommended that daily maintenance be conducted thoroughly according to the manual. The operator grasps the problems above and understands the necessity of proper and careful operation and maintenance, so the problem may not become serious.

In both the water and sewage facilities, some workers failed to wear helmets for safe operation because of lack of safety instructions. It is hoped that safety measures will be introduced and followed thoroughly in the future.

In light of the above, no problems have been observed in the institutional, technical, and financial aspects of the operation and maintenance system. Therefore, the sustainability of the effects of this project is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The purpose of this project is to address water contamination problems in the Xiangjiang River and to improve the living environment of citizens by constructing water and sewage facilities in Changsha City, Hunan Province.

The project is highly relevant, because at the time of the appraisal and ex-post evaluation, it meets the development policies and needs indicated by the governments of China, Hunan Province, and Changsha City as well as the Japanese aid policies. Concerning the operation and effect indicators of the resulting waterworks, the goal achievement ratio is about 50% of

the plan. However, the effect is sufficient in consideration of the project role in the citywide water supply system confirmed during ex-post evaluation. In the resultant sewage works, all the indicators have reached their goals defined at the time of the appraisal—both the effectiveness and impact of the project are recognized as high because of the improvement of contaminated rivers including the Xiangjiang River, which run through the City, and of the living environment of residents. Both the project cost and the project period exceeded the planned ones significantly, resulting in low efficiency. The systems, technologies, and financial condition of operation and maintenance are good, so the effects resulting from the project are highly sustainable.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

- a. The distribution pipe running along Hongqilu will be completed by the middle of June 2015. It is necessary to keep striving to carry on the work on schedule while strengthening cooperation with the city government.
- b. “3.5.4 Current Status of Operation and Maintenance” shows the following problems in operation and maintenance, which should be addressed correctly. In the Huaqiao Wastewater Treatment Plant, all the facilities shall be maintained strictly, because an overload is put on them. Because the screen has been worn at a rate faster than expected, the maintenance frequency shall be increased. In the Xinkaipu Wastewater Treatment Plant, it is desired to continue daily and thorough maintenance of the blower that requires a high maintenance cost.
- c. The results of surveying people receiving benefit and giving a hearing to residents showed that to improve the water quality of the rivers running through Changsha City, many people demanded stricter control of companies that discharged raw wastewater and garbage into them. To address this problem, the operator is expected to monitor water from the water and sewage facilities continuously, to strengthen cooperation with the city government in protecting the water environment included in the policy “Making Local Government’s Responsibility Stronger,” and to continue activities for improving the living environment of citizens in accordance with the “Action Plan for Water Contamination Prevention (Ten Water Articles)” mentioned previously.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

Ensuring the range and accuracy of the geological survey

Although the geological survey conducted at the time of the F/S met the national standards, once the project started, problems that were caused by topographical features and faults that were not found in the F/S appeared which resulted in a prolonged project period and an increase in its cost. Each country and/or executing agencies have their own standards when it comes to the level of accuracy of F/S geological surveys. However, as in the case of this project, when a project covers an extensive area, it can more or less be assumed that different topographical features and soils exist. In such cases, once complying with the country and/or executing agency's standards for the level of accuracy of the F/S topographical survey, it is desirable to internalize the possibility that the level of accuracy of the topographical survey during the detailed design will have to be increased, by reflecting this fact beforehand in the project's cost and period, thereby elaborating an efficient project plan.

Establishing the range of the Impact

One of the project's impacts was to improve the water quality of the Xiangjiang River. However, it was difficult to measure its degree, because of too many factors related to the improvement of the Xiangjiang River that has such a huge scale. Therefore, specifying the impacts requires checking the project scale, external factors for presence, and the extent to which each factor affects the project.

END.

Comparison of the Original and Actual Scopes of the Project

Item	Plan	Actual
(1) Project Outputs		
[Waterworks]		
I. Intake and conveyance		
a. Intake facility from Liuyang Zhushuqiao Dam	950,000 m ³ /day	650,000 m ³ /day
b. Pipeline	76 km	98 km
II. Liaojia Citang Water Purification Plant	300,000 m ³ /day	As planned
III. Water distribution network		
a. New	412 km	23.23 km
b. Repair	141 km	0 km
[Sewage works]		
IV. Xinkaipu Wastewater Treatment Plant	100,000 m ³ /day	107,000 m ³ /day
V. Huaqiao Wastewater Treatment Plant	160,000 m ³ /day	168,600 m ³ /day
VI. Sewer network		
a. Sewers	116.60 km	119.51 km
b. Pump stations	9 places	6 places
[Training]		
VII. Training	57 trainees	54 trainees
(2) Project Period	Mar. 2005 to Dec. 2008 (46 months)	Mar. 2005 to Aug. 2012 (90 months)
(3) Project Cost		
Amount paid in foreign currency	19,964 million yen	19,803 million yen
Amount paid in local currency	26,999 million yen (2,030 million yuan)	51,744 million yen (3,819 million yuan)
Total	46,963 million yen	71,547 million yen
Japanese ODA loan portion	19,964 million yen	19,803 million yen
Exchange rate	1 yuan = 13.3 yen (as of Sept. 2004)	1 yen = 0.0732 yuan (Average from 2005 to 2012)

Appendix: Results of Surveying Persons Receiving Benefit

Survey period	November 24-26, 2014
Area and number of samples	50 residents living around the Liaojia Citang Water Purification Plant, Xinkaipu Wastewater Treatment Plant, or Huaqiao Wastewater Treatment Plant
Sampling method	The facility operator called out to residents for cooperation, and those that gathered filled a survey sheet.
Characteristics of respondents	<ul style="list-style-type: none"> • 50 people (20 men and 30 women) • Age distribution: 20-29 years (56%); 30-39 years (20%); 40-49 years (18%); 50-59 years (6%) • Jobs: Agriculture (55%); Commerce (38%); Fishing (2%); Other (5%) • Dwellings: Apartment house (72%); detached house (20%); Other (8%) • Living years in Changsha City: 10 years or more (46%); 5 to less than 10 years (32%); Less than 5 years (22%) • Waterworks: Water supply ratio (98%); Home use (94%); Most of the respondents used a purifier. • Residents having flush toilet in house: 47; Joint cesspool toilet: 3 • Monthly average water and sewage charges: 78.75 yuan in total
Survey results	
<p>1. Project goal achievement ratio</p> <ul style="list-style-type: none"> • “The project goal was achieved,” said 32 residents (64%). The main reasons were (1) The quality of both tap and river water was completely improved (neither bad odor nor strange taste) and (2) The environment was better than before because completing the basic part of the urban sewer network made it possible to collect and treat wastewater. • “The project goal was not achieved,” said 16 residents (32%). Note that two residents gave no answer. The main reasons were (1) The water quality was better than before, but the pollution problem was still serious and (2) The improvement was not enough, because tap water was sometimes too chloric, stinky (smell like a fish), or awful-tasting. 	
<p>2. Waterworks: Checking for the degree of satisfaction in the following items before and after the project</p> <ul style="list-style-type: none"> • Water quality: Concerning tap water after the project completion, “Safe,” said 40 residents (80%) and “Anxious,” said the remainder (10). The main reasons for the latter were (1) The water source was contaminated and (2) The purification process used a large amount of chemicals (e.g., chlorine). • Water quality and health: “No change in health before and after the project,” answered 20 residents (40%), “I do not know what kind of disease is derived from contaminated water,” said 12 residents (22%), “Diseases derived from contaminated water reduced,” said 13 residents (26%), and “My health became worse,” said four residents (8%). Those who showed the third answer described the reasons as follows: “No dysentery” or “No stomachache.” The residents who put the fourth answer said, “Change in water quality increases the number of residents that suffer from a calculus.” • Water services: “Satisfactory,” said 41 residents (82%) and “Unsatisfactory,” said the remainder 9. Of the latter, seven said, “Tap water is not tasty,” 1 said, “Anxious about safety,” and 1 said, “The water charge is too high.” • Improvements residents want in the future: Improving the water pressure, repairing the pipeline, and making the water quality standards stricter. 	
<p>3. Sewage works:</p> <ul style="list-style-type: none"> • Concerning changes in sewage facilities and services before and after the project, “Satisfactory,” said 40 residents (80%) and “Unsatisfactory,” complained the 10 remaining residents (20%). The latter all said, “The river water is not clear.” The other reasons were (1) The sewage works did not spread, (2) Providing information including charges was not enough, and (3) Measures against heavy rain and flood were not enough. • Water quality and surrounding environment of city rivers: Regarding changes, before and after the project, in river water’s turbidity, the presence of garbage and suspended matter, odor, and the living environment of animals and plants, “Improved,” said 80% of the respondents and “No change,” said 20%. The main reasons for the former were (1) Wastewater treatment advanced significantly, (2) Resident’s awareness was raised, and (3) The government paid attention to the protection of the water quality environment. The reasons for the latter were (1) Wastewater and garbage were still put into the river and (2) The government did not let the residents know about environmental protection. • Awareness of wastewater: Concerning change in resident’s awareness of wastewater after the completion of sewage works, two questions were put to the residents. To one question “Do you know that neither oil nor garbage should flow into the kitchen drain?” 94% of the residents answered, “My awareness of it was raised a little or very much.” To the other question “Do you know soap or detergent should not be used too much?” 72% of the answerers said, “My awareness of it was raised a little or very much.” Note that the news of water quality problems provided by newspapers and media as well as public relations delivered by water and wastewater treatment companies contributed significantly to a rise in residents’ awareness. • Improvements residents want in the future: Strengthening the control of companies who discharge raw wastewater into the Xiangjiang River and making the water quality standards stricter. 	
<p>4. Project running process</p> <ul style="list-style-type: none"> • Land acquisition and resettlement by the project: 40 residents (80%) knew about them. Of them, 30 people said, “The land acquisition process went on relatively smoothly.” The main reasons were (1) The compensation was reasonable and satisfactory and (2) A meeting for telling that the purpose of the project was to improve the living environment of residents encouraged the residents to give cooperation and support to the project. On the other hand, 10 people said, “The land acquisition process did not go on smoothly.” The main reasons were (1) It took a long time and (2) The moving process was complicated in China. • Environmental impacts during construction: Concerning exhaust gas, disposal of waste, dust, turbid water, noise, and vibration, “I minded them,” said 28-44% of the answerers and “I did not mind them,” told 44-56% of the residents—the latter was a little more than the former (12-16% shows no answer). The former added, “Exhaust gas and dust were the most mindful.” After 13 residents made a request to the city government for taking action, seven received a satisfactory answer. 	

Ex-Post Evaluation of Japanese ODA Loan
“Henan Panshitou Reservoir Construction Project”

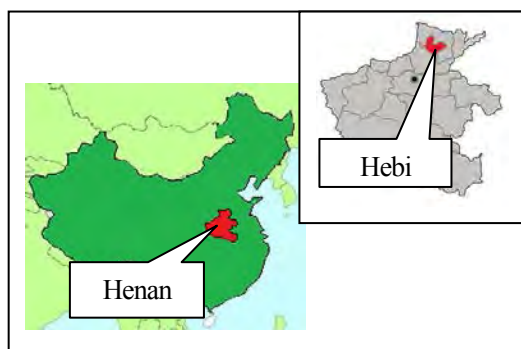
External Evaluators: Yumiko Onishi and Yuko Kishino, IC Net Limited

0. Summary

The objective of the project was to reduce flood damage while providing irrigation, urban water supply and power supply by constructing a multi-purpose dam in the Panshitou area of Qihe River where flood damages are frequent, thereby contributing to the improvement of the living standards of residents in the area and the economic development of the region. At the times of the appraisal and ex-post evaluation, flood control was mentioned as an important area in China's development policy. At the time of the ex-post evaluation, the Panshitou dam is playing an important role for urban water supply and irrigation around Hebi City, and consistency with the development needs at the time of the appraisal was confirmed. In addition, consistency with Japan's ODA policy at the time of the appraisal was confirmed. With regard to efficiency, the outputs were almost as planned, but because of the enactment of a new resettlement law and the delay in F/S approval by the State Council of China, both the cost and the period of the project exceeded the plan significantly. Because of the decreasing precipitation in recent years, the achievement level is low in a few operational indicators such as water level of dam reservoir, but the Panshitou dam, as planned, is made to withstand once in 100-year flood. Stable water supply is provided for urban water and irrigation. In addition, the dam is making a significant contribution to conserve the natural environment of the area surrounding reservoir and downstream. There is a large-scale resettlement in the project, and its process was prolonged because of the enactment of the new resettlement law and changes in the social situation. The process resulted in more respect for the rights and views of the people affected than before. Institutional aspects of operation and maintenance are in place, and the technical level of personnel for operation and maintenance is appropriate. In financial aspects as well, necessary budget allocations for operation and maintenance are likely to continue. No problem was observed in the current status of operation and maintenance.

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

1. Project Description



Project Location



Photo 1: Panshitou Dam

1.1 Background

In China, the distribution of water resources is uneven, and the northern region has limited water resources than the south. This is because the precipitation decreases towards the north and inland areas as most of the water vapor, which is the source of rainfall, originates around the Pacific coast in the south. In particular, because surface water (river stream) constitutes 96.4% of China's 2.81 trillion m³ water resources, the northern region with low precipitation and a high evaporation rate suffers from chronic shortage of water resources.

By contrast, as the seasonal wind from the Pacific coast containing vapors hits the mountains and then it rains, rainfall is concentrated in two to three months during summer and does not accumulate sufficiently as groundwater, making the northern region susceptible to flooding.

In this way, the Haihe River basin in the North China Plain has suffered damages from recurring floods since the dawn of history. Flood damages have been particularly frequent in northwest Henan Province. The flood of 1963 was particularly devastating, affecting 22 million people and 4.86 million m² of agriculture land while causing the economic loss of 6 billion yuan.

Subsequently, the Chinese government launched in 1988 a full-fledged effort to control flood and created a water resource master plan for the Haihe River system (*Haihe River Basin Comprehensive Regulations*) including Weihe River to prepare for floods that are of a scale similar to the 1963 flood.

Based on the master plan, the State Council of China decided in 1993 to construct a multi-purpose dam for flood control, irrigation, urban water supply and power supply in the upstream of Weihe River. In other words, the State Council decided to implement the Panshitou Reservoir Construction Project.

1.2 Project Outline

The objective of the project is to reduce the flood damage in downstream areas while providing irrigation, urban water supply and power supply in the Panshitou area located along a branch of Weihe River, i.e., 15 km southwest of Hebi City of northwest Henan Province, by constructing a multi-purpose dam, thereby contributing to the improvement of the living standards of residents in the area and the economic development of the region.

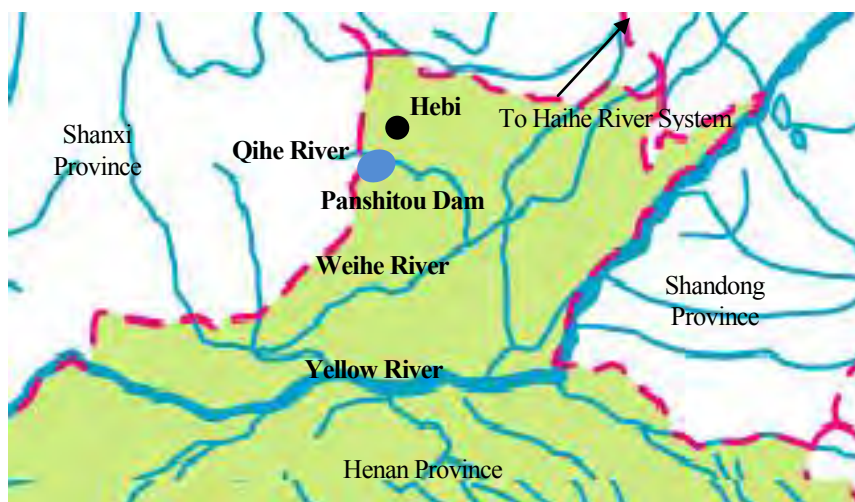


Figure 1: Project Site and Nearby River Systems

Loan Approved Amount/ Disbursed Amount	6,734 million yen / 6,727 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	December 1998 / December 1998
Terms and Conditions	<p>Interest Rate 1.3% (equipment) 0.75% (generator and consulting services¹)</p> <p>Repayment Period 30 years (equipment) 40 years (generator and consulting services²)</p> <p>(Grace Period) (10 years)</p> <p>Conditions for Procurement General untied (Bilateral tied for consulting services³)</p>
Borrower/ Executing Agency	Government of the People's Republic of China/ Henan Provincial Department of Water Resources
Final Disbursement Date	July 2006
Main Contractor (Over 1 billion yen)	Inner Mongolia North Hauler Joint Stock Co., Ltd (China)
Main Consultant (Over 100 million yen)	N/A
Feasibility Studies, etc.	Henan Water Resources Research Institute, 1990 F/S
Related Projects	<p><u>ODA Loan</u>: Liaoning Baishi Reservoir Construction Project (1996–2002); Sanjiang Plain Longtouqiao Reservoir Construction Project (1996–2002); Tongyu River Irrigation Development Project (I) (II) (1991–1997, 1995–2000); Guanying Multipurpose Dam Project (I) (II) (III) (1988–1995, 1989–1996, 1990–1997); Hunan Urban Flood Control Project (2000–2011); Hubei Urban Flood Control Project (2000-); Jiangxi Urban Flood Control Project (2000-)</p> <p><u>Technical Cooperation</u>: Capacity Development Project for Management Plan of Dam in China (2009–2013); Regional Training for Flood Hazard Mapping (2008)</p> <p><u>World Bank</u>: Taihu Basin Flood Control Project (1993–2001); Xiaolangdi Multipurpose Project (1994–2000); Yellow River Flood Management Project (2002–2008); Xining Flood Control and Watershed Management Project (2009-)</p> <p><u>ADB</u>: Henan Wastewater Management and Water Supply Sector Project (2006–2011); Henan Hebi Qihe River Basin Environment Improvement and Ecological Conservation Project (Planned)</p>

¹ However, the consultants were hired at the Chinese side's own expense after the project started. For details, see "3.2.1.2 Consulting Services."

² Same as above.

³ Same as above.

2. Outline of the Evaluation Study

2.1 External Evaluators

Yumiko Onishi and Yuko Kishino (IC Net Limited)

2.2 Duration of Evaluation Study

Duration of the Study: August 2014 - November 2015

Duration of the Field Study: November 2–14, 2014, and March 8–13, 2015

2.3 Constraints during the Evaluation Study

It was not possible to obtain permission from the Hebi Municipal Government to conduct a beneficiary survey because the resettlement process was still taking place at the time of the ex-post evaluation⁴. Therefore, no survey targeting the beneficiaries of the project was conducted in the ex-post evaluation.

In addition, there are limits to some of the data related to effectiveness and finance of the Panshitou Dam Construction Management Bureau (hereinafter referred to as the “implementing agency”) that are provided by the implementing agency because of regulations by the Chinese side on information disclosure. The ex-post evaluation was attempted with the information collected with these constraints.

3. Results of the Evaluation (Overall Rating: B⁵)

3.1 Relevance (Rating: ③⁶)

3.1.1 Relevance to the Development Plan of China

Triggered by the flood that occurred in the Haihe River basin in 1963, the Chinese government launched a full-fledged effort to control flood. Based on the 1988 water resource master plan on the Haihe River system, the State Council of China decided in 1993 to construct a multi-purpose dam (i.e., the project) upstream of Weihe River. The project was designated as one of the most important ones in the *Ministry of Water Resources (Haihe River Basin Development) Ninth Five-Year Plan* and the *Henan Province Ninth Five-Year Plan*. In addition, as a decision of the State Council, the Chinese government began in October 1997 implementing the industrial water policy for the period between 1997 and 2010. Specifically, seven major river systems⁷ including Haihe, Yangtze and Yellow Rivers would continue to be the priority for water resource development. Furthermore, the following were mentioned as major issues:

- Establishment of flood control system that can withstand a flood that may occur once in 50-year in major rivers and urban cities
- Repairing and remodeling of existing outdated water resource facilities
- Expansion of water supply capacity (providing drinking water supply in drought-prone areas, South-North Water Transfer Project (Nanshui Beidiao Gongcheng)⁸, watershed conservation, water

⁴ The project has been in operation because only a portion of resettlement in the upstream areas has been incomplete and it is possible to store a certain amount of water in the reservoir.

⁵ A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

⁶ ③: High, ②: Fair, ①: Low

⁷ Songhua River, Liao River, Haihe River, Yellow River, Huaihe River, Yangtze, and Zhu Jiang.

⁸ A project that diverts water from the southern region to the north to resolve chronic water shortage.

saving using advanced technology, agricultural irrigation, drainage, etc.)

- Rational water pricing and establishment of a fee collection system
- Comprehensive water resource use, hydroelectric power, research and development on water resource technologies, etc.

In addition, the Chinese government decided in the summer of 1998 to put high priority on water resource construction and strengthening of facilities for ecological and environmental protection as being central to national economy and social development over the next few years in response to the worst ever flood that occurred around the Yangtze River basin and the northeast region. Specifically, the government envisaged the following: by enhancing the national budget for investment in water resource construction, strengthening the embankment of the seven major rivers, development of medium and small rivers, construction of water resource centers, repairing damaged facilities, and afforestation and protection of natural forest resources in the up- and midstream areas of the seven major rivers.

The *People's Republic of China National Economic and Social Development Twelfth Five-Year Plan* (2011–2015), the national development plan at the time of the ex-post evaluation, still cites as a priority the strengthening of flood control capacity. In addition, the National Water Resource Development Plan (2011–2015) that was formulated in 2012 mentions strengthening flood control in the Yangtze and Yellow River basins where the damage from flood has been historically severe. Regarding the Haihe River system, the latter plan states that water pollution is a serious problem and it is necessary to protect the ecosystem in its watershed. Therefore, flood control remains an important area in China. In addition, the project has contributed to conserving the water quality of Qihe River⁹ located in the project area and protection of the environmental and ecological systems in the river's watershed in recent years. These activities match the objective of the National Water Resource Development Plan.

3.1.2 Relevance to the Development Needs of China

The Haihe River basin located in the North China Plain has suffered damages from recurring floods since the dawn of history. In northwestern Henan Province, the damages from floods have been frequent, and the flood of 1963 was particularly devastating. In the Qihe River basin, floods also occurred in 1970 and 1996. The flood of 1996 was scale of once in 18-year and affected an area of 15,800 km² and a population of 100,000, causing the economic loss of 900 million yuan.

There has been no flood in the project area after 1996 until the time of the ex-post evaluation; however, the possibility of floods cannot be ruled out. The average annual precipitation of Hebi City of Henan Province where the Panshitou dam is located is 664.9 mm. In recent years, precipitation has decreased. The year 2013 saw so little precipitation that it was said to be the first drought in 63 years. Although it was not possible to obtain the precipitation data of 2013 for Hebi City, those of the same year for Qixian County and Xunxian Country adjacent to Hebi City were only 485.5 mm and 348.5 mm, respectively.

Development needs for urban water supply, irrigation and power generation along with flood control were confirmed ex-post facto. It was not possible to collect data on demand changes on urban water supply in Hebi

⁹ The river belongs to the Haihe River system.

City, which is within the project area. However, according to the Hebi City Annual Statistical Yearbook, the city population increased from 0.42 million in 1996 to 1.45 million in 2007, and then 1.62 million in 2013, indicating that the demand for urban water must have also increased tremendously. The project serves the water supply needs of Hebi City by providing stable water supply to the ever-increasing urban population continuously while other sources of water supply are limited.

Henan Province is an agricultural area where the cultivation of maize and wheat has been thriving from earlier time. The project aimed to provide stable supply of irrigation water with an irrigation water guarantee rate¹⁰ of 55%.

No information is available on the power demand of Hebi City from the time of the appraisal. However, according to the Henan Province Statistical Yearbook, the power consumption in the Province increased from 7.244 million ton SCE¹¹ in 1998 to 1.8 times that amount in 2004, and then more than three times by 2013. The trend in the power consumption of Hebi City from 2007 is also listed in the yearbook; the consumption increased to 1.7 times the 2007 amount in the six-year period to 2013.

Accordingly, in addition to flood control, the Panshitou dam plays an important role in urban water supply and irrigation. Power generation from the project also meets the power demand in China to a limited extent. Therefore, it is fair to say that the project is in line with the development needs of the target area at the times of the appraisal and ex-post evaluation.

3.1.3 Relevance to Japan's ODA Policy

The First Three-Year¹² of the Fourth Japanese ODA Loan (fiscal years 1996–98) corresponds to the Chinese government's *Ninth Five-Year Plan* by placing priority on assistance to agriculture, addressing regional income disparities, and the environment. In the *Medium-Term Strategy for Overseas Economic Cooperation Operations* (1999–2002) that was in force at the time of the appraisal, a) assistance for poverty alleviation and economic and social development, b) tackling global issues, and c) assistance for economic structural reform were identified as important areas. In addition, the *Economic Cooperation Program for China* formulated in 2001 gave priority to the following six areas:

- Cooperation in addressing global issues such as environmental problems
- Support to reforms
- Promotion of mutual understanding
- Assistance for poverty alleviation
- Support to private sector activities
- Promotion of bilateral cooperation

In the light of the Japanese aid policy at the time of the appraisal, the assistance to the water resource sector, which would result in development of agricultural infrastructure, increase in food production, and reducing regional income disparity, was in line with the *Medium-Term Strategy for Overseas Economic Cooperation*

¹⁰ The water guarantee rate is the ratio of years in which a minimum amount of irrigation water is guaranteed during drought. A guarantee rate of 50% means that a response to drought can be done once every two years.

¹¹ SCE stands for Standard Coal Equivalent. In China, SCE is used to measure energy consumption.

¹² The Fourth Japanese ODA Loan (fiscal years 1996-2000) was divided into two terms, fiscal years 1996-98 was the first three years and fiscal years 1999-2000 was the second three years.

Operations at that time.

Therefore, the project is highly relevant to China's development plan and development needs as well as Japan's ODA policy, and its relevance is high.

3.2 Efficiency (Rating: ①)

3.2.1 Project Outputs

3.2.1.1 Major Structures

The output of the project is the construction of a multi-purpose dam for flood control, urban and industrial water supply, irrigation and power generation. Table 1 shows the planned and actual major structures of the project.

Table 1: Comparison between Planned and Actual Major Structures

Output		Planned	Actual
Dam	Height	101.0 m	102.2 m
	Length	588 m	626 m
	Width	8 m	8 m
	Storage capacity	616 million m ³	608 million m ³
	Effective storage capacity	586 million m ³	586 million m ³
Spillway		102 m	102 m
Drainage		525.56 m	525.56 m
Power generation		7,890 kw	9,380 kw

Source: Materials provided by JICA (planned) and the executing agency (actual)

There is a slight difference between the planned and actual specifications of the dam including dam height, length and water storage capacity. These changes are made because a few modifications were made in the detailed design after the project started, taking into consideration such matters as the condition of the construction site. With regard to flood control, the main objective of the project, a dam that can withstand once in 100-year flood was constructed, and the flood control area of 1,915 km² remained unchanged from the plan.

According to the plan at the time of the appraisal, out of the effective storage capacity of 586 million m³, 333 million m³ was to be for flood control, 118 million m³ for irrigation, and 135 million m³ for urban water supply. The actual effective storage capacity is 363 million m³ for flood control and 283 million m³ for other purposes; however, 60 million m³ overlaps for flood control and other purposes. Urban water supply, irrigation and the environment constitute the portion of the effective storage capacity other than flood control. The environment refers to the water released into Qihe



Photo 2: Spillway¹³

¹³ Gate used for releasing water when flood of a once in 100-year scale occurs.

River for protecting the environment and the ecological system downstream of the Panshitou dam.

The generation capacity of the power station constructed next to the dam was planned to be 7,890 kw at the time of the appraisal, but it was modified to 10,000 kw in the detailed design. However, the actual capacity was changed to 9,380 kw after it was once again reconsidered in line with the storage capacity of the dam and the altitude difference between the dam and the power station. Two stations use the hydropower from the dam; the power station No. 1 has two generators with the capacity of 1,250 kw and one with 630 kw and the power station No. 2 has two 2,500 kw generators and a 1,250 kw one. All the hydroelectricity from the Panshitou dam is supplied to the national grid. Therefore, except for the portion connecting to the national grid, no new transmission and distribution networks were developed.

Besides the dam and the power station that were constructed using the funds from the project, the existing water treatment plants No. 1 and 2 in Hebi City for supplying water in urban areas using the water of the Panshitou dam were expanded. However, the expansion was implemented not by the implementing agency of the project but by Hebi Water Service Company using funds other than those of the project. Also, the Hebi City Water Resources Bureau developed water transmission and distribution lines.

Regarding irrigation using the water from the Panshitou dam, because the project aimed to improve the water guarantee rate in the existing irrigated areas, the field channels in the project area were in existence even before the project, and no new irrigation facilities were developed. The water guarantee rate in the project area is unknown, but a plan was to achieve 55.4% using the Panshitou dam. According to the Hebi City Water Resources Bureau, although there are no detailed data on the actual water guarantee rate, it achieved approximately more than 50%.

As described above, there have been slight changes in major structures; however, the dam was constructed with flood control capacity as per the initial plan. With regard to the power generation capacity, the changes were a result of reconsidering the dam's specifications, and it can be judged that the changes made to the major structures were appropriate.

3.2.1.2 Consulting Services

The plan at the time of the appraisal was to hire international consultants for consulting services in the project. However, after the project started, the implementing agency requested changes in the agreement made at the time of the appraisal between the executing agency and the Japan International Cooperation Agency (hereinafter referred to as JICA)¹⁴ regarding the appropriateness of man-months (M/M) of international consultants and a possibility of doing away with the pre-qualification process. The schedule for employment of consultants was delayed for about one year while changes in consulting services were considered. Meanwhile, to make progress in the project, the implementing agency carried out basic design that international consultants had been supposed to take charge of, and tried minimizing the delay in the project. In addition, of the consulting services envisaged at the time of the appraisal, the implementing agency completed 51 M/M out of 85 M/M for the team leader who was to supervise the design as a whole including the work of such personnel as a design engineer and a geological engineer. Furthermore, it became possible to reduce significantly the

¹⁴ Overseas Economic Cooperation Fund at that time.

amount of procurement-related work because *Standard Bidding Documents under Japanese ODA Loans* was prepared in November 1999 and applied to the project. International consultants' M/M related to procurement was no longer required because procurement for the project did not require special technical consideration. In addition to such circumstances, because China has many design agencies and academic experts that have a wealth of experiences and technical capabilities on the construction of dams with a height of more than 100 m, it was deemed appropriate to hire local consultants. Therefore, in January 2000, it was decided not to hire international consultants, and hire local consultants at the Chinese side's expense instead. Based on these changes, the tasks initially planned to be carried out by international consultants were changed as shown in Table 2.

Table 2: Tasks of International Consultants and Agencies

Task	Agency
Construction management	Local consultant
Advisory for environmental protection measures based on environmental guidelines	Hebi City Bureau of Environmental Protection
Procurement	Panshitou Dam Construction Management Bureau
Reporting to JICA	Panshitou Dam Construction Management Bureau
Training	None

Source: Materials provided by JICA and the executing agency

At the time of the ex-post evaluation, project related personnel of Panshitou Dam Construction Management Bureau which implemented the project explained that the Chinese side asked JICA at the time of the appraisal to hire local consultants for the project. However, because the project was the first ODA Loan project for the executing agency, JICA was concerned about the agency's procurement and management capacity, and decided eventually to hire international consultants. When the change from international consultants to local ones was being considered, the implementing agency carried out such tasks as basic design, and the delay in the project was very limited. Furthermore, hiring the local consultants made it possible to reduce the cost of consulting services. Because the Chinese side bore the cost related to hiring local consultants, the cost of consulting services to be covered by the ODA Loan was used in construction. The implementing agency stated that the performance of the local consultants was highly satisfactory. It is fair to say that it was appropriate in the project to hire local consultants instead of international ones.

3.2.2 Project Inputs

3.2.2.1 Project Cost

Out of the total project cost of 16,382 million yen planned at the time of the appraisal, 6,734 million yen was in foreign currency and 9,648 million yen (603 million yuan) was in local currency. The ODA Loan covered the entire amount of the foreign currency portion. For the local currency portion, the Ministry of Water

Resources was to invest 2,560 million yen (160 million yuan) while the Henan Provincial Government and the Hebi Municipal Government were to invest 4,960 million yen (310 million yuan) and 2,128 million yen (133 million yuan), respectively.

At the time of the ex-post evaluation, the total project cost was confirmed to be 29,513 million yen (180% against the plan). The actual disbursed amount was 6,727 million yen (100% against the plan). Table 3 compares the planned and actual project costs.

Table 3: Comparison of Planned and Actual Project Cost (Unit: million yen)

	a. Foreign currency	b. Local currency	c. Total (a + b x exchange rate)
Planned	6,734	9,648	16,382
Actual	6,727	22,786	29,513

Source: Materials provided by JICA and the executing agency
 Note: The exchange rate for “Planned” is 1 yuan = 16 yen (May 1998, at the time of the appraisal) and “Actual” is 1 yuan = 14.10 yen (average rate between December 1998 and October 2014 obtained from OANDA).

The reason that the project cost became significantly higher than the original plan was the increase in the cost of the resettlement. At the time of the appraisal, the cost of the resettlement was 1,848 million yen; however, it was 15,933 million yen (1,130 million yuan) as confirmed during the ex-post evaluation, which was about nine times the planned amount. The main causes of the significant increase in the cost of the resettlement after the project started are the additional cost and well-equipped infrastructure facilities of the resettlement site developed through negotiations with the affected people based on the resettlement law that was newly enacted in 2006. Resettlement is compensated on the basis of domestic laws; in 2006, the existing related law was abolished, and a new resettlement law named “Regulations on Compensation for Land Acquisition and Resettlement for Large- and Medium-scale Construction Projects for Water Resource and Hydropower Generation” was enacted. The new law, emphasizing the rights of people who are affected, increased significantly the compensation for land acquisition from farmers. Under the old law, the norm for the compensation for land acquisition was three to four times the average market price of the past three years, and it was possible to reduce the compensation amount in the case of a large project; however, the new law increased the compensation amount to 16 times the market price, causing a substantial increase in the cost of land acquisition for resettlement sites. In addition, some of the affected people opted for “community migration,” a type of resettlement described in a later section, incurring an additional cost for developing well-equipped community infrastructures in the relocation site.

The project cost may increase even more because a portion of the resettlement has not been completed at the time of the ex-post evaluation.

The project cost has exceeded the plan significantly because of the increase in the resettlement cost.

3.2.2.2 Project Period

According to the plan at the time of the appraisal, the project period was from December 1998 (time of signing the Loan Agreement) to June 2003 (four years and seven months, i.e., 55 months) and the project would be completed when all the related projects began their operation. As the actual project period, the

construction of the Panshitou dam was completed in June 2006, and the final disbursement was made in July 2006. Storage of water in the dam started in June 2007 and the operation of urban water supply, irrigation and power generation using the water from the dam started in August 2008. Accordingly, the project period is nine years and nine months (117 months) from December 1998 to August 2008, i.e., 213% against the plan. As described in “3.3 Effectiveness,” it was not possible to bring the water level of the reservoir to full because the resettlement is not completed at the time of the ex-post evaluation, but measures are in place to rectify the situation, and the dam can withstand the scale of flood that was originally envisaged. Therefore, it can be judged that the project was completed when the dam and urban water supply, irrigation and power generation using the water from the dam became operational.

The major reasons for the prolonged project period are as follows:

- Delay in the State Council’s approval of the feasibility study (F/S): At the time of the appraisal, it was expected that the State Council would grant necessary approval by the end of 1998 for starting the construction in the project; however, the State Council did not approve the F/S until August 2000, resulting in a delay of about 21 months. According to the Panshitou Dam Construction Management Bureau, although the approval for the F/S by the State Council was assured, it was not possible to estimate how long the actual approval process would take. To keep the delay to a minimum, the implementing agency took actions before the start of the dam construction such as proceeding with the resettlement process and constructing an access road to the construction site.
- Delay in the resettlement process: The resettlement process took time because of such reasons as the enactment of the new resettlement law. Although the process was to be completed by December 2001 at the time of the appraisal, it is still continuing at the time of the ex-post evaluation. The delay in the resettlement of people living in the reservoir area caused a 12-month delay in operationalizing the dam. When the project started, the implementing agency was aware that the resettlement law was going to be changed, but did not know the actual timing of the enactment of the new law. When the timing of the enactment of the new law was confirmed, the implementing agency tried to secure additional funding because it became clear that the resettlement cost would increase on the basis of the new law.

Accordingly, the delays in the approval for the F/S and the resettlement process were not necessarily within the control of the implementing agency. However, because the process of F/S approval is relatively time-consuming, the project period should have been planned upon carefully checking the time required for the process when the project started.

The project period was significantly longer than planned.

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

At the time of the appraisal, the Financial Internal Rate of Return (FIRR) was calculated to be 7.6% and the Economic Internal Rate of Return (EIRR) 15.8%. Benefits envisaged at that time were flood control, urban water supply, irrigation, and electricity supply. At the time of the ex-post evaluation, the External Evaluators discussed re-calculation of IRR with the implementing agency. However, it was not possible to re-calculate IRR for the following reasons: (1) the original calculation method of IRR at the time of the appraisal could not have been confirmed; (2) it was not possible to obtain the cooperation of multiple relevant agencies in

collecting data on not only flood control but also other items including urban water supply, irrigation, and electricity.

Both the project cost and the project period significantly exceeded the plan. Therefore, the efficiency of the project is low.

3.3 Effectiveness¹⁵ (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

In the project, the construction of the multi-purpose dam, i.e., Panshitou dam, was expected to bring about effects on the following: a) flood control; b) urban water supply (domestic and industrial); c) irrigation water supply; and d) power supply. Among these, the implementing agency confirmed that flood control was the most important in the project. After flood control, urban water supply and irrigation were important but power supply was the least important of the four areas. Based on the priority of the four areas, it was decided to evaluate with emphasis on flood control. This section explains the operational and effect indicators for each of the four areas along with their level of achievement.

¹⁵ Rating is based on the judgment on Effectiveness and Impact.

Table 4: Operational and Effect Indicators

	Baseline	Target ¹⁶	Actual	Actual	Actual
	1998	2003	2008	2010	2014
	Year of appraisal	Year of project completion	Year of project completion	2 years after project completion	6 years after project completion
Operational Indicators					
1. Annual maximum flow (m ³ /s)		Design value 6,650	—	—	—
2. Annual highest water level (m)		Design value 254 ¹⁷	No data	233.55	238.10
3. Discharge capacity (m ³ /s) ¹⁸		Design value Spillway 6,263 Spillway tunnels 2,374	—	—	—
4. Annual total volume of inflow (m ³)	240 million	360 million	No data	130 million	120 million
5. Incidence of flood control (times/year)	0	—	—	—	—
6. Annual supply of industrial and domestic water (m ³)	0	135 million	80 million	82.95 million	92.74 million
7. Irrigated area (ha)	20,000	20,000	20,000	20,000	20,000
8. Annual supply of irrigation water (m ³)		13.77 million	No data	No data	27.00 million
9. Capacity factor (%) ¹⁹		Not established	Average 75		
10. Availability factor (%) ²⁰		Not established	Average 77		
11. Unplanned outage hours (hours/year) ²¹		0	Average 0		
12. Hydropower utilization factor (%)		Not established	Average 77		
13. Beneficiary population (people)		1.8 million	No data	No data	2.1 million
Effect Indicators					
14. Corresponding capacity for flood return period		Once in 100-year	Once in 100-year	Once in 100-year	Once in 100-year ²²
15. Annual maximum inundated area (km ²)	15,800	0	—	—	—
16. Population served (%)	96	No data	No data	No data	100
17. Yield of major agriculture crops (kg/mu ²³)	Wheat 430 Maize 450	430 450	No data	No data	620 600
18. Annual power generation (kwh)		25.00 million	Average 6.15 million		
19. Electricity supply (kwh/year)		No data	Average 390		
20. Maximum output (kw)		Design value 9,380	9,380	9,380	9,380

Source: JICA and the executing agency

Note: Actual values of operational and effect indicators 1, 3, 5 and 15 are marked “—” because there has been no flood in the project area since the project started. They do not indicate the achievement level of these indicators.

Flood control

The target values of the operational indicators from 1 to 3 are based on the design of the Panshitou dam. The reservoir, spillway, and spillway tunnels are properly maintained and have capacity as per the design. In recent years, “2. Annual highest water level” has not reached 247 m, the highest level possible while the resettlement is incomplete, because of the reduced precipitation in the project area. “4. Annual total volume of

¹⁶ In the project, operational and effect indicators and their target values were not established at the time of the appraisal. Therefore, representative indicators for flood control, urban water supply, irrigation and the power sector were selected at the time of the ex-post evaluation, and baseline and target values were confirmed ex post facto to the extent possible.

¹⁷ The maximum water level according to the design is 254 m; however, because the resettlement is incomplete upstream at the time of the ex-post evaluation, 247 m is the maximum possible water level.

¹⁸ Spillway is used to release water downstream when once in 100-year flood occurs. Spillway tunnels are used to release water when there is flood smaller than the scale of once in 100-year.

¹⁹ Capacity factor = electricity supply / (maximum output x annual number of hours) x 100

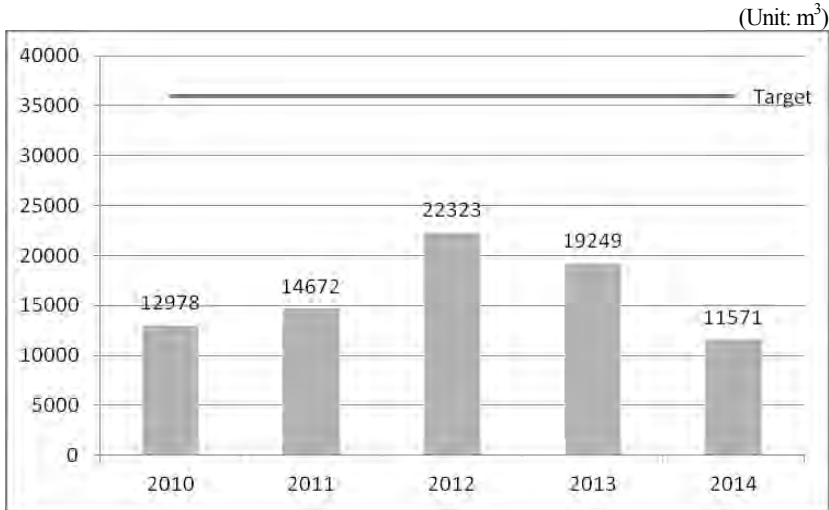
²⁰ Availability factor = (annual operation hours / annual number of hours) x 100

²¹ Unplanned outage hours = (electricity supply / annual possible power generation in the year) x 100

²² When the maximum water level is 254 m. Currently, to achieve this figure, the residents need to be evacuated because the resettlement is not completed upstream.

²³ Unit indicating the size of agricultural land in China. 1 mu = 1/15 ha.

inflow” has been monitored since 2010 and, as shown in the figure below, the annual total volume of inflow is significantly below the target value because of the reduced precipitation. Actually, the volume of inflow since 2010 has been lower than the baseline value. The average annual precipitation of Hebi City at the time of the appraisal was 674.8mm, but in 2013, the precipitation data of Qixian County and Xunxian County adjacent to Hebi City were 485.5 mm and 348.5 mm, respectively.



Source: Executing agency

Figure 2: Changes in Annual Total Volume of Inflow

Similarly, for the effect indicator “14. Corresponding capacity for flood return period,” the Panshitou dam is capable of withstanding once in 100-year flood.

Because the relocation of residents has not been completed, based on the instructions from the Henan Province Flood Control Office, there is a regulation to evacuate upstream residents and protect the people downstream if a major flood of once in 100-year occurs. According to the implementing agency, there is a regulation to compensate for damaged houses and agriculture land of the residents who are forcefully evacuated in an emergency situation.

Urban water supply

With regard to “6. Annual supply of industrial and domestic water” using the water from the Panshitou dam, the average actual value from 2008 to 2014 is 85.59 million m³ and the achievement against the target is 63%. The probable reason that the achievement is below the target is the low water level in the reservoir in recent years. Approximately 30 to 40% of the water supplied is provided to water treatment plants as domestic water, and the rest of the water is supplied to industries such as cement factory around Hebi City.

“16. Population served” in Hebi City by the water connection was 96% in 1998, i.e., the time of the appraisal, and is estimated to have reached 100% in 2014. In addition, although it was not selected as an indicator because of the lack of detailed data, according to the implementing agency, water supply hours that had been restricted became 24 hours a day because of the project, implying that stable water supply is provided to the residents. In addition, as described in “3.4.2 Other Impacts,” the water quality of the dam is one of the

best in China, and high-quality soft water is supplied to Hebi City.

Irrigation

At the time of the appraisal, supply of water to a total of 20,000 ha in four irrigation areas was planned. The four irrigation areas were existing ones, and after considering the size of the areas, three irrigation areas ended up using the water from the Panshitou dam. The actual value of “8. Annual supply of irrigation water” is an estimate by the Hebi Water Resources Bureau. However, the figure is 196% against the target, making it an unrealistically high figure considering the low level of water in the reservoir. The figure includes the irrigation using groundwater, and it was not possible to measure only the effect of the project.

The target and actual values of “17. Yield of major agriculture crops” are the average of Hebi City. The increase in the yield of agriculture crops may be due to not only the irrigation but several other reasons such as improvement in agricultural technology.

Power supply

For power supply, except “11. Unplanned outage hours” and “18. Annual power generation,” it was not possible to set the target values of operational indicators ex-post facto. The target and actual values of “20. Maximum output” are based on the design of the generator. With regard to actual values of power generation, only the average actual values between the time that the power stations started operating and the ex-post evaluation were provided.

Because target values were not set, it was difficult to determine the degree of achievement in regard to the actual values. Therefore, “9. Capacity factor” and “10. Availability factor” were checked with a hydropower expert of the Hangzhou Regional Center for Small Hydro Power. The expert stated that the actual values of the project were relatively high. For reference, in the Hubei Small-Sized Hydropower Project (Loan Agreement signed in 2001), the target for the capacity factor is set at 34 to 49%. For “12. Hydropower utilization factor,” the average in China is 45% according to the Hangzhou Regional Center for Small Hydro Power, and it is clear that the rate for the project is relatively high.

“18. Annual power generation” is significantly below the target because of the low precipitation and the low level of water in the dam that also affected power generation.

3.3.2 Qualitative Effects

In the project, appropriate flood control and reduction in flood damage were expected as qualitative effects. As described earlier, there has been no flood in the project area from the start of the project to the time of the ex-post evaluation. Therefore, it is not possible to confirm specific effects that may appear at the time of a flood other than those confirmed based on the design of the dam.

“3.4 Impact” describes other qualitative effects of the dam constructed by the project that were confirmed by interviewing the implementing agency.

3.4 Impacts

3.4.1 Intended Impacts

As impacts of the project, improvement of the living standards of local residents and economic development of the region were expected. At the time of the ex-post evaluation, citing the ongoing resettlement process related to the project, the approval for conducting a beneficiary survey could not have been obtained from Hebi Municipal Government and the survey targeting local residents and businesses was not carried out. Therefore, the information in the following section is based on the interviews with the implementing agency and secondary data.

Improving the income and living standards of local residents

It was not possible to obtain detailed data on the annual income of farmers who live around the Panshitou dam before and after the project implementation and the rate of its increase. However, according to the implementing agency, the income increased by 795 yuan.

The Panshitou dam supplies water to Hebi City. At the time of the ex-post evaluation, the water supply to Hebi City was available 24 hours a day using the water from the dam. However, before the project, the water supply was limited to specific hours daily. As indicated in the change in water supply hours, the dam contributed to improving the living standards of local residents to a certain extent.

Regional economic development

According to the Henan Province Statistical Yearbook, the amount of industrial water consumption in Hebi City in 2013 was 50.85 million m³. According to the data provided by the Panshitou Dam Construction Management Bureau, 89.45 million m³ of urban water was supplied from the dam in 2013 out of which 57.27 million m³ was provided to industrial units such as cement and chemical fertilizer plants. Although there is a slight gap between the data of the Henan Province Statistical Yearbook and the one provided by the implementing agency, it is not an exaggeration to say that the dam plays an important role for the industries in the region because the amount of industrial water supplied from the dam exceeds the industrial water consumption of Hebi City.

3.4.2 Other Impacts

Impacts on the Natural Environment

With regard to the environmental approval on the project, the Environmental Impact Assessment (EIA) was conducted according to the People's Republic of China Environmental Protection Act and Supervision for Environmental Protection in Construction Project Act, and the result of the EIA was ratified by the Ministry of Environmental Protection in June 1993. At the time of the appraisal, the project was classified as category A in the *OECD Guideline for Environmental Considerations Version II* because the project faced an issue of land acquisition. In the EIA, impacts on water quality, volume and temperature were considered relatively high. At the time of the EIA, the water quality in the project area was fairly good and categorized in Class I and II²⁴ in

²⁴ The permissible level is specified for several items that indicate the quality of surface water. There are Class I to V, and Class I indicates

the national water quality standards. The need for appropriate environmental measures was pointed out because the dam is close to the Hebi City urban area and there was a concern on the inflow of domestic and industrial wastewater into areas surrounding the dam during and after the project. In addition, after the completion of the reservoir, it was forecasted that the river temperature will change from the range of 4.8-25 °C at the time of the EIA, to 6.9 -18.9 °C. It was also pointed out that it was necessary to analyze the impact on agricultural crops and the ecosystem such as fish (organisms that required special protection do not exist) downstream caused by the change in water temperature and take appropriate measures to address the impact. Also regarding water volume, reduction in it was a concern because of the change in the amount of water in the river after the completion of the dam reservoir; therefore, it was pointed out that appropriate water volume management was required. With regard to monitoring, regular monitoring was to be carried out by the environmental protection agency.

At the time of the ex-post evaluation, it was confirmed that, from the period of project implementation until now, the Hebi City Environmental Protection Bureau has been conducting monitoring on water quality of Qihe River every month. Monitoring is conducted for 27 items including biological oxygen demand (BOD) and chemical oxygen demand (COD), and the water quality of the Panshitou dam meets national standard Class I (best quality) for 26 out of the 27 items. Thus the water quality in the areas surrounding the dam is good, and the effort to maintain good water quality and protect the ecosystem in the surrounding area has been recognized and resulted in being certified as a “National Good Ecology and Environment Lake” in 2013. Further, the Chinese government has provided funds to maintain the water quality and protect the ecosystem in the future. In relation to water volume, a record of discharge from the Panshitou dam to downstream is kept every month. With reference to monitoring of the water temperature, the matter was consulted with environmental experts after the project started. It was determined that monitoring was unnecessary because the discharge from the dam merges with other rivers downstream and the water temperature would be kept constant.



Photo 3: Qihe River Wetland Park

The interviews conducted during the ex-post evaluation revealed a positive impact on the environment of the downstream area of Qihe River due to the construction of the dam. According to the implementing agency, before the project, the water volume of Qihe River decreased to less than 70% of usual years in the dry season. However, after the project, thanks to the dam, a constant amount of water flows throughout the year. In addition, in the Qihe River Wetland Park located downstream of the dam, vegetation in the park improved after the construction of the dam.

It was not possible to confirm the status of environmental pollution during the project implementation through a beneficiary survey. However, according to the implementing agency, problems from the

good quality while Class V means poor quality of water.

construction of major structures did not arise because the relocation of residents from the surrounding area was completed when the construction started.

Land Acquisition and Resettlement

The plan at the time of the appraisal envisaged 334 ha of agricultural land acquisition and resettlement of 12,727 people or 3,264 households. Resettlement was to be carried out in stages by dividing the people into three groups: 1,381 people were to be relocated to an area close to the project site, and 11,346 people to the existing national farm in Xunxian County close to Hebi City. For the resettlement, compensation was to be paid in accordance with the domestic law and was to be completed by the end of 2001.

The table below shows the progress of resettlement at the time of the ex-post evaluation. Note that the resettlement of Group 3 is still ongoing at the time of the ex-post evaluation. The resettlement of the remaining 1,000 people is to be completed by June 2015.

Table 5: Progress of Resettlement (As of March 2015)

	Land acquisition	Resettlement	Population	Cost (thousand yuan)
Group 1	August 2000	December 2000	1,746	25,000
Group 2	Nov. 2001–Sept. 2009	Nov. 2001–Oct. 2009	12,660	455,000
Group 3	December 2011–2014	Dec. 2011–June 2015 (planned)	4,710	650,000
Total			19,116	1,130,000

Source: Executing agency

Reasons for increased resettlement population from the original plan are; population increase with the passage of time; and inclusion of people who wanted to be relocated along with other residents although the houses of the former would not be affected but their agricultural land would be submerged. The cost and timeline of the resettlement are as described in “3.2 Efficiency.”

For resettlement, briefings were provided to the affected people prior to the resettlement, and repeated negotiations were done regarding compensation and plans for relocation. Each affected person was compensated with 0.07 ha of agricultural land and cash. For housing and community infrastructure in the new site, two types, namely “agricultural migration” and “community migration” were made available. In agricultural migration, the affected people are provided with the cost of housing construction by the implementing agency, and build individual houses in the allocated land area. Group 1 and 2 are those of agricultural migration. By contrast, community migration is an option to relocate to group housing equipped with medical and commercial facilities in addition to basic infrastructure such as electricity, gas



Photo 4: Exterior of Nanhai Community

and the internet based on the demand from the affected people.

At the time of the ex-post evaluation, a few residents were interviewed in “Nanhai community” where the resettlement took place as part of Group 3. One of the residents seemed very satisfied with his new home equipped with running water and gas because, in the village where he had lived before the resettlement, drinking water had to be brought from the river and wood and coal were used for cooking.

Judging the effectiveness and impact overall, the project effects are seen as per the plan in flood control, the most important area. Although the actual value is below the target one for the annual highest water level and the annual total volume of inflow for the reservoir, it does not hamper the effect of flood control because it is caused by reduced precipitation in recent years. In urban water supply, the second most important area after flood control, high-quality water is supplied in a stable manner to the residents and industries of Hebi City. There are somewhat weak effects from urban water supply, irrigation and power, but these are caused by the water shortage in recent years.

The project maintains high-quality water in the reservoir and its downstream area while conserving the ecology of the area by releasing water constantly.

The resettlement was of a large scale and negotiations for compensating the affected people were difficult at times. However, it was eventually done in such a way that it respected the views and rights of the affected people.

This project has largely achieved its objectives. Therefore, effectiveness and impact of the project are high.

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

The executing agency of the project is the Henan Province Water Resources Department that is overseen by the Ministry of Water Resources and the Henan Provincial Government. The implementing agency is the Panshitou Dam Construction Management Bureau that was established in June 1997 by funds from the Henan Province Water Resources Department and the Hebi Municipal Government. According to the plan at the time of the appraisal, for operation and maintenance after the project completion, the Panshitou Dam Management Bureau was to be newly established based on the Panshitou Dam Construction Management Bureau.

The project was implemented as planned by the Panshitou Dam Construction Management Bureau as the implementing agency. The Bureau has ten divisions including those dealing with operation, resettlement, finance and water resources. The number of personnel in the Bureau is 40 and there is no vacancy at the moment. The Bureau intends to keep the same number of personnel even after the completion of the resettlement. This is to avoid a plethora of tasks among the current personnel in operation and maintenance by shifting those who are involved in resettlement to operation and maintenance.

The role of the Panshitou Dam Construction Management Bureau is the operation and management of the dam with special attention to flood control. The system required for this purpose is in place. The release of water during a flood is carried out based on the instructions from the Henan Province Flood Control Office. And, the Hebi City Water Resources Bureau takes charge of the forecast and warning for water release.

Hebi City Water Company is in charge of the water treatment plants of urban water, and the Hebi City

Water Resources Bureau is in charge of irrigation facilities. Heyuan Qianhehu Hydropower Company Ltd. is responsible for the operation and maintenance of the power station, and all the electricity generated from the power station is supplied to the national grid.

3.5.2 Technical Aspects of Operation and Maintenance

At the time of the appraisal, the Henan Province Water Resources Department, the executing agency, had experience in implementing many water-related projects in the province and its capacity for project implementation was deemed to have no problems. The project was actually implemented by the Panshitou Dam Construction Management Bureau without any technical problems.

Out of 40 personnel of the Panshitou Dam Construction Management Bureau, three have a high-level technical certification while 20 have a mid-level and 10 have a basic-level. In addition, five more personnel with a university degree are expected to obtain a technical certification in due course. According to the Panshitou Dam Construction Management Bureau at the time of the ex-post evaluation, the technical level of its personnel is sufficient for carrying out proper maintenance for facilities. To maintain and improve their technical level, there are systems of sending them to university and conducting training by inviting experts; and the systems are used when necessary.

According to the implementing agency, manuals on maintenance of the Panshitou dam have been developed and are used by its personnel properly. Regarding the spillway that will be used when once in 100-year flood occurs, inspection is conducted every month to ensure that it works properly. Therefore, it is fair to say that the technical aspects of operation and maintenance of the Panshitou dam have no issues at the time of the ex-post evaluation.

3.5.3 Financial Aspects of Operation and Maintenance

The Panshitou Dam Construction Management Bureau was expected to have enough assets during and after the project with assistance from the Ministry of Water Resources and the Henan Provincial Government through the Henan Province Water Resources Department. Financial aspects of operation and maintenance of the dam were verified at the time of the ex-post evaluation. The Panshitou Dam Construction Management Bureau receives financial assistance each year for operation and maintenance mainly from the Hebi Municipal Government. Normally, the Bureau prepares budget documents and requests the municipal government for the budget. In fiscal year 2014, the originally requested amount of the budget was 1.5 million yuan and the actual amount spent was 1.71 million yuan. According to the implementing agency, the operation and maintenance budget and expenditure is about 1.5 million yuan each year. The Panshitou dam releases the water required for urban water supply for Hebi City, irrigation and power generation. The agencies in charge of each project collect fees for these purposes. The collected fees do not become direct revenue of the implementing agency because they are given to the municipal government.

Table 6 shows the public finance of the Hebi Municipal Government indicated in the Henan Province Statistical Yearbook. From 2009 to 2013, both revenue and expenditure are on the rise. It is noteworthy that, in the last three years, the public fiscal expenditure is a huge amount of 8 billion yuan against the public fiscal revenue of 3 billion yuan.

Table 6: Public Finance of Hebi City (Unit: million yuan)

Fiscal year	Public fiscal revenue	Public fiscal expenditure
2009	1,801	4,634
2010	2,215	5,913
2011	2,802	7,425
2012	3,266	8,350
2013	3,964	8,692

Source: Henan Province Statistical Yearbook

Meanwhile, the municipal government receives financial reinforcement from the provincial government. In fiscal year 2013, there were transfers of 2.2 billion yuan general revenue and 2.4 billion yuan special revenue from the Henan Provincial Government to the Hebi Municipal Government; the actual fiscal revenue becomes 9.4 billion yuan when other revenues are taken into account. With regard to expenditure, in addition to the public expenditure of 8.7 billion yuan, the total is 9.3 billion yuan including principal repayment of government bonds among other items. Thus it is fair to say that the public finance of Hebi City is sound.

Budgetary provision from Hebi City and the Henan Provincial Government to the implementing agency is expected to continue hereafter as well. The Panshitou dam is very important from the perspective of flood control and urban water supply for Hebi City located in its downstream area. In addition, the maintenance budget allocated to the Panshitou Dam Construction Management Bureau is only 4% of the fiscal revenue of the municipal government in 2013, which is not a huge financial burden. Therefore, the finance of the implementing agency as well as the Hebi Municipal Government that allocates budget to the implementing agency does not have any major problems, and stable budget allocation is expected in the future as well.

3.5.4 Current Status of Operation and Maintenance

At the time of the field survey, it was confirmed that the dam and the spillway were kept in proper conditions. Regarding the spillway, to ensure that it works properly, regular inspection is conducted to prepare for flood. So far, there has been no siltation problem. There are no spare parts that are difficult to procure within the country for the project. There has not been any trouble until today since the dam started its operation.

Other than in the field of flood control, the irrigation channels are in relatively good condition. The power station is also kept clean and seems to be in good condition. It was not possible to visit the urban water treatment plant because there was no cooperation from Hebi Water Service Company.

No major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance system. Therefore, the sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The objective of the project was to reduce flood damage while providing irrigation, urban water supply and power supply by constructing a multi-purpose dam in the Panshitou area of Qihe River where flood damages are frequent, thereby contributing to the improvement of the living standards of residents in the area and the economic development of the region. At the times of the appraisal and ex-post evaluation, flood control was mentioned as an important area in China's development policy. At the time of the ex-post evaluation, the Panshitou dam is playing an important role for urban water supply and irrigation around Hebi City, and consistency with development needs at the time of the appraisal was confirmed. In addition, consistency with Japan's ODA policy at the time of the appraisal was confirmed. In efficiency, the outputs were almost as planned, but both the cost and period of the project exceeded the plan significantly because of the enactment of a new resettlement law and the delay in F/S approval by the State Council. Because of the decreasing precipitation in recent years, the achievement level was low in a few operational indicators such as water level of reservoir, but the Panshitou dam is made to withstand once in 100-year flood. Stable water supply is provided for urban water and irrigation. In addition, the dam is contributing significantly to conserving the natural environment of the area surrounding the reservoir and downstream. There is a large-scale resettlement in the project, and its process was prolonged, but it was due to the enactment of the new resettlement law and changes in the social situation. The process resulted in more respect for the rights and views of the people affected than before. Institutional aspects of operation and maintenance are in place, and the technical level of personnel for operation and maintenance is appropriate. In financial aspects as well, necessary budget allocations for operation and maintenance are likely to continue. No problem was observed in the current status of operation and maintenance.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

At the time of the ex-post evaluation, resettlement of approximately 1,000 people has not been completed. It is recommended that the executing agency keep working to complete the resettlement firmly and as soon as possible.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

Check carefully the procedure and time required for starting construction at the time of the appraisal

In the project, the project period was prolonged significantly because of the delay in the approval of the F/S by the State Council. The process of F/S approval requires a relatively long time. Therefore, at the time of the appraisal, the executing agency and JICA should check the required procedure and process for starting the construction in a project as well as the approval status at the time and possibilities of delay thereafter. After

checking these matters, if a delay is likely, then the executing agency and JICA should set the time for starting the project and the project period in such a way that certain delay can be absorbed.

END.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs		
Dam		
Height	101 m	102.2 m
Length	588 m	626 m
Width	8 m	As planned
Storage capacity	616 million m ³	608 million m ³
Effective storage capacity	586 million m ³	As planned
Spillway	102 m	As planned
Drainage	525.56 m	As planned
Power station	7,890 kw	9,380 kw
2. Project Period	December 1998 – June 2003 (55 months)	December 1998 – August 2008 (117 months)
3. Project Cost		
Amount paid in Foreign currency	6,734 million yen	6,727 million yen
Amount paid in Local currency	9,648 million yen (603 million yuan)	22,786 million yen (1,616 million yuan)
Total	16,382 million yen	29,513 million yen
Japanese ODA loan portion	6,734 million yen	6,727 million yen
Exchange rate	1 yuan = 16.00 yen (As of May 1998)	1 yuan = 14.10 yen (Average between December 1998 and October 2014)

Ex-Post Evaluation of Japanese ODA Loan
“Gansu Afforestation and Vegetation Cover Project”

External Evaluators: Shima HAYASE / Yuko KISHINO, IC Net Limited

0. Summary

The Gansu Afforestation and Vegetation Cover Project (hereinafter referred to as the “Project”) aims to improve the forest and vegetation coverage ratios by afforestation and crop planting for preventing desertification, and contribute to social and economic stability. The Project was prompted by the increased importance of afforestation because of the escalation of desertification in China. The relevance of the Project is high because the Project is consistent with the Chinese government’s policies, development needs, and Japan’s aid policy. For further contribution to desertification prevention in areas with the severe natural environment, the main Project implementation bodies for Economic Forests changed from small-scale farmers to groups of farmers or enterprises, and those for Protection Forests and Closure changed to local governments or state-owned forest farms that act for the public interest. The change was sound for implementing afforestation and crop planting in a more effective area on a larger scale and sustaining the operation and maintenance system while also benefitting the small-scale farmers. The Project’s afforestation and vegetation area, equivalent to 63% of the desert decreased in the same period in the entire Gansu Province, contributed to desertification prevention. At the time of the ex-post evaluation, trees and grasses were growing well, and the Project helped increase the production of forest products and income, and improve the living environment. Thus the effectiveness and impacts of the Project are high. With regard to the efficiency, the project period was within the planned limit, although the project cost exceeded the plan because of the additional afforestation and vegetation area. Thus the efficiency of the Project is fair. The exclusive project office for the yen-loan project was dissolved, but no problem was seen in the institutional aspects of sustainability because the Gansu Provincial Government Finance Bureau Agricultural General Development Office, an upper-tier office, took over the office’s functions. The budget for operation and maintenance was secured by a subsidy from the national government, and the budgets of the finance and forestry bureaus and the local government. Some farmers needed improvement because of insufficient technical transfer and lack of forest and irrigation facility maintenance. However, both the technical aspects and the operation and maintenance status in most of the forests and grasslands were generally favorable. Therefore the sustainability of the Project is high.

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

1. Project Description



Project Location



Photo 1: Economic Forest of grapes where drip irrigation facilities were equipped (Gansu Province Jiayuguan city)

1.1. Background

In China, nearly 30% of the national territory was a desert or faces the risk of desertification as a result of major deforestation, excessive cultivation and grazing accompanying the the country's rapid economic growth. The damage by the sand and dust storms coming from the desert areas have been increasing year by year; in May 1993, 85 people died, and 120,000 head of livestock were lost in four provinces and autonomous regions. Yellow sand and dust from the deserts reach the other countries in East Asia.

Shortly after the devastating flood in 1998, in response to the flood and the major natural disasters above, the Chinese government implemented the National Plan for Ecological Construction. The plan set four priority projects¹ for natural environment improvement, target areas and numerical targets, and prepared the development of systems for improving the ecological environment as well as large-scale afforestation projects.

Gansu Province was part of all the target areas² including the "Desertification area." At the time of the appraisal, the forest coverage ratio of the province was much lower than the national average. The vegetation coverage ratio in Hexi Corridor, where it has an extremely small amount of precipitation, decreased significantly because of artificial elements such as waste of water resources, excessive logging and cultivation. Under such circumstances, the Gansu Provincial government requested the Japanese government for an afforestation and vegetation project with yen-loan to increase the forest and vegetation coverage ratios and improve the living environment by preventing desertification. The Japanese government approved the request.

¹ Projects related to erosion control, preventing desertification, increasing forests area, and increasing forest coverage ratio.

² ①Upper and middle basin of the Yellow River; ②Upper and middle basin of the Yangtze River; ③ Desertification area; ④Grassland area

1.2. Project Outline

The objective of this Project is, through afforestation and crop planting, to raise forest and vegetation coverage, and improve the living environment by preventing desertification in the area and the one surrounding it, thereby contributing to social and economic stabilization of the Hexi Corridor area in Gansu Province.

Loan Approved Amount/ Disbursed Amount	12,400 million yen / 12,388 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March, 2003 / March, 2003
Terms and Conditions	Interest Rate 0.75% Repayment Period 30 year (Grace Period) (10 year) Conditions for Procurement: General Untied
Borrower / Executing Agency	Government of People's Republic of China / Gansu Provincial People's Government
Final Disbursement Date	October, 2012
Main Contractor (Over 1 billion yen)	None
Main Consultant (Over 100 million yen)	None
Feasibility Studies, etc.	Feasibility Study Report by Forestry Surveying and Designing Institute of Gansu Province, July 2002 Special Assistance for Project Implementation (March 2004)
Related Projects	<ul style="list-style-type: none"> ● Ningxia Afforestation and Vegetation Cover Project (L/A 2002) ● Shaanxi Loess Plateau Afforestation Project (L/A 2001) ● Shanxi Loess Plateau Afforestation Project (L/A 2001) ● Gansu Water-Saving Irrigation Project (2000-2007) ● Dissemination of New Forestation Technology in Loess Plateau (2010-2015) ● Loess Plateau Afforestation Project (World Bank 1999-2009)



Figure 1: Project Sites in Gansu Province

2. Outline of the Evaluation Study

2.1. External Evaluator

Shima HAYASE, IC Net Limited

Yuko KISHINO, IC Net Limited

2.2. Duration of Evaluation Study

The ex-post evaluation study was carried out as follows:

Duration of the Study: August 2014 –November 2015

Duration of the Field Study:

1st Field Study: December 5, 2014 – December 16, 2014

2nd Field Study: April 25, 2015 – April 28, 2015

2.3. Constraints during the Evaluation Study

As this ex-post evaluation was carried out 5 years after the Project completion in 2009, it was premature to observe the Project's mid- to long-term effects, and analyze future prospective conclusively. Accordingly, the ex-post evaluation focused on analyzing of basic effect indicators, prospects for the development and sustainability of the Project's effects and the status of the institutional, financial and technical environment to realize the prospects. Also, because of the following constraining factors, the Project's effectiveness had to be provisionally evaluated by using the sampling data collected through field survey³. Firstly, the forests were still growing and not ready for observation of their fully developed status. Secondly, the Project covered a vast area consisting of 5 cities in Hexi Corridor, and it was impossible to visit all the project

³ The Project was implemented in 5 cities in the Hexi Corridor, which is a vast area. It was impossible to conduct a field study in all the project sites during the evaluation study period. To address this problem, the evaluation team asked the Gansu provincial government, the implementing agency, to collect operation and effect indicators in all the sites. In addition, the evaluation team chose six representative sites to conduct questionnaire, site-visit, and beneficiary surveys in order to grasp the overall picture.

sites within the allocated study period.

3. Results of the Evaluation (Overall Rating: A⁴)

3.1. Relevance (Rating: ③⁵)

3.1.1. Relevance to the Development Plan of China

(1) Development Policy at the Time of the Appraisal

At the time of appraisal, in the National Plan for Ecological Construction (1998-2050), the Government set four target areas for natural environment protection and restoration. Gansu Province was included in all the target areas, such as Loess Plateau Basin, Yangtze River Basin, Desertification, and Grassland.

(2) Development Policy at the Time of the Ex-post Evaluation

Under the 12th Five-Year Plan (2011-2015), Gansu province was target of Yangtze River Basin Shelter Forest Programs to reduce soil loss, Natural Forest Resource Protection Program, and Steep Farmland Conversion to Forestland. The Gansu Province 12th Five-Year Plan (2011-2015) also set ecological environment conservation and natural environment protection as the important sources for the economic development and improving quality of life. The Gansu Province implemented policies to restore and to increase forest and vegetation coverage by Yangtze River Basin and Yellow River Basin erosion reduction, by Steep-Farmland Back to Forest and grassland programs for restoration and increasing of forest and vegetation coverage, and to promote water conservation by building ecological forest in the river basin. At the same time, the province aimed to promote forestry with local color by enhancing production of Gansu's indigenous products, also by promoting sightseeing industry by building national conservation areas and parks.

To implement the policies, the Gansu provincial government encouraged the use of foreign loans. Since the 1990s, the government has executed afforestation projects funded by the World Bank and the Government of Japan. As shown in Table 1, the Project is larger in both the afforestation area and the budget than other projects implemented around the same period. The Project contributes largely to the policies, and the implementation of the Project is relevant.

Table 1: Foreign Funded Afforestation Projects

Project	Donor	Duration (year)	Afforestation Area (ha)	Cost (10 thousand US Dollar)
Forestry Development Project	World Bank	2003-2011	2,582	364
Ecological Afforestation Project	Korea	2001-2006	1,540	288
The Project	Japan	2003-2010	136,000	13,833

Source: Gansu Provincial Government Finance Bureau Agricultural General Development Office

⁴ A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

⁵ ③: High, ② Fair, ① Low

3.1.2. Relevance to the Development Needs of People's Republic of China

(1) Relevance to the Development Needs at the Time of the Appraisal

At the time of the appraisal, the forest coverage ratio in Gansu Province was 9%, which was lower than the national average of 17%. Hexi Corridor has a very small amount of precipitation. In addition, artificial causes such as waste of water resources, deforestation, and excessive cultivation decreased the vegetation coverage in the area. To address the situation above, the Gansu Provincial People's Government took such measures as restrictions on grazing, but the desertification came near the irrigation and residential areas and threatened people's daily lives.

(2) Relevance to the Development Needs at the Time of Ex-post Evaluation

At the time of the ex-post evaluation, the forest coverage ratio in Gansu province was 13.42%, which was lower than the national average of 20.36%⁶. The annual average precipitation in the province was around 300 mm/year, but the evaporation amount was between 1,259 and 3,522 mm/year, greatly exceeding the precipitation. Moreover, the altitude of the province is between 1,000 and 3,000 m⁷. Because of such severe environment, the desert area of the province reached 192,100 km², which was the fourth in the nation. The province's desert area was equivalent to 7.3% of the desert area of the nation, and occupied 42%⁸ of the province's territory⁹. Also, in 2012, sand and dust storms occurred 44 times¹⁰, the highest number in the past ten years. As mentioned above, the desertification prevention was still an important agenda. The Gansu Province 12th Five-Year Plan (2011–2015) set such targets as afforestation in 1,233,000 ha increasing the forest coverage ratio to 17% or higher, and the stock volume of 6.83 million m³ or higher by the end of 2015. Thus the development needs on desertification prevention and afforestation were high at the time of the ex-post evaluation.

3.1.3. Relevance to Japan's ODA Policy

Both the Economic Cooperation Plan for China issued by the Government of Japan in October 2001 and Japan's Medium-Term Strategy for Overseas Economic Cooperation Operations (2005–2008) gave priority to addressing global environmental issues, and cited the following means to do so: cooperation to environmental conservation, forest conservation and management. The Country Assistance Strategy for China (2002) set its main targets as environmental conservation and human resource development in the inner part of China, because environmental problems in China might have a direct impact on Japan. The Project targeted afforestation and vegetation in Gansu Province, and contributed to environmental conservation. Therefore, relevance to Japan's ODA

⁶ Gansu Province Statistical Yearbook (2013)

⁷ Gansu Provincial Government Finance Bureau Agricultural General Development Office (2014)

⁸ National Forestry Bureau "National Desertification Situation Report"(2011)

⁹ The territory of Gansu province is 451000 km².

¹⁰ Gansu Province Environmental Protection Bureau "Gansu Environmental Quantity Review" (2010-2013)

policy is high.

3.1.4. Appropriateness of the Project Plan and its approach

At the time of the appraisal, it was expected that the main implementation bodies would be small-scale farmers, and they would plant trees and grasses in their own land¹¹ for ecological conservation effects and poverty reduction, improving the ecological environment by preventing winds and sand flow, and yielding economic and social effects by the income from the Economic Forests. In reality, small-scale farmers did not participate in the Project because of the very long 40-year repayment period for the loan from the county government and concerns about the economic pressure. Eventually, large-scale farmers, groups of farmers, and enterprises became the main implementation bodies for Economic Forests, and the afforestation area¹² per implementation body became more than 10 times the original assumption.

Afforestation projects require inputs including materials for planting and maintenance costs before a forest is fully grown to generate sufficient income. Because of the change, the implementation bodies were able to manage with their own financial resources the entire process from leveling before planting, securing costs for management and repayment, and employing necessary manpower for forest management. Thus the change was a good choice for enhancing the Project's effects as well as securing the Project's financial sustainability. The change had no negative impact on social aspects because small-scale farmers became secondary beneficiaries by earning rental fees and labor wages.

Protection Forests¹³, Closure¹⁴, and Engineering Sand Fixation¹⁵ incur maintenance costs but do not generate sufficient income. Thus the executing agency did away with allocation of such areas to the farmers, and all the areas were allocated to the bodies for the public interest such as state-owned forestry farms and erosion control station. By changing the implementation bodies to public agencies, afforestation and planting were executed in the most effective locations for the whole district on a larger scale, enabling the Project to benefit a larger population.

The Project was highly relevant to the development policies of the Chinese and Gansu Provincial governments, their development needs, and Japan's ODA policy. The main

¹¹ At the time of the planning, it was anticipated that the average forest area per implementation body would be 0.86 ha, and 50,250 farming households would participate in the Project.

¹² According to the beneficiary survey with 100 samples, the average area per implementation body was 12.4 ha.

¹³ The documents provided by JICA state that sand fixation by shrubbery procurement and plantation, and building windbreak forests. Gansu Province uses the term "Ecological Forest" throughout from the time of the Feasibility Study. The Japanese side considered that the forests consisted only of shrubbery, but the Chinese side divides the Ecological Forests into the categories of Arbores (e.g., Poplar) and Shrubby (e.g. Locust, Saxaul). The Forestry Law of China uses the term "Sand-Fixing Forest."

¹⁴ Closure is a method to protect forests. According to the Forestry Law of China, the method is to restore the vegetation by sealing off half or all of the target area to prohibit logging for energy and the entry of livestock.

¹⁵ A technique to fixate a sand dune and prevent the movement and flow of the sand by making a lattice called "square grass frame" by mixing straw and mud and burying it in the surface of a desert, then planting shrubbery in the frame.

implementation body was changed to increase the Project's effectiveness and sustainability while providing benefits to small-scale farmers who were planned at the time of the appraisal to be the main implementation body. Therefore the relevance of the Project is high.

3.2. Efficiency (Rating: ②)

3.2.1. Project Outputs

At the time of appraisal, the Project's envisioned outputs consisted of afforestation, materials, vehicles, irrigation and road construction, facilities and equipment, and training/technical guidance. Table 2 shows the plans and the results of the outputs of the Project.

Table 2: Output

Item	Plan (Target year 2010)	Actual (Project completion 2009)
Afforestation		
Afforestation	91,072 ha	136,472 ha
Protection Forests	16,204 ha	23,825 ha
Arbores	3,471 ha	7,900 ha
Shrubbery	12,734 ha	15,975 ha
Economic Forests	18,264 ha	20,758 ha
Grape	5,042 ha	4,847 ha
Jujube	1,658 ha	1,821 ha
Hop	770 ha	2,626 ha
Fruits mixed	810 ha	1,300 ha
Alfalfa	9,988 ha	10,164 ha
Closure Afforestation	51,106 ha	86,284 ha
Engineering Sand Fixation	5,493 ha	5,604 ha
Afforestation Material		
Seedling	190.5 million	247.65 million
Chemical Fertilizer	12,993 ton	19,739 ton
Organic Fertilizer	113,942 ton	147,367 ton
Pesticide	682 ton	863 ton
Facilities and Equipment		
Canal	1,110 km	1,202 km
Irrigation	8,978 ha	9,317 ha
Impoundment	780 m ³	4,780 m ³
Road construction	845 km	1,134 km
Electric Line	20.8 km	As planned
Transformer	8 sets	As planned
Construction	13,280 m ²	13,560 m ²
Farm Machinery	894 sets	949 sets
Vehicle	125	99
Motorcycle	217	12
Truck	35	As planned
Environment Monitoring Tools	350 pieces	322 pieces
Training		
Training (Project Managers /Engineers)	30 persons	As planned
City Government	3,610 persons	6,710 persons
County /Township Government	1,030 persons	1,365 persons
Gansu Farms Agribusiness Corp ¹⁶		
Technical Guidance(participants)	23,800 persons	34,500 persons

Gansu Provincial Government Finance Bureau Agricultural General Development Office

(1) Afforestation

The actual afforestation area was 136,472 ha, which was 150% of the planned area of 91,072 ha. Along with the change in implementation bodies, the area by forest type was modified, and afforestation areas increased in all the forest types. However, Economic Forests of grapes decreased to 96% of the planned area due to the economic reasons such as the decrease in grape prices since the time of the appraisal, and the higher costs of grape planting compared to other crops because of such facilities as stakes. The area reduced was

¹⁶ Gansu Farms Agribusiness (Group) Corporation had been the provincial government agriculture development bureau that was responsible for supervising farms directly; in 1978, it was converted to a company along with the farms under its supervision. Under the Project's institutional structure, it was equivalent of the city government level.

converted to other products that would generate profits. Thus the change brought no negative impact on outputs.

Protection Forests, Closure, and Engineering Sand Fixation were considered afforestation projects for the public interest. The total areas of these afforestation projects increased because local governments and state-owned farms took the lead in implementing them in the areas where sand and dust flew from deserts. While the allocation of Closure and Engineering Sand Fixation for the farmers decreased, the one of Economic Forests was increased proactively.

(2) Afforestation Materials

Along with the increase of the Economic Forests and Protection Forests areas, the consumed quantity increased in seedlings (130% of the plan), fertilizer (chemical: 152% of the plan; organic: 129% of the plan), and pesticides (127% of the plan), respectively. The government procured seedlings, fertilizer, and pesticides in bulk, and distributed them to the implementation bodies upon presentation of the afforestation passbook.

(3) Facilities and Equipment

① Facilities and construction

Facilities were mostly procured as planned. The total capacity of reservoirs was 613% of the plan because the Zhangye city government increased its financial input to build a reservoir of 4,000 m³ as a new water source for increasing Economic Forests of jujube in Linze county. As public works, Protection Forests, Closure, and Engineering Sand Fixation were mainly built in the areas where a large amount of sand and dust flew from the desert. Access roads to the areas constructed because the areas were remote. Thus the total length of constructed roads amounted to 1,134 km, which was 134% of the plan.

② Vehicles

The needs for vehicles were reassessed after the Project started because some vehicles and motorcycles that had been purchased by other projects existed. Then the number of vehicles to purchase was decreased.

(4) Training and Technical Guidance

① Training for Project Managers and Engineers of Local Governments

In the training for project managers and engineers of local governments (city, county/township, Gansu Farms Agribusiness Corp.), the number of potential trainees increased significantly, and 8,105 people in total, or 174% of the plan, took the training. The reason for the increase is that the afforestation of forests in the public interest became a public works project. The training subjects for the project managers included the following: project and financial management; desert ecological environment management; water resource management; and project inspection. For engineers, the training covered the

following subjects: water-saving irrigation; biological and Engineering Sand Fixation; desert afforestation techniques; cultivating indigenous products of Economic Forests; artificial grassland creation, production and processing; aerial dispersion; and arid land afforestation.

② Technical Guidance for Implementation Bodies

For the implementation bodies who took part in the Project, county and township engineers provided technical guidance. The number of trainees was 34,500, which was 145% of the planned 23,800 because implementation bodies to build forests as public works increased. The training subjects were as follows: water-saving irrigation including drip irrigation; biological and Engineering Sand Fixation; fruit tree production in Economic Forests; and artificial grassland creation and management.

③ Other Training Courses

The Project implemented no training in Japan. However, during the Project implementation, 14 project office managers and engineers at the province, city, and county levels took part in JICA's "Training on Water-Saving Irrigation Technology." In addition, two managers of the provincial project office participated in JICA's "Capacity Building Training for Forestry Managers." The outputs of the two JICA training courses were reflected in the Project's training and the implementation.

At the time of the appraisal, the prospective main implementation bodies were small-scale farmers with forests for afforestation of about 1ha per implementation body. However, for Economic Forests, groups of farmers or large-scale farmers implemented the Project in more than ten times the planned area¹⁷ per implementation body. In addition, public institutions implemented afforestation in the ecological forests such as Protection Forests, Closure, and Engineering Sand Fixation. As a result of the change, the total afforestation area increased to 150% of the plan, and the plans on afforestation materials, facilities and construction were modified. In the procurement of vehicles and environment monitoring devices, the revision in the necessary amounts helped reduce the costs. Thus the changes in the outputs were appropriate.

3.2.2. Project Inputs

3.2.2.1 Project Cost

The planned total Project cost was 16,600 million yen (of which the ODA loan portion was 12,400 million yen). The actual cost was 16,933 million yen¹⁸ (of which the ODA loan portion was 12,388 million yen), which exceeded the plan slightly (102% of the planned amount¹⁹). In

¹⁷ According to the result of the beneficiary survey, the average area per farmer was 12.4 ha, which was 14 times more than the original plan i.e., 0.86 ha.

¹⁸ The average exchange rate during the Project period, i.e., 1 yuan = 14.19588 yen, was calculated from the monthly average rates between January 2004 and December 2009. The data were obtained from the Pacific Exchange Rate Service provided by the University of British Columbia.

¹⁹ The executing agency did not provide the detailed costs for the increase and decrease of all the individual outputs (including all forest types). Thus the evaluation team was unable to analyze if the costs were appropriate to the

the total Project cost, the afforestation cost increased because of the expansion of the afforestation area. The planned afforestation cost was 10,464 million yen as opposed to the actual one at 12,477 million yen, i.e., 119% of the planned one. The increased areas were mostly Mountain Closure and Protection Forests with relatively low planting costs. In addition, farms for grapes, a costly crop to plant, were converted to those for jujube or other less costly fruits. Thus the increase in the Project cost was kept to a minimum.

3.2.2.2 Project Period

At the time of the appraisal, the planned Project period was 92 months from March 2003 to October 2010²⁰. The actual Project period was 80 months from March 2003 to October 2009, i.e., 87% of the planned one. The frost in 2005 and the low temperature in 2008 damaged Protection and Economic Forests²¹, and supplemental planting was done. In the inspection in October 2009, all the areas passed as planned, and the Project was completed within the planned period.

3.2.3. Results of Calculations of Economic Internal Rates of Return

At the time of the appraisal, the economic internal rate of return (EIRR) of the Project was not calculated because the main objective of the Project was desertification prevention, and the method to calculate the EIRR in a way that suited the Project did not exist. This ex-post evaluation does not implement an analysis based on the EIRR because it was not calculated during the Project execution either.

As mentioned above, the Project period was within the planned limit, but the Project cost was more than planned. Therefore, the efficiency of the Project is fair.

3.3. Effectiveness²² (Rating: ③)

The main component of the Project was afforestation. Therefore, the Project's effectiveness was to be evaluated by the quantitative indicators set at the time of the appraisal, forest condition based on the field studies, forest coverage ratio, and stock volume. Expected impacts were "improvement of the living environment by desertification prevention," and "contribution to the area's social and economic stability." The former was judged by the size of the desertification area and the reduction in the damage from sand and dust storms; the latter by Economic Forests' production amount and sales prices, and Project participants' income change. Incidentally, because training was not a main component of the Project, its effects were to be

output changes. Sub-rating of the Project cost followed the JICA ex-post evaluation reference by comparing the planned total Project cost and the actual one. Based on the sub-rating standard (more than 100% and less than 150% of the plan), the evaluation team determined that it was ②.

²⁰ The following definition of the Project completion was agreed upon: when the entire Project area passes the third growth year inspection on the survival rate.

²¹ Total damaged area of Protection Forests was 8,677ha, of Economic Forests 7,553ha. In total, 8,468,000 seedling planted supplementary.

²² The rating for Effectiveness is to be made in consideration of Impact.

evaluated in the technical aspect of operation and maintenance in the section on sustainability, but not in the sections on effectiveness or impact.

3.3.1. Quantitative Effects (Operation and Effect Indicators)

(1) Survival Rate and Preservation Rate²³

The survival rate and preservation rate targets at the time of the appraisal were achieved in all the afforestation types (Table 3). In the inspection in the first growth year, the survival rates were lower than the target values at four Protection Forest sites²⁴ and two Economic Forest sites²⁵. At the sites, the implementation bodies executed supplemental planting. In the third year inspection, all the sites achieved the target preservation rates.

A local forestry expert cited the following reasons for the high survival and preservation rates despite the severe natural environment: ① appropriate sand prevention measures were taken; ② at the time of the planting, techniques such as soil exchange and frozen ground transplanting were applied and allowed the seedlings to retain sufficient water in the roots; ③ water was appropriately supplied by canals and drip irrigation after the planting; ④ forests were protected by fences that prevented damages from the entry of people and livestock; and ⑤ species and varieties that matched the areas were selected.

Table 3: Target and the result of survival and Preservation ratios

	Target at Appraisal (2003)				Result at Completion(2009)			
	Protection Forest	Economic Forest	Closure	Grassland Creation	Protection Forest	Economic Forest	Closure	Grassland Creation
Survival rate 1 st growing year	85 %	85 %	None	40 %	89.4 %	91.4 %	33.8 %	96.0 %
Preservation rate 3 rd growing year	65 %	85 %	30%	80 %	84.6 %	95.4 %	36.5 %	97.9 %

Source: Gansu Provincial Government Finance Bureau Agricultural General Development Office

Note: The survival/ preservation ratio of fencing closure area was measured by the ratio of shrub trees.

²³ China’s Forestry Law sets the following definitions: [Survival rate] number of survived trees divided by the number of planted trees at the first growth period; [Preservation rate] the equivalent value in the third growth period.
²⁴ Wuwei City Gulang county, Jinchang City Jinchuan district, Jiuquan city Guazhoudistrict, and Linze farm.
²⁵ Wuwei City Su wushan forestry farm, Zhangye city Sunan county



Photo 2: Protection Forest build around the artificial lake in the center of the city. (Gansu Province, Jiayuguan city)



Photo 3: Closure site (Gansu Province, Jinchang city, Jinchuan district)

(2) Forest and Vegetation Coverage Ratios

As shown in Table 4, both the forest and vegetation coverage ratios in the Project sites achieved the targets set at the time of the appraisal. The forest coverage ratio reached 9.77%, exceeding the target by 3.73%, and the vegetation coverage ratio was 40.64%, surpassing the target value by 18.76%.

Table 4: Forest and Vegetation Coverage Ratios

	Baseline	Target	Actual
	Appraisal (2002)	One year after Completion (2011)	One year after Completion (2010)
Forest Coverage	6.04 %	9.46 %	9.77 %
Vegetation Coverage	21.88 %	25.62 %	40.64 %

Sources: The baseline and target refer to JICA document at appraisal, the result provided Gansu Provincial Government Finance Bureau Agricultural General Development Office.

Note 1: Forest coverage ratio: Forest area for the total area

3.3.2. Growth Situation in the Project Sites

The evaluation team conducted a field study in 30 project sites in total in five cities and one Gansu Farms Agribusiness (Group) Corporation. The sites included Protection Forests, Economic Forests, and Mountain Closures. The team examined forest design, maintenance status, and preservation rates for the planted trees. In addition, the team measured the height, circumference and so on so to inspect the growth of the trees. The following is a summary of the study results. The details and measurement data of the study are in the attachment.

(1) Protection Forests

①Arbores (Poplar, Locust, Japanese Pagoda Tree, Euphrates Poplar, Willow, Spruce, Scots Pine, Russian Olive)

The preservation rate was over 75% in all the species. Arbores were planted as a windbreaker in roadsides, farm fields and the banks of waterways. The trees were mostly

growing well, and appropriate disease and pest control measures were taken. Almost all the sites were mixed forests. Mixed forests in parks were formulated by putting together simple forests of multiple species because the parks were meant to display the trees.

② Shrubbery (Chinese Tamarisk, Saxaul, *Hedysarum scoparium*, *Caragana intermedia*)

The shrubbery sites were effective in wind breaking. Local species that are suitable for desert were selected and planted. All the sites were mixed forests with multiple species. The preservation rate was higher than 73%, and the growth condition was generally good. The coverage ratio of shrubbery reached more than 30% in all the sites. Thus it is fair to say that sand flow prevention effects were generated.

(2) Economic Forests (Jujube, Grapes, Pears, Apple, Alfalfa)

The preservation rates in all the sites²⁶ were 85% or higher. No disease or pest damage was observed, and trees grew generally well. Regarding the maintenance status, weeding, fertilization, disease and pest control, and irrigation system maintenance were appropriately executed. A few farmers cultivating jujube and pears had problems in implementing such maintenance tasks. Other farmers selected varieties that were unsuitable for dry and cold areas such as apple and jujube. It would be desirable for Forestry bureau engineers to provide advice to the farmers on nursing and variety selection.

(3) Mountain Closure (*Nitraria roborouskii*, Saxaul, Chinese Tamarisk, *Kalidium gracile*, *Reaumuria soongorica*)

The vegetation coverage ratio was more than 40%. The evaluation team confirmed that, ten years after the beginning of the closure, multiple species of shrubbery and grasses grew well, and sand flow prevention effects were generated as a result of the vegetation recovery. In a few sites that were closed for 11 years, the vegetation coverage ratio was 20%, which was below the target. However, this was not a problem because irrigation facilities and wind protection forests were built near the sites to convert them into Economic Forests of apple trees.

²⁶ Because the field study was done in December, there were a few sites where the evaluation team was unable to visually examine or measure the growth of the trees. In the winter months from October to April, grape vines were buried underground to prevent damage from freezing. The team was unable to measure the growth of the vines. Thus the team interviewed engineers to confirm the growing status. Alfalfa had been cropped. However, by calculating the remaining stumps, the team confirmed that the coverage ratio was nearly 90%. The team was unable to visit hop planting sites, but confirmed the growth status through the interviews with the engineers, and pictures of the sites in every season.



Photo 4: Shrubbery planted for desertification prevention. (Gansu Province, Jiayuguan city)



Photo 5: Measuring the arbore planted in a Protection Forest. (Gansu Province, Jinchang city, Jinchuan district)

3.4. Impacts

3.4.1. Contribution to Improvement of the Living Environment by Desertification Prevention

(1) Impact on Desertification Prevention

As shown in Table 6, about 10 thousand ha of desert on average was reduced annually in the cities where the Project was implemented. From the time of the appraisal to the Project completion (2003–2009), 140,000 ha of desert area in total was reduced in Gansu Province (Table 5). This project reduced 87,800 ha of desert, which is equivalent to 63% of the total desert reduction in Gansu province.

The damage from sand and dust storms decreased in Wuwei and Jiayuguan cities. However, in Jinchang, Zhangye and Jiuquan cities, the damage fluctuated, and no trend was discerned (Table 7). According to the beneficiary survey (Table 8), to the question on whether the Project helped reduce yellow sand damages, 43% answered that the Project “contributed a lot,” and 57% said “contributed somewhat.” It is thus fair to say that the Project’s contribution to living environment improvement was recognized.

The causal relationship between the prevention of sand and dust storms and the Project is unclear. However, the Project implemented 45,000 ha of afforestation, which was equivalent to 51% of the desert reduction in Hexi Corridor. In addition, as desertification prevention measures, the Project carried out 86,000 ha of Mountain Closure, and 6,000 ha of Engineering Sand Fixation. Thus it is fair to say that the Project’s contribution to the desertification prevention in Hexi Corridor was not insignificant. Additionally, the results of the beneficiary survey show that the Project contributed to the improvement of the living environment.

Table 5: Desertification area in the nation and Gansu Province (unit: ten thousand ha)

	Appraisal (2003)			Project Completion (2009)		
	National	Gansu Province	Gansu ratio To the national	National	Gansu Province	Gansu ratio To the national
Desert Area	26,362	1,935	7.34 %	26,237	1,921	7.32 %

Source: National Forestry Bureau "National Desertification Gazette (January 2011)

Table 6: Changing of the Desertification Area²⁷ in the Project Implementation Districts

(unit: ten thousand ha)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total Area	612	609	608	608	606	605	603	602	600	599	589
Wuwei City	188	188	188	188	187	186	186	185	184	183	174
Jinchang City	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Zhangye city	34	34	33	33	32	31	31	31	30	30	29
Jiayuguan city	11	9.2	9.2	9.2	9.2	9.2	81	8.1	8.1	8.1	7.6
Jiuquan city	374	374	374	374	374	374	374	373	373	373	373

Source: Gansu Provincial Government Finance Bureau Agricultural General Development Office.

Note: the eight Gansu Farms Agribusiness (Group) Corps were located within the districts, this table do not have a line for the corps.

Table 7: Changing number of sand and dusts storm outbreak (unit: times/year)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Average of the Project Cities	9.6	7.8	7.6	9.4	7.4	8.4	6.8	6.2	4.0	4.0	3.0
Wuwei City	11	15	10	14	9	7	7	8	1	0	3
Jinchang City	2	1	2	6	6	5	3	5	3	2	1
Zhangye city	2	3	3	3	4	4	3	4	3	4	2
Jiayuguan city	24	16	16	18	12	17	9	5	5	8	5
Jiuquan city	9	8	7	6	5	9	12	9	8	6	4

Source: Gansu Provincial Government Finance Bureau Agricultural General Development Office.

Note: the eight Gansu Farms Agribusiness (Group) Corps were located within the districts, this table do not have a line for the corps.

Table 8: Result of the Beneficiary Survey (100 samples)

Did the Project contributed to reduce damage from yellow sand?	
Contributed a lot.	43 %
Contributed somewhat.	57 %
Did not contribute.	0 %
Did not contributed at all.	0 %

3.4.2. Contribution to Economic and Social Stability

(1) Contribution to Stable Production of Forest Plants

The growth status of the Project's Economic Forests had no problem. The production amount per unit area increased every year. Among the main products, grapes and hop were to be in the stable production period three years after planting. These products attained the targets in production and shipment price ahead of others (Table 9). The price of jujube has been growing steadily, but its production has not stabilized. The production and price of alfalfa have stabilized since 2011. Regarding fruits, it was unclear what species were given targets at the time of the appraisal, and it was not possible to compare targets with actual

²⁷ Desert is defined as an area with an annual rainfall amount of 250 mm or less; half-desert, an area with an annual rainfall amount between 250 and 500 mm. The area in the table is the sum of desert and half-desert areas.

values.

Table 9: Annual Production and Shipment Price of the main Economic Forests Products

		Target	Actual					
		2010	2008	2009	2010	2011	2012	2013
Grapes	Production (t/ha)	25.0	19.0	24.8	33.8	37.6	38.0	39.0
	Price (yuan/t)	5,000	4,582	4,608	5,737	6,318	6,898	6,457
Hop	Production (t/ha)	5.0	5.3	5.3	5.7	5.7	6.3	7.4
	Price (yuan/t)	6,500	11,070	5,943	6,763	6,466	5,913	7,160
Jujube	Production (t/ha)	8.0	4.0	5.0	8.0	5.3	7.3	9.0
	Price (yuan/t)	6,000	4,500	4,200	5,100	6,600	6,300	7,800
fruits ²⁸	Production (t/ha)	37.5	10.7	12.8	15.1	18.1	22.1	25.7
	Price (yuan/t)	3,000	2,255	2,285	2,350	2,565	2,815	3,020
Alfalfa	Production (t/ha)	30	24	26	29	31	30	30
	Price (yuan/t)	800	555	591	1,065	1,127	1,204	1,159

Source: Gansu Provincial Government Finance Bureau Agricultural General Development Office

(2) Contribution to Economic Stability

At the time of the appraisal, the target annual income for farmers and farm employees was 3,068.4 yuan. All the Project cities and Gansu Agribusiness Corp attained the goal (Table 10). Compared to the numbers in Table 11, the average income of the project area was higher than the national and provincial averages, i.e., 1.3 times the national average, and 2.2 times the average for farmers in the province. The annual income growth rate between 2004 and 2010 was 194%. Even if the inflation rate of 20.5% in China during the same period is taken into account, the income growth was significant. Thus it is fair to say that the Project contributed to increasing the farmers' income.

Table 10: Average Annual Income in the Project Implemented Cities (unit: yuan/year)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Wuwei City	4,174	4,469	4,744	5,106	5,763	6,410	6,685	6,814	6,996	7,198
Jinchang City	3,535	3,751	3,943	4,137	4,515	4,989	6,195	7,780	9,133	10,200
Zhangye city	2,535	2,802	3,043	3,302	3,591	3,972	5,864	6,674	8,041	8,959
Jiayuguan city	3,823	4,645	4,947	5,268	5,625	6,956	7,865	9,304	10,999	12,351
Jiuquan city	4,407	4,750	5,315	5,836	6,452	6,956	7,180	8,030	9,450	11,190
Gansu Farms Agribusiness Corps	5,160	6,194	6,956	9,056	10,512	11,824	12,061	12,496	12,848	13,521
Average	3,939	4,435	4,825	5,451	6,076	6,851	7,642	8,516	9,578	10,570

Source: Gansu Provincial Government Finance Bureau Agricultural General Development Office

Table 11: Average income of farmers in nation and Gansu Province (unit: yuan/year)

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Nation	2,936	3,255	3,587	4,140	4,761	5,153	5,919	6,977	7,917
Gansu Province	1,852	1,980	2,260	2,645	2,724	2,980	3,425	3,909	4,507
Inflation Rate	3.90	1.80	1.50	4.80	5.90	-0.70	3.30	5.40	2.65

Source: National Statistical Yearbook, inflation rates referred to IMF World Economic Outlook Database

(3) Social Impacts from Afforestation

In the original Project plan, small-scale farmers were expected to plant trees and crops in

²⁸ The data of apple and pears

their own lands and generate ecological and economic effects. However, the main implementation bodies were changed to large-scale farmers, group of farmers, and private entities. The small-scale farmers, who had been scheduled to take part in the Project, benefitted indirectly from the Project by renting their lands or being employed for planting and harvesting and as forest patrol. In addition, consideration was made for low-income areas and minorities when hiring people for afforestation. Thus it is fair to say that the Project made a contribution in social aspects.

3.4.3. Other Impacts

(1) Impacts on the Natural Environment

No negative impacts from the Project on the natural environment have been found. To protect native vegetation, ground leveling was done on a limited scale. This method also minimized the loss of water by evaporation. To enrich forest resources and biodiversity, it was recommended to build mixed forests with multiple tree species. Almost all the Project sites became mixed forests as planned. There were a few mixed forests consisting of groups of simple forests. According to a local forestry expert, they were just as vulnerable to diseases and pests as simple forests. However, Gansu's temperature and humidity are low throughout the year, which is a climate that is unlikely to cause an outbreak of diseases and pests. Thus it is fair to say that the influence of those few mixed forests was limited.

Regarding the diversity of animals and plants, forest patrol people in a Closure area confirmed the habitation of Mongolian gazelles, an endangered species.

The Project used existing water for irrigation instead of digging new wells. Thus problems such as drying up of ground water did not occur. In addition, there was no concern on salt accumulation because the Project applied water-saving irrigation. The periodical monitoring of salt accumulation was not conducted.

(2) Land Acquisition and Resettlement

No land acquisition or resettlement occurred in the Project because afforestation was implemented by the farmers or forestry farms that had forest land tenure, or prepared by renting the tenure. In a few Project sites, local governments built parks with public forests. However, these parks were built in desert areas where no land tenure had existed, and there was no land acquisition or resettlement.

(3) Other Positive and Negative Impacts

The Protection Forests, Closure, Engineering Sand Fixation were for ecological improvement. No economic effects could be expected from them because they incurred costs

for maintenance but would not produce forest products. The sites in four cities²⁹ have been trying to use those forests as a tourism resource to increase economic and social impacts.

In summary, the Project contributed to desertification prevention because the Project's afforestation and planting areas were equivalent to 63% of the desert reduction area in Gansu Province. In addition to the ecological conservation effects, economic and social impacts also emerged. Therefore the effectiveness and impacts of the Project are high.

3.5. Sustainability (Rating: ③)

3.5.1. Institutional Aspects of Operation and Maintenance

(1) Executing Agency

To implement the Project, the independent Yen Loan project office was established under the Gansu Provincial Government Finance Bureau Agricultural General Development Office. The project office was closed upon the expiration of the loan contract in 2012. Then the Agricultural General Development Office took over the Project's operation and maintenance responsibility including administrative work for repayment, and guidance and supervision to the city and prefectural governments.

The operation and maintenance structure at the city and county level had no major change after the completion of the Project. The city and prefectural financial bureaus managed repayment, and provided guidance and supervision to the implementation bodies. In a few counties, forestry bureaus took the same responsibilities. Table 12 shows the numbers of human resources in the cities where the Project was implemented and the Gansu Farms Agribusiness Corp. At the time of the ex-post evaluation, the executing agency's scope of work and responsibilities were clearly defined, and no problem was found in the institutional aspects of operation and maintenance.

The Project set project offices in the province, city, and county finance bureaus that supplemented expertise by hiring desert and afforestation experts. In a few Project sites visited for the field study, some farmers selected species such as jujube and apple that were unsuitable to the local climate and soil, and a few irrigation facilities and forests were not maintained properly. In such sites, economic returns to afforestation expenses were low. It would be necessary to strengthen local engineers' guidance on selecting species, cultivation methods, and forest operation and management. It would also be desirable to work more closely with the specialized section for training in the forestry bureau.

²⁹ The four sites are: ①Jiuquan city Jinta county state-owned Jinta lake forestry farm: protection forest to prevent sand flow to the dam lake. ②Jiayuguan city eastern lake: park with protection park surrounding a water source in the central city. ③Jinchang city Jinchuan district Jinshui lake: park with protection forests surrounding an artificial lake. ④Wuwei City Gulang county Malutan forestry farm: model forest displaying fencing closure, Engineering Sand Fixation and desert plants.

Table 12: Number of Human Resources in Project Office (unit: persons)

	Total	Manager	Finance	Engineers	Of Senior level
	Plan	N/A			
	Actual (2014)				
Wuwei City	74	14	7	53	10
Jinchang City	39	11	1	27	0
Zhangye city	173	22	9	142	31
Jiayuguan city	14	4	1	9	0
Jiuquan city	126	13	5	108	3
Gansu Farms Agribusiness Corps	58	18	8	32	5
Total	484	82	31	371	49

Source: Gansu Provincial Government Finance Bureau, Agricultural General Development Office.

(2) Implementation Bodies

Large-scale farmers, groups of farmers, and enterprises operated and maintained Economic Forests. Afforestation sites for the public benefit such as Protection Forests, Closure, and Engineering Sand Fixation were under the responsibility of local governments and state-owned forests including afforestation and erosion control stations.

At the beginning, small-scale farmers were to be the main implementation bodies. However, it would take years until farmers can gain stable income from forests, and it would be difficult for them to cover the maintenance costs of forests until then. Thus the change of implementation bodies was favorable for securing the institutional sustainability in operation and maintenance.

The executing agency and its subordinate organizations defined their coordination, scope of work, and responsibilities clearly. In addition, implementation bodies with financial resources and organizations for the public interest have been operating and managing the Project. Therefore no problem was found in the institutional aspects of operation and maintenance.

3.5.2. Technical Aspects of Operation and Maintenance

The Gansu Provincial Government Finance Bureau Agricultural General Development Office said that county and township project offices have sufficient leadership skills and sufficient technical transfer was executed. At the time of the ex-post evaluation, the provincial project office transferred Yen Loan project management techniques to local governments. Every local government followed the provincial filing method for document management, and was fully equipped with publicity videos, brochures, and project reports. Training on forest and grassland operation management techniques for city, county, township, and forest farms was implemented for 8,105 people, i.e., 174% of the plan, and provided the trainees with necessary knowledge and techniques for the operation and management of forests.

Training for implementation bodies was provided to 34,500 people, or 145% of the plan. According to the results of the beneficiary survey, 78% of the respondents received training more than once while 22% never took the training. About 80% of the respondents attended the

sessions on afforestation techniques, seedling handling, and forest disease and pest control, but not many answered that they took other subjects. To the question on the effects of the training, the respondents answered that effective training subjects were also afforestation techniques, seedling handling, and disease and pest control (Table 13).

Training was provided between 2004 and 2007, which was the timing for planting trees and grasses. The subjects for the training were made suitable for the timing by prioritizing afforestation techniques, seedling handling, and disease and pest control. It is fair to assume that, at the time of the training, there was not much interest in forest maintenance, forest products utilization and sales, which would be needed in the mid- to long term.

In the field study, problems were found in some of the Economic Forest sites where farmers selected that were unsuitable to the climate and soil, and maintenance was not appropriately provided, reducing the productivity. To the farmers with variety selection and maintenance problems, it would be desirable to provide additional training and individual guidance.

Table 13: Result of the Beneficiary survey on Technical Training (100 samples)

What subject(s) did you learn from the training?		How the training affected to your skills?	
Afforestation Technique	77 %	Afforestation technique improved	82 %
Seedling and plants handling	80 %	Seedling and plants handled appropriately	87 %
Forestry diseases and pests prevention	86 %	Prevented and cured forest diseases and pests	73 %
Fertilizer usage	59 %	Fertilizer used appropriately	45 %
Forest management	36 %	Managed forest appropriately	28 %
Funds management	26 %	Managed funds appropriately	34 %
Products and thinning cut sales	5 %	Sold products and thinning cut appropriately	27 %
water facility management	24 %	Water utilized reasonably.	34 %

Closure and large Protection Forests prepared a patrolling system and manuals, and monitoring station personnel patrol the area. Farmers kept their forests by themselves, but had no manual or maintenance records.

No problem was found in the executing agency’s technical aspects of operation maintenance. Among the implementation bodies, some farmers lacked knowledge and appropriate forest maintenance, and needed additional training. The vast majority of the bodies had no problem in technical aspects.

3.5.3. Financial Aspects of Operation and Maintenance

(1) Executing Agency

The provincial forestry budget in 2010 was three times the one in 2004, and secured budget allocations for new afforestation and maintenance. National programs such as the Program of Converting Steep-Farmland Back to Forest, Natural Forest Resource Protection Program, Yangtze River Basin Shelter Forest Programs, and Ecological Forest Program provide subsidies as the part of their budgets. For forest maintenance, fire prevention, disease and pest control, departments in the provincial forestry bureau have their own budgets.

Budgets were distributed to the city and county level based on the needs, and the necessary amounts were secured every year. In the Closure area neighboring the Inner Mongolia autonomous region, the regional government's subsidies for grazing reduction and helping nomads settle down reduced damages to forests by livestock in the Project areas.

Table 14: Provincial Forestry Related Annual Spending (unit: ten thousand yuan)

	Total Spending	Forests & Pasture maintenance	Ratio to the total Spending	New Afforestation and Vegetation	Ratio to the total Spending
2010	722,797	43,326	6.0 %	64,285	8.9 %
2011	608,123	13,100	2.2 %	80,692	13.3 %
2012	756,920	77,567	10.2 %	93,647	12.4 %
2013	790,723	52,614	6.7 %	79,513	10.1 %

Source: Gansu Provincial Government Finance Bureau Agricultural General Development Office.

Table 15: Annual Budget for Forestry and the Sources (unit: ten thousand yuan)

Year	Annual Budget	Budget from National	Domestic Loans	Bonds	Foreign Investment	Self-financing	Other Funds
2004	206,800	38,576	160,752	676	180	236	298
2005	253,385	34,332	200,486	12,398	87	1,751	4
2006	233,372	17,496	208,315	6,906	612	0	43
2007	254,377	22,295	218,892	10,850	2,340	0	0
2008	367,149	36,319	304,688	10,198	1,239	0	6,985
2009	482,817	29,681	316,741	13,000	2,733	693	112,724
2010	715,630	34,870	472,783	34,600	6,779	5,187	122,632
2011	610,611	487,233	53,000	0	16,000	8,432	40,577
2012	756,920	596,809	93,695	0	16,572	31,349	16,255

Source: National Statistical Yearbook

(2) Implementation Bodies

Large-scale farmers, groups of farmers, and enterprises shouldered the operation and maintenance costs of the Economic Forests. For less profitable forests such as Protection Forests and Closure, state-owned farms and local governments covered the maintenance costs.

According to the beneficiary survey (sample size: 100), the average annual income was 46,641 yuan, which exceeded the average maintenance cost of 43,927 yuan by 2,714 yuan. In the comparison of the income and the maintenance cost (Table 16), 80% answered that their "income is more than the maintenance cost," 11% said that maintenance cost was larger than the income, and 5% said that the income and the maintenance cost were about the same. The reason was that Economic Forests of such plants as jujube and apricots did not reach the tree age for stable production, and those who built only Protection Forests had no income from the forests.

Table 16: Result of Beneficiary Survey on Income and Maintenance Costs

Are you earning or spending more for the Project's forest?	
Income is more than maintenance cost.	80 %
Income and maintenance cost are about the same.	5 %
Maintenance cost is more than income.	11%
Not answered.	4 %

The implementation bodies' repayment to the loan from the county government started in March 2013 at the frequency of once a year. Based on this frequency, the repayment for the first year had been completed by the time of the ex-post evaluation.

The beneficiary survey revealed that the average loan amount was 453,496 yuan (about 8.6 million yen) (Table 17). Regarding the repayment situation (Table 18) at the time of the ex-post evaluation, 20% of the respondents said that their "repayment is going on as scheduled," 26% said that they "have not paid back," 2% said that they paid back with some delay, and another 2% said that they had yet to pay back. The reasons that they failed to repay the loan include "income from Economic Forests is still unstable," "I planted jujube but the profit is too low to pay back the loan." Some answered that they "would like an exemption from repayment and interests."

To the questionnaire survey to the forest farm managers (33 replies), 60% answered that their employees' "repayment is going on as scheduled." For the other 40%, the employees' repayment was stopped or delayed because of insufficiency of income from Ecological Forests and Economic Forests.

In Gansu Province with severe natural conditions, the forests were expected to bring ecological conservation effects. The implementation bodies had the primary responsibility for operation and maintenance, but the county (city, district) forestry bureau would keep paying back the loan for the implementation bodies with the bureau's own sufficient funds until the forests provided sufficient income for the implementation bodies. Therefore no problem was found with repayment.

Table 17: Result of the beneficiary Survey on Repayment Status (100 samples)

Total Loaned Amount	Rate	Starting date for Repayment	Amount Repaid
453,496yuan	0.75%	March 2013	Not answered

Table 18: Result of the beneficiary Survey on Repayment Situation (100 samples)

How is the situation of repayment?	
Repayment is going on as scheduled.	20 %
Repayment is going on with some delay	2 %
Repayment is disrupted.	2 %
Do not pay back	26 %
Not answered	50 %

(3) Operation and Maintenance Cost for Irrigation Facilities

Irrigation facilities were owned by farms, enterprises, and farmers; this means that they had maintenance responsibility. However, according to the beneficiary survey (100 samples), none of the respondents were charged for using the facilities, and only 21% answered that "a maintenance fee was collected." In most of the sites, the local governments covered the operation and maintenance cost.

According to the interviews with province, city, and county governments, in most of the

Project sites with irrigation facilities, the maintenance costs were chronically deficient, and subsidies from provincial government would be essential for current and future operation and maintenance. The Gansu Province Water Resources Bureau obtained a budget of 92 million yuan (2014 performance) for the maintenance and repair irrigation facilities. Thus it is fair to say that sustainability is expected.

Including subsidies from national programs, the provincial forestry budget increased year by year, and the costs for operation and maintenance were secured. The implementation bodies gradually gained stable income as the Economic Forests grew, and financial sustainability would be secured in three to five years. Under normal circumstances, it would be desirable for individual owners or agencies of the irrigation facilities to bear the operation and maintenance costs; however, it is fair to say that, with the government subsidies, sustainability of the irrigation system is secured. In summary, no major problem was found in the financial aspects of operation and maintenance.

3.5.4. Current Status of Operation and Maintenance

(1) Operation and Maintenance of Forests

The provincial government considered that the status of forests and grassland and the maintenance situation were good and found no problem. In the five counties and one Gansu Farms Agribusiness Corp where the evaluation team visited for the field study, all the sites including Economic Forests, Protection Forests, Closure, and Engineering Sand Fixation were generally in good condition and maintained appropriately. A few maintenance problems were observed such as that unsuitable species for the area were selected in Economic Forests, necessary nursing and pruning were not done in some farmers' sites, and irrigation facilities were not maintained appropriately.

According to the beneficiary survey, with regard to the forest condition (Table 19), 86% of the respondents said that the condition of their forests was "fine," while 14% considered that "there are a few problems." The causes of the problems were "insufficient water supply" (54%), "damaged by yellow sand" (42%), "damaged by diseases and pests" (39%), "low survival and preservation rates" (39%), and "low yield of products" (31%).

About the forest maintenance, 74% thought that it was "fine," and 26% said "there are a few problems." The problems included "insufficient maintenance budget" (56%), "unable to secure water" (24%), "insufficient manpower" (23%), and "periodical maintenance was not provided" (17%).

Table 19: Result of Beneficiaries Survey on Forest Maintenance (100 samples)

How is the condition of the Forest?		How is the status of forest maintenance?	
Fine	86 %	Fine	94 %
There are a few problems.	14 %	There are a few problems.	2 %
There are many problems.	0 %	There are many problems.	0 %
Not answered.	0 %	Not answered.	4 %

(2) Operation and Maintenance of Irrigation Facilities

The provincial project office believed that the condition of irrigation facilities and maintenance situations had no problem. According to the beneficiary survey (100 responses), 88% of the respondents answered that the condition of their irrigation facilities was “fine,” but 9% thought that there were a few or many problems. The problems were explained as “damage and leak of water of the irrigation facilities” (56%), and “deterioration of facilities”. The facilities with problems were not the ones built by the Project, but those that the implementation bodies built themselves. However, the field study revealed that some of the Project’s irrigation facilities were broken or clogged by trash and needed repaired or better maintenance. Irrigation facilities were used by 99% of the respondents, and 61% answered that water supply was “sufficient” while 33% said that it was “insufficient.” The main reason for the insufficiency in water supply was the climate-related causes in desert areas. All the Project sites that answered that water supply was insufficient were either those of shrubbery or fruits that require a large amount of water.

Table 20: Result of Beneficiaries Survey on Irrigation Facilities (100 samples)

How is the condition of the irrigation facilities?		How is the amount of water supplied by the irrigation facilities?	
Fine	88 %	Water supply amount is sufficient	61 %
There are a few problems.	7 %	Water supply amount is insufficient	33 %
There are many problems.	2 %	Not answered	6 %
Not answered.	3 %		

(3) Operation and Maintenance of Facilities and Equipment

- ① Vehicles (99 units), Motorcycles (12 units), trucks (35 units) were operated and maintained by the allocated organizations, and no problems in use were reported at the time of the ex-post evaluation.
- ② According to the provincial government, environmental monitoring devices (322 units) were distributed to state-owned forestry farms, erosion control stations, and Gansu Farms Agribusiness Corp and used without any problem. The interviews in the field study did not elicit any clear answer to the questions on what organization had which device, who was responsible for maintaining the device, and how the devices were used.
- ③ Farm machinery (949 sets) was registered as the property of farms, forestry farms, and Gansu Farms Agribusiness Corp, and each organization took the responsibility for maintenance.

The evaluation team confirmed that the machines were maintained well and kept in a garage. At the time of the ex-post evaluation, some of the tractors and grass reaping machines in heavy use were scrapped because they had broken down.

The maintenance status and condition of forests and grasslands built by the Project were generally good although a few irrigation facilities needed better maintenance. Allocated facilities and devices such as vehicles and farm machinery were used

according to the original purposes.

As mentioned above, no major problems were found in institutional, technical, financial aspects. Therefore the sustainability of the Project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1. Conclusion

The Gansu Afforestation and Vegetation Cover Project aims to improve the forest and vegetation coverage ratios by afforestation and crop planting for preventing desertification, and contribute to social and economic stability. The Project was prompted by the increased importance of afforestation because of the escalation of desertification in China. The relevance of the Project is high because the Project is consistent with the Chinese government's policies, development needs, and Japan's aid policy. For further contribution to desertification prevention in areas with the severe natural environment, the main Project implementation bodies for Economic Forests changed from small-scale farmers to groups of farmers or enterprises, and those for Protection Forests and Closure changed to local governments or state-owned forest farms that act for the public interest. The change was sound for implementing afforestation and crop planting in a more effective area on a larger scale and sustaining the operation and maintenance system while also benefitting the small-scale farmers. The Project's afforestation and vegetation area, equivalent to 63% of the desert decreased in the same period in the entire Gansu Province, contributed to desertification prevention. At the time of the ex-post evaluation, trees and grasses were growing well, and the Project helped increase the production of forest products and income, and improve the living environment. Thus the effectiveness and impacts of the Project are high. With regard to the efficiency, the project period was within the planned limit, although the project cost exceeded the plan because of the additional afforestation and vegetation area. Thus the efficiency of the Project is fair. The exclusive project office for the yen-loan project was dissolved, but no problem was seen in the institutional aspects of sustainability because the Gansu Provincial Government Finance Bureau Agricultural General Development Office, an upper-tier office, took over the office's functions. The budget for operation and maintenance was secured by a subsidy from the national government, and the budgets of the finance and forestry bureaus and the local government. Some farmers needed improvement because of insufficient technical transfer and lack of forest and irrigation facility maintenance. However, both the technical aspects and the operation and maintenance status in most of the forests and grasslands were generally favorable. Therefore the sustainability of the Project is high.

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

4.2. Recommendations

4.2.1. Recommendations to the Executing Agency

(1) In many project sites, the local government covered the irrigation facility maintenance costs. Implementation bodies such as forest farms, farmers, and enterprises would be responsible for the costs and implementation of maintenance and repair under normal circumstances. However, shortage of the maintenance budget caused delays in repair. From now on, to prepare for the decrease in the government's support and address a constant budget shortfall, it is necessary to set a system in which the implementation bodies secure budget by themselves. The facilities built at the beginning of the Project were more than 10 years old at the time of the ex-post evaluation, and were approaching the service life of 15 to 20 years. The executing agency must encourage the implementation bodies to launch an irrigation facility maintenance administration, and establish a system to collect fees or share maintenance cost burdens.

(2) The Project provided training for 34,500 people of implementation bodies, which was more than the planned. However, the beneficiary survey revealed that 78 out of 100 respondents received training, meaning that the Project did not cover all the implementation bodies. The evaluation team found in some Economic Forests, farmers had problems in selecting proper species and maintaining forests. The farmers did not select trees and maintain forests based on scientific knowledge, but kept switching species on a trial-and-error basis. It is desirable that prefectural engineers provide additional training or individual technical guidance for such farmers at the earliest possible stage.

4.2.2. Recommendations to JICA

None.

4.3. Lessons Learned

(1) To raise the ecological effects of an afforestation project, it is important that the executing agency provide consistent guidance and supervision throughout all the steps from the selection of implementation bodies, forest type and species, and to technical transfer.

At the time of the appraisal, the main implementation bodies for the Project were supposed to be small-scale farmers. However, in Gansu Province's severe natural environment, to contribute more for desertification prevention, Sand Protection Forests and Closure were implemented by local governments and state-owned farms. With the sand control experts' opinions taken into consideration, the Project target areas were selected so that they would be where the entire community would benefit such as the entrance of wind from the desert and the areas around water sources, and major desertification prevention measures were implemented. Economic Forests were implemented by large-scale farmers, groups of farmers, and enterprises. They appropriately executed sand protection at leveling, planting, provision of water through

irrigation, and selection of species. As a result, the implementation bodies succeeded in keeping the forests with high survival and preservation rates under the severe environmental conditions. The Project gained the desired ecological conservation effects and enriched ecological system by diversifying tree species because the executing agency dispatched an expert team that not only monitored the indicators but also provided guidance and supervision in selecting forest types and species and maintaining forests. By contrast, because of the lack of guidance and monitoring, in some of the Project sites farmers selected the wrong species, and failed to maintain forests and irrigation facilities appropriately. It would have been desirable to work with the section specialized in technology dissemination in the forest bureau to cover local farmers. Thus, to raise the effects of an afforestation project, the executing agency needs to work with research institutions, engineers, and the technology dissemination section at the local level. It is also important for the executing agency to provide guidance and supervision throughout the process in all the steps from the selection of implementation bodies, forest type and species, and to technical transfer.

(2) By promoting Ecological Forests for tourism, it is possible to envision social and economic effects.

Four Ecological Forests of the Project were built by local governments with the vision to use them for tourism. The main effects of the afforestation were to prevent soil flow into lakes and dams, and improve the residents' living environment by converting deserts in the city area into forests. In addition to Closure and Engineering Sand Fixation, the cities built facilities such as leisure facilities, a meteorological tower, roads, walking paths, fish culture facilities, and electric power plants, and used the Ecological Forests to display the desertification prevention measures, desert-oriented industries, and plants in the desert. If, at the time of project planning, an executing agency considers new ways to use Ecological Forests for purposes such as tourism, it can expect not only ecological conservation effects but also social and economic ones.

END.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs		
Afforestation		
Afforestation	91,072 ha	136,472 ha
Protection Forests	16,204 ha	23,825 ha
Arbores	3,471 ha	7,900 ha
Shrubbery	12,734 ha	15,975 ha
Economic Forests	18,264 ha	20,758 ha
Grape	5,042 ha	4,847 ha
Jujube	1,658 ha	1,821 ha
Hop	770 ha	2,626 ha
Fruits mixed	810 ha	1,300 ha
Alfalfa	9,988 ha	10,164 ha
Sand Enclosure Afforestation	51,106 ha	86,284 ha
Engineering Sand Fixation	5,493 ha	5,604 ha
Afforestation Material		
Seedling	190.5 million	247.65 million
Chemical Fertilizer	12,993 ton	19,739 ton
Organic Fertilizer	113,942 ton	147,367 ton
Pesticide	682 ton	863 ton
Facilities and Equipment		
Canal	1,110 km	1,202 km
Irrigation	8,978 ha	9,317 ha
Impoundment	780 m ³	4,780 m ³
Road construction	845 km	1,134 km
Electric Line	20.8 km	As planned
Transformer	8 sets	As planned
Construction	13,280 m ²	13,560 m ²
Farm Machinery	894 sets	949 sets
Vehicle	125	99
Motorcycle	217	12
Truck	35	As planned
Environment Monitoring Tools	350 pieces	322 pieces
Training		
Training		
City Government	30 persons	As planned
County /Township Government	3,610 persons	6,710 persons
Gansu Farms Agribusiness Corp	1,030 persons	1,365 persons
Technical Guidance(participants)	23,800 persons	34,500 persons
2. Project Period	March 2003 -October 2010 (92 months)	March 2003-October 2009 (80 months)
3. Project Cost	208 million yen	12,388 million yen
Foreign currency	16,392 million yen	4,534 million yen
Domestic currency	(826 million yuan)	(319.4 million yuan)
Total	16,600 million yen	16,933 million yen
Yen loan	12,400 million yen	12,388 million yen
Exchange rate	1 yuan=15yen (September 2002)	1 yuan=14.19588yen (average rate 2004-2009)

Attachment: Growth Situation in the Project Sites

1. Economic Forests

(Jujube, Apple, Pears, Grapes, Alfalfa)

The preservation rates in all the sites were 85% or higher. No disease or pest damage was observed, and trees grew generally well. The team was unable to measure the growth of the vines. As the alternative the team interviewed engineers to confirm the growing status. Alfalfa had been cropped. However, by calculating the remaining stumps, the team confirmed that the coverage ratio was nearly 90%. Regarding the maintenance status, weeding, fertilization, disease and pest control, and irrigation system maintenance were appropriately executed. A few farmers cultivating jujube and pears had problems in implementing such maintenance tasks, and needed guidance. Other farmers selected varieties that were unsuitable for dry and cold areas such as apple and jujube. It would be desirable for Forestry bureau engineers to provide advice to the farmers on nursing and variety selection.

Variety	Tree Age (year)	Height (m)	Tree Crown (m)	Base Circumference (cm)	Density (#of tree/mu)	Preservation Rate (%)
Jujube	8	1.5	2.9	1.4	296	85
	11	3.5	1.4	5.1	45	85
	17	3.4	2.2	7.0	45	85
	Average	2.8	2.2	4.5	---	85
Apple	8	3.4	2.9	12.8	45	95
Pears	8	5.3	1.9	10.3	56	85
	11	3.0	1.8	7.0	133	90
	Average	4.2	1.9	8.7	---	87.5
Grapes	8	---	---	---	185	---
	10	---	---	---	167	---
Alfarfa	10	---	---	---	(Coverage rate) 90	

2. Protection Forests

2-1 Arbores (Poplar, Locust, Japanese Pagoda Tree, Euphrates Poplar, Willow, Spruce, Scots Pines, Russian Olive)

The preservation rate was over 75% in all the species. Arbores were planted as a windbreaker in roadsides, farm fields and the banks of waterways. The trees were mostly growing well, and appropriate disease and pest control measures were taken. In a park (Jiyuguan City), Willow, Spruce, Scots Pines were planted in favorable environment where pipe irrigation fully equipped and provided irrigation water 25 times in a year. Almost all the sites were mixed forests. Mixed forests in parks were formulated by putting together simple forests of multiple species because the parks were meant to display the trees.

Variety	Tree Age (year)	Height (m)	Circum-ference (cm)	Density (#of tree/mu)	Preservation Rate (%)	note	
Poplar	11	14.1	10.1	667	80		
	10	18.3	13.4	197	90		
	Average	16.2	11.75	---	85		
Locust	10	8.4	9.75	154	83		
Japanese Pagoda Tree	6	3.3	6.4	42	80		
	10	10.2	12.4	111	80		
	Average	6.75	9.4	---	80		
Euphrates Poplar	10	6.4	8.3	16	85		
Willow	10	10.9	12	167	80	cut to 2.5m	park
Spruce	9	2	4.4	167	90		
Scots Pines	9	5.6	8.9	167	90		
Russian Olive	10	2.3	10.1	333	75		

2-2 Shrubbery (Chinese Tamarisk, Saxaul, *Caragana intermedia*, *Hedysarum scoparium*)

The shrubbery sites were effective in wind breaking. Local species that are suitable for desert were selected and planted. All the sites were mixed forests with multiple species. The preservation rate was higher than 73%, and the growth condition was generally good. Regarding the maintenance, pruning work needed at a few *Hedysarum scoparium* sites. The coverage ratio of shrubbery reached more than 30% in all the sites. Thus it is fair to say that sand flow prevention effects were generated.

Variety	Tree Age (year)	Height (m)	Tree Crown (m)	# of branches	Density (#of tree/mu)	Preservation Rate (%)
Chinese Tamarisk	10	2.5	2.4	11.8	121.5	85
Saxaul	10	2.2	2.1	9.3	296	80
<i>Caragana intermedia</i>	10	2.0	1.6	11.8	146.3	73.3
	11	2.2	1.9	10.8	167	75
<i>Hedysarum scoparium</i>	10	1.8	2.2	10.2	80.0	77.5

3. Closure

(*Nitraria roborouskii*, Saxaul, Chinese Tamarisk, *Kalidium gracile*, *Reaumuria soongorica*)

The vegetation coverage ratios were 47% in Jinchang City Jinchuan district and 40% in Jiayuguan City. Ten years after the beginning of the closure, multiple species of shrubbery and grasses grew well, and sand flow prevention effects were generated as a result of the vegetation recovery. In one site that was closed for 11 years, the vegetation coverage ratio was 20%, which was below the target. However, this was not a problem because irrigation facilities and wind protection forests were built near the sites to convert them into Economic Forests of apple trees. In some sites, *Nitraria roborouskii* were planted, and were given nutritional supplement

because their roots could be sold as herbal medicine.

Variety	Tree Age (year)	Vegetation coverage (%)	Location
Nitraria roborouskii, Saxaul, Kalidium gracile	10	47	Jinchang City Jinchuan district
Nitraria roborouskii , Reaumuria soongorica	10	40	Jiayuguan City

END.

People's Republic of China

Ex-Post Evaluation of Japanese ODA Loan
“Jiangxi Province Afforestation Project”

External Evaluator: Shima HAYASE / Yuko KISHINO, IC Net Limited

0. Summary

The Jiangxi Province Afforestation Project (hereinafter referred as to the “Project”) aims to improve the quality of forests in Jiangxi Province, and to restore their multi-dimensional functions by afforestation and Mountain Closure. The Project was prompted by the increase in the importance of afforestation because of the escalation of flood damage in the Yangtze River basin area. The Project’s relevance is high because its aim is consistent with the Chinese Government’s development policies, development needs and Japan’s aid policy. Affected by the Forest Tenure Reform¹, the main project implementation body was changed from small-scale to large-scale farmers. The change was positive one for assuring forestation and for setting the sustainable system for forest management, while benefitting the small-scale farmers. In contrast, a problem at the time of the appraisal is that erosion control effects by forest type were not examined. The afforestation plan should have been drawn in accordance with the flood and erosion damages based on examination of effects. However, the problem is not taken into consideration for the relevance rating because, regardless of the forest type, a certain amount of ecological conservation effects exist, and the risk of a significant decrease in the Project’s sustainability is low.

The project planted trees in the area equivalent to 18% of the water and soil erosion control area of Jiangxi Province, and contributed to improving the forest coverage ratio and forest stock volume². The forests are still growing but expected to bring economic impacts in the future. However, because tree planting and forest management did not follow the afforestation design, the improvement in the quality of forests and ecological conservation effects are limited. Thus the effectiveness and the impacts of the project are fair.

With regard to efficiency, although the cost of the Project was within the planned limit, the project period was longer than planned because of the supplemental planting and additional forests building. Thus the efficiency of the Project is fair.

There was no major change in the Project’s executing agency, and the funds for the

¹ The Forest Tenure Reform was meant to allocate ownership of forest lands to individual farm households. In Jiangxi Province the reform was executed between 2004 and 2011.

² The forest stock volume is an indicator to measure the quantity of a forest by cubic volume of the timbers in the forest. It shows the status of a forest per unit area.

operation and management of the Project were secured by subsidies and forestry bureau's budget. However three years after the planting, forests were not maintained properly because of the rising employment costs and lack of relevant knowledge. It is necessary to upgrade technology on forestation, nursing, and thinning among engineers and farmers and disseminate accurate knowledge to them. The sustainability of the Project is fair because a few problems were observed in technical and implementation bodies' financial aspects and the maintenance status.

In light of the above, the Project is evaluated to be partially satisfactory.

1. Project Description



Project Location



Photo 1: Chinese Fir forest
(Jiangxi Province Yongxing County)

1.1. Background

Since 1949, afforestation has been one of the main policies of the Government of China. The major deforestation to meet the demand for timbers due to the economic growth led to the deterioration of the quality forestry resources, an increase in the damages of natural disasters such as floods, the degradation in the natural environment, and the rural poverty due to lower productivity in cultivated and pasture lands. After the devastating flood in 1998, the Government implemented "National Plan for Ecological Construction". The plan set prioritized projects for natural environment improvement, their target areas, and quantitative goals, and launched large-scale afforestation projects. Jiangxi Province was a part of the target area of the Yangtze River Basin Shelter Forest program and the program of Converting Steep-Farmland Back to Forest. At the time of the appraisal, forest coverage ratio in Jiangxi Province was 53%, which was higher than the national average of 17%. However, the quality of the forests in the province deteriorated because they were not maintained properly. The erosion area amounted to 21% of the provincial territories. The drained soil that raised the river and lake bed also exacerbated the damages by

floods and other natural disasters. Under such circumstances, the Jiangxi provincial government requested the Government of Japan for an afforestation project to recover the multi-dimensional functions of forests such as ecological conservation and water and soil erosion control. The Government of Japan approved the request as a yen-loan project.

1.2. Project Outline

The objective of the Project is to increase the forest coverage ratio and to enrich forest resources by afforestation and Mountain Closure³, thereby contributing to restoring the multi-dimensional functions of forests, such as ecological conservation and erosion control in Jiangxi Province.

Loan Approved Amount/ Disbursed Amount	7,507million yen / 7,506 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2004 / March 2004
Terms and Conditions	Interest Rate 0.75% Repayment Period 30 years (Grace Period) (10 years) Conditions for Procurement: General Untied
Borrower / Executing Agency	Government of People's Republic of China/ Jiangxi Province People's Government
Final Disbursement Date	August 2012
Main Contractor (Over 1 billion yen)	None
Main Consultant (Over 100 million yen)	None
Feasibility Studies, etc.	"Feasibility Study Report" Forestry Prospect and Design Institute of Jiangxi Province, July2002
Related Projects	<ul style="list-style-type: none"> ● Gansu Afforestation and Vegetation Cover Project (L/A 2003) ● Hubei Province Afforestation Project (L/A 2004) ● The Japan-China Cooperation Science and Technology Center for Forest Tree Improvement Project (Technical Cooperation 1996-2006) ● Forestry Development in Poor Areas Project (World Bank 1999-2005) ● EU Bank Energy Forest Building Project (EU Bank 2003-2009) ● ADB Loaned Afforestation Project (ADB 2005-2012)

³ Mountain closure is a measure to promote natural growth of tree and vegetation in the area by prohibiting the entry of people and live stocks.



Figure 1: Project Sites in Jiangxi Province

2. Outline of the Evaluation Study

2.1. External Evaluator

Shima HAYASE, IC Net Limited

Yuko KISHINO, IC Net Limited

2.2. Duration of Evaluation Study

The ex-post evaluation study was carried out as follows:

Duration of the Study: August, 2014 – November, 2015

Duration of the Field Study:

1st Field Study: November 11, 2014 – November 22, 2014

2nd Field Study: April 16, 2015 – April 19, 2015

2.3. Constraints during the Evaluation Study

As this ex-post evaluation was carried out two years after the project completion, it was premature to observe the Project's mid- to long-term effects, and analyze future prospects conclusively. Accordingly, the ex-post evaluation focused on analyzing basic effect indicators, prospects for the development and sustainability of the Project's effects, and the status of the institutional, financial and technical environments to realize the prospects. Also, because of the following constraining factors, the Project's effectiveness had to be provisionally evaluated by using the sampling data collected through the field survey⁴. Firstly, the forests were still

⁴ The Project was implemented in 36 counties, which is a vast area. It was impossible to conduct a field

growing and not ready for an observation of their fully developed status. Secondly, the Project covered a vast area consisting of 36 counties, and it was impossible to visit all the project sites within the allocated study period. Moreover, the survival rate, i.e., the main operational indicator, was not measured by the method agreed at the time of the appraisal. Thus the evaluation team did not compare the target figure and the actual one provided by the provincial government, but made a judgment based on the results of the field survey.

3. Results of the Evaluation (Overall Rating: C⁵)

3.1. Relevance (Rating: ③⁶)

3.1.1. Relevance to the Development Plan of China

(1) Development Policy at the Time of the Appraisal

At the time of the appraisal, in the National Plan for Ecological Construction (1998–2050), the Government of China set four target areas for natural environment protection and restoration. Jiangxi Province was included in the Yangtze River Basin area where soil loss and afforestation were the prioritized agenda.

(2) Development Policy at the Time of the Ex-post Evaluation

Under the 12th Five-Year Plan (2011–2015), Jiangxi Province was a target area of the Yangtze River Basin Shelter Forest Program to reduce soil loss, the Natural Forest Resource Protection Program, and the Steep Farmland Conversion to Forestland. The 12th Five-Year Plan (2011–2015) of Jiangxi Province also aimed at development through conserving the ecological environment and harmonizing the society with the economy. The provincial plan was to promote afforestation and reforestation by converting steep-farmlands to forestlands, protect natural forests, promote Mountain Closure, and use forests as a means of erosion reduction for flood control.

To implement the policies, the Jiangxi Provincial Government encouraged the use of foreign loans. Since 1990's, the government has executed afforestation projects funded by the World Bank, and the Japanese Government. A large-scale project is needed to attain the policies' goals in vast area. As shown in Table 1, the Project is larger in both the afforestation area and the budget than other projects implemented around the close period, and thus the implementation of the Project is

study in all the counties during the evaluation study period. To address this problem, the evaluation team asked the Jiangxi Province People's Government, the executing agency, to collect operation and effect indicators in all the counties. In addition, the evaluation team chose six representative counties to conduct questionnaire, site-visit, and beneficiary surveys in order to grasp the overall picture.

⁵ A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

⁶ ③: High, ② Fair, ① Low

relevant.

Table 1: Foreign Funded Afforestation Projects

Project	Donor	Duration (year)	Afforestation Area (ha)	Cost (million yuan)
Forestry Development in Poor Areas Project	World Bank	1999-2005	55,401	260
EU Bank Energy Forest Building Project	EU Bank	2003-2009	20,287	560
ADB loaned Afforestation Project	ADB	2005-2012	50,862	450
The Project	Japan	2004-2012	236,548	730

Source: Jiangxi Province Forestry Bureau Foreign Funds Afforestation Project Office.

3.1.2. Relevance to the Development Needs of China

(1) Relevance to the Development Needs at the Time of the Appraisal

At the time of the appraisal, forests in Jiangxi Province were not maintained properly, and the quality deteriorated. The average forest stock volume in Jiangxi Province was 32.3m²/ha at appraisal, which was far below the national average of 83.9 m²/ha. Thus the forests did not fully perform their multi-dimensional functions, such as retention of water and soil.

It was estimated that 200 million tons of soil inflows into Yangtze River annually. The soil inflow raised the bed, and made the river basin vulnerable to natural disasters, such as floods. It was also a cause of flood damage that cost more than 10 billion yen in a year. The Jiangxi provincial government prioritized the improvement of forest quality, and aimed to implement afforestation in a total area of 1.27 million ha through the Jiangxi 10th Five-Year Plan (2001-2005).

(2) Relevance to the Development Needs at the Time of Ex-post Evaluation

At the time of the ex-post evaluation, the average stock volume in Jiangxi province was 40.6 m³/ha⁷, which was still far below the national average of 70.2 m³/ha⁸. The forest coverage ratio reached to 63.1%⁹, which is above the national average of 20.4%, and the forest area kept increasing. However, the forests' multi-dimensional functions such as water and soil retention capability were still at a low level because the forests consisted mostly of newly-planted young trees, and the quality of most of the forests was not very good. According to the National Ministry of Water Resources, the water and soil erosion area in Jiangxi Province in 2010 reached nearly 1,813 thousand ha, which was equivalent to 10% of the

⁷ Jiangxi Province Statistical Yearbook (2013)

⁸ The stock volume at the time of the ex-post evaluation is lower than the one at the appraisal time. This is because the ratio of the area with growing trees became larger although afforestation projects increased the total forest area.

⁹ Jiangxi Province Statistical Yearbook (2013)

national damaged area of 17,525 thousand ha. Therefore the situation remained serious.

The 12th Five-Year Plan (2011-2015) of Jiangxi province laid out the goals to increase the forest area to 10.13 million ha, the forest coverage ratio to 64%, and the forest stock volume to 500 million m³ by adding 55 million m³ in one year. Thus, at the time of the ex-post evaluation, the development needs for improving the forest quality were high.

3.1.3. Relevance to Japan's ODA Policy

The main targets of both "The Economic Cooperation Plan for China" issued in October 2001 and "The Medium-Term Strategy for Overseas Economic Cooperation Operations (2005-2008)" gave priority to addressing grovel environmental issues, and cited the following means to do so: cooperation to environmental conservation, forest conservation and management. The Country Assistance Strategy for China (2003) set its main target as environmental conservation and human resource development in the inner part of China, because environmental problems in China might have a direct impact to Japan. The Project targeted afforestation in Jiangxi Province in inland China, and contributed to environmental conservation. Therefore its relevancy to Japan's ODA policies is high.

3.1.4. Appropriateness of the Project Plan and its Approach

The project documents provide by JICA explained the Project was aiming for "restoration of forests' multi-dimensional functions," and the main effect of the Project as "ecological conservation and reduction of erosion¹⁰." By contrast, the Feasibility Study prepared by the Chinese Government cited "social and economic effects by enriching forest resources," and expected that income earned from the forest resources would be an incentive for taking part in the Project and a funding source for forest management.

The Government of Japan also recognized that, although the social and economic effects were not the main objective, the revenue from the forests were necessary resource to make the project sustainable¹¹. It is undeniable that the two sides'

¹⁰ The Project's effect, "restoration of forests' multi-dimensional functions" was determined as ecological conservation and reduction of erosion. According to the JICA documents, ecological conservation can be interpreted as "enrichment of forest resources and biodiversity by securing plant coverage." However, the Project's appraisal did not mention the development needs of "enrichment of forest resources and biodiversity," or any indicator for reduction of erosion. The JICA official in charge at the time of the appraisal said that the Project's main effect was determined as reduction of soil erosion.

¹¹ There was no description what "social and economic effects by enriching forest resources" meant in the Project documents provided by JICA. The definition was confirmed by interview to a JICA person

interpretations differed on the main effect of “restoration of forest’s multi-dimensional functions.” The difference became apparent after the project commencement through the major modification in the Project plan at the time of appraisal and Project approaches. The following are the modifications and their relevance.

(1) Changing the Project’s Participants

The Project’s approach was to have individual farmers, farmers’ groups, collective forest farms, and state-owned forest farms¹² plant trees for improving the ecological environment of their farms. For this purpose, the main implementation bodies would have been small-scale farmers, and they were to have built Protection Forests, Economic Forests and set Mountain Closure areas in their own lands¹³ for environmental effects and poverty reduction. The farmers were to have provided necessary manpower for nursing and forest maintenance and have earned income from the timber from thinning and forest products. In reality, farmers with larger forests became the main implementation bodies of the project, and the number of the participants was about 30% to the original plan.

The change was partly due to the Forest Tenure Reform that was implemented nationally after the start of the Project. The reform allocated forest tenure to individual farming households. Small-scale farmers who allocated small areas have chosen to participate in the project by organizing association with other farmers, or chosen to rent their lands to large-scale farmers or enterprises to earn rental fees, or chosen to provide man-power and earning labor wage.

The farmer or farm wishing to participate in the Project, applied to their county forestry bureau and signed the loan agreement. Large-scale farmers belonging in associations, and enterprises became the main implementation bodies because the bodies had to meet a few preconditions such as financial capability for maintaining forest lands and repaying loans.

Afforestation projects require inputs including material for planting and maintenance costs before the forest is fully grown to generate sufficient income. Because of the change in the conditions of the loan agreement, the implementation bodies were able to manage with their own financial resources the entire process

at screening.

¹² Mountain Closure is a measure to promote natural growth of trees and vegetation by prohibiting the entry of people and livestock in the area. It incurs maintenance costs but generates no financial profit. Thus Mountain Closure areas were allocated to only state-owned forest farms because they were for the public interest.

¹³ The plan at the time of the appraisal expected that 57,164 farmers would take part in the project. The expected average forest size per farmer was about 1 ha.

from leveling before planting, securing costs for management and repayment, and employing necessary manpower for forest management.

Thus, the change was better alternative for enhancing the Project's effects as well as securing the Project's financial sustainability. The change had no negative impact on social aspects because small-scale farmers became secondary beneficiaries and earning rental fees and labor wages.

(2) Appropriateness of Appraisal and Change by Project Purpose and Afforestation Method

The main objective of the Project was the improvement of the quality of forests which consisted of the effects of soil erosion reduction and ecological conservation through afforestation. As explained in ① and ② below, JICA should have provided supervision and guidance to the Project through the executing agency on the following: whether the Project examined the appropriateness of appraisal and change regarding afforestation methods, selection of tree species, and forest design based on difference in effects on the project objectives and contribute to the effects.

However, a certain amount of effects were realized in erosion reduction and ecological conservation regardless of afforestation methods, and the risk of significant deterioration was low in the sustainability of the Project's effects. Thus the points mentioned above were not taken into consideration in rating the relevance of the Project.

① Effects on Water and Soil Erosion Control

At the time of the appraisal, it was determined that erosion control effects yielded by afforestation were the same regardless of forest type (Protection Forest¹⁴, Economic Forest¹⁵, Timber Forest¹⁶, or Mountain Closure¹⁷). Based on the recognition above, the project plan set the afforestation method and areas according to the Chinese needs. During the implementation of the Project, the executing agency requested to increase Timber Forests and artificial afforestation. At that time, the difference on erosion control effect by afforestation method was

¹⁴ According to "Forestry Law of China" (below definitions referred the same law), Protection Forest is a forest including water conservation, water and soil retention, engineering sand fixation, farm land protection, revetment forests, and road-side trees.

¹⁵ Economic Forest is purposed to produce fruits, oil, drink, seasoning, industrial material and medicine.

¹⁶ Timber Forest is mainly for timber production. Bamboo forest is included in the definition.

¹⁷ Mountain Closure is a method to protect forests. According to the "Technical Regulations for Afforestation," the method is taken to restore the vegetation by half or fully blockading the target area, so to prohibit tree cutting for energy and livestock access.

not considered. In an afforestation project that aims to control soil erosion, usually the location of Protection Forest shall be decided first depending on the needs to control soil erosion, and then the area of Economic and Timber Forest shall be decided according to the economic needs. The Project did not follow the procedure above and prioritized needs of the Chinese side.

② Effect to Ecological Conservation

At the appraisal ecological conservation was defined as enrichment of forest resources and biodiversity. The forest design of the project plan aimed to build mixed-forest by planting multiple species. However, in reality, selection of type and species fell under the operation of the participants, they prioritized economic effects over ecological conservation. The forest inspection did not have criteria for if the participants successfully build mixed-forest as designed. As the result, majority of project sites, which supposed to be mixed forests, ended up to be simple forests. Simple forests utilize limited species of trees, therefore the intended biodiversity was not actualized. Also, when forest diseases and pests occurred, simple forests have higher chances to spread the damage to the same species and varieties, thus durability of the forests were weakened. In order to build and maintain a forest with quality, the forest sector expert said that promotion of stable growth of trees was important, therefore mixture of broad-leaf and needle-leafed trees was desirable. The project's contribution to improvement of forest quality, as required in development needs, was limited because most of the Protection Forests ended up to being simple forests.

This Project has been highly relevant with the development policies of the Chinese and Jiangxi Governments, the development needs as well as Japan's ODA policy. The appropriateness of the project approach had a problem because the project plan was designed at the time of the appraisal without considering differences in erosion control effects by forest type. However, regardless of the forest type, certain ecological effects observed and the problem did not compromise the Project's relevance seriously. Therefore, it is fair to say that the relevance of the Project is high.

3.2. Efficiency (Rating: ②)

3.2.1. Project Outputs

The Project's envisioned output at appraisal was consisted of afforestation, afforestation material, vehicle, facilities and equipment, nursery facility, irrigation system, training center construction and training/ technical guidance. The plans and the result of each item in this project are as shown in Table 2.

Table 2: Output

Item	Plan (Target year 2009)	Result (Project completion 2012)
Afforestation		
Afforestation	219,203 ha	235,890 ha
Timber Forest	65,637 ha	87,389 ha
Economic Forest	5,350 ha	2,077 ha
Protection Forest	148,180 ha	146,424 ha
Mountain Closure	52,167ha	42,411 ha
Afforestation Material		
Afforestation Material		
Seedling	167.97 million	370.84 million
Seed	151.8 ton	Import 3.43 ton Domestic N/A
Fertilizer	20,498 ton	Cancelled
Facilities and Equipment		
Vehicle		
Forest Monitoring Vehicle	44 sets	40 sets
Motorcycle	90 sets	8 sets
Farm Vehicle	None	4 sets
Office Equipment	167 pieces	87 pieces
Environment Monitoring Tools	36 pieces	22 pieces
Nursery Facility		
Small Nursery House (350 m ²)	5 places	3 places
Middle-size Nursery House (600 m ²)	5 places	Canceled
Large Nursery House (800 m ²)	2 places	2 places
Irrigation	30 hm ²	20 hm ²
Sprinkler	3 sets	1 set
Battery for nursery	3 sets	As planned
Construction	6,446 m ²	3,000 m ²
Dam	None	2,500 m
Leveling	None	70 hm ²
Training Center	4,000 m ²	built in the premises of the provincial forest bureau
Training		
Overseas Training	3 times 60 persons	3 times 45 persons
Province (Manager/Engineers)	N/A	15 times 1,560 persons
City (Manager/Engineers)		21 times 150 persons
County (Manager/Engineers/ Forest Farm Engineers/ participants)		186 times 25,000 persons
Technical Guidance(participants)	N/A	29,000 persons

Source: Jiangxi Province Forestry Bureau Foreign Funds Afforestation Project Office

(1) Scope of the Project

At the appraisal, the Project was to be implemented at 7 cities 36 counties because national afforestation projects launched before the project, and used provisional forest lands was used for the national afforestation projects. With the reason, Yihuang county and Changjiang district withdrawn, and as the alternation, Guangfeng and Shangli counties joined the project. Besides the above change, one county level unit was changed to two forest farm units, the 7 cities 37 counties executed the project. As the project whole, the scope was as planned.

(2) Forested Area

The actual afforestation area was 235,890 ha in total, which was 108% to the planned area of 219,203 ha. The breakdown consisted of 87,389ha of Timber Forest, Economic Forest of 2,077 ha, and Protection Forest of 146,424 ha. Of the Protection Forest, the afforestation area of Mountain Closure was 42,411 ha.

In reality, the area of Timber Forest largely increased¹⁸, amounted 37% of the afforestation area in total, while at the planning the area of Timber Forest amounted 30%. According to the hearing to the provincial government and the local forestry bureaus, Protection Forests are practically recognized as Timber Forests, thus without the area of Mountain Closure more than 80% of the project total afforestation area is practically considered as Timber Forests. According to the Provincial Forestry Bureau, since the implementation bodies were in charge of selecting forest type and tree species, economic effects were prioritized, and the area of practical Timber Forests increased.

With regard to the artificial afforestation and reforestation areas, the project plan at the time of the appraisal set the reforestation area as 186,422 ha, i.e., 85% of the total area. However, the artificial afforestation area was eventually increased to 117,143 ha, nearly the same as the reforestation area of 118,747 ha. The provincial forest bureau applied for the change on the basis of the mistaken notion that artificial afforestation had better multi-dimensional functions,¹⁹ and JICA approved the application as well. The artificial afforestation area increased to 117,143 ha, which was 357% to the planned area of 117,143 ha, and the reforestation area decreased to 118,747 ha, which was 64% to the planned area of 186,422 ha respectively.

As mentioned in the section on relevance, forest type and selection of species should have been examined and decided on the basis of differences in erosion reduction and ecological conservation effects that the Project was aiming at. The effects and influences on future forests by the change in forest type will be discussed in the sections on effectiveness and sustainability.

¹⁸ The former JBIC explained that Timber Forests would satisfy the requirements on economic and ecological effects better and approved the change. The ecological effects were recognized as follows: Timber Forests have a larger area of leaves and branches as well as higher rainwater retention effects, thus yield higher erosion control effects. However, according to a local forestry expert, the notion above is inaccurate because there is no correlation among forest type and species, leave and branch area, and rainwater retention and erosion control effects.

¹⁹ In artificial afforestation, soil erosion prevention effects decrease in nearly the five-year period between planting and the time that trees are fully grown, but the effects afterward are the same as those of reforestation. Reforestation helps enrich forest resources and promote biodiversity because it increases tree species in the existing vegetation.

Table 3: Area of Artificial Afforestation and Reforestation (unit: ha)

	Target at Appraisal (2009)		Result at Completion (2012)		Target/Result Ratio
	Area (ha)	Ratio	Area (ha)	Ratio	
Artificial Afforestation	32,781	15 %	117,143	49.7 %	357 %
Reforestation	186,422	85 %	118,747	50.3 %	64 %
Total Area	219,203	—	235,890	—	

Source: Jiangxi Province Forestry Bureau Foreign Funds Afforestation Project Office

Table 4: Project Area and the Ratio of Afforestation/Reforestation (unit: ha)

Type of Afforestation / Improvement	Planned Area (2004)	Result (2012)	Plan/Result Ratio
Timber Forest	65,673	87,389	133 %
Artificial Afforestation	16,101	59,358	369 %
Improvement of Young Growth Forest ²⁰	49,572	28,032	57 %
Economic Forest	5,350	2,077	39 %
Protection Forest	148,180	146,424	99 %
Artificial Afforestation	6,850	55,454	836 %
Improvement of Poor Stand ²¹	35,010	4,148	11 %
Improvement of Low Yield Mao Bamboo forest ²²	38,743	42,826	110 %
Improvement of Secondary Broad-Leaved Forests ²³	10,930	1,331	12 %
Four-Side Afforestation ²⁴	4,480	255	6 %
Mountain Closure	52,167	42,411	81 %

Source: Jiangxi Province Forestry Bureau Foreign Funds Afforestation Project Office

(3) Afforestation Materials

The planned number of the seedlings to plant at the time of the appraisal was 167.97 million. The actual number of planted seedlings was 370.84 million, i.e., 221% of the plan. It was due to the increase in the afforestation area in the Project as a whole and the change of the reforestation area to artificial afforestation. Another cause was that the seedlings were planted in a higher density than planned. The Project imported seeds from overseas in bulk. However, the total amount of the procured seeds is unknown because seeds made in China were purchased by each county and a few local governments provided subsidies for the purchase. Bulk purchase of fertilizer was cancelled, and each county procured it according to its needs. The reasons include that Economic Forests requiring a large quantity of

²⁰ A method to improve young growth forests that are three years after planting or older by providing maintenance tasks such as fertilizing, pruning, and thinning.

²¹ A maintenance method to improve the forest's protection functions by controlling the density of existing natural forests, weeding, or supplemental planting.

²² A method to improve a bamboo forest's quality by controlling the density of the existing bamboo forest, soil condition and fertilization so that the ecological environment is better and revenues from the forest increase.

²³ By pruning, thinning, and controlling the density of existing broad-leaved trees, this method provides sufficient water and fertilizer for the trees' growth. The purposes of the method are to make the forests retain and conserve water and yield more products.

²⁴ A kind of Protection Forest in which trees are planted to surround a farmland or house, or on both sides of a road.

chemical fertilizer decreased, and that farmers used self-procured organic fertilizer for environmental considerations.

(4) Facilities and Equipment

After the project started, the executing agency reexamined the necessary amount of facilities and equipment, and reduced the purchase amount of motorcycles, office equipment and environmental monitoring equipment, number of nurseries to build, and irrigation facilities. The training center was built in the premises of the provincial forest bureau. The center reduced time for moving during training sessions, increased convenience, and helped save the maintenance costs.

(5) Training

① Overseas Training

The original plan was to dispatch a total of 60 project office personnel of the province, city, and county forestry bureaus to such locations as Gifu and Okayama prefectures in Japan. However, the number of project office personnel to dispatch was reduced to 45 because of the instructions of the Jiangxi provincial government.

② Training in China

Training sessions in China were provided to a total of 26,710 staff members and engineers of the province, city, county forestry bureaus and forestry stations. It is unclear how many implementation bodies were trained because the trainees included engineers of county and state-owned forestry farms.

③ Technical Guidance

The provincial government provided technical guidance to more implementation bodies than had been planned because of the addition in the afforestation area. The beneficiary survey revealed that 95 out of the 100 respondents received technical guidance, and the average number of technical guidance sessions was 9.2 per implementation body. Many implementation bodies received technical guidance more than once, but a few implementation bodies did not receive it. Thus the coverage of technical guidance was imperfect.

With regard to the output, the afforestation area increased to 108% the one of the planned. However, in reality, the implementation bodies took control of the selection of type and species, and prioritized economic effects. As the consequence, more than 80 of the total forests became practically Timber Forests.

The executing agency should have controlled in selection of forest type and species. The executing agency reexamined the necessary amount of facilities and equipment and reduced the purchase amount, which contributed to saving the cost. Appropriateness of the number of trainees was not able to be evaluated because the planned number was not available.

3.2.2. Project Inputs

3.2.2.1 Project Cost

The planned project cost was 10,065 million yen in total (of which the ODA loan portion accounted for 7,507 million yen). The actual project cost was 10,062 million yen (of which the ODA loan portion was 7,506 million yen), which was within the planned amount (99% of the planned). In the planned project cost, the afforestation cost was to be 7,843 million yen. However, the actual afforestation cost was 9,662 million yen, i.e., 123% of the planned one. This was because the afforestation area increased to 108% of the plan, the actual number of seedling planted doubled to the planned one, and the labor cost, which was about 20 yuan per day at the time of the appraisal, increased to 100 to 120 yuan per day during the project period.

3.2.2.2 Project Period

Although the planned project period was 70 months from March 2004 to December 2009²⁵, the actual project period was 95 months from March 2004 to June 2012, i.e., 136% of the planned one. At the originally planned project completion time, the project period was extended because of the following reasons: supplemental planting in the rejected area and the area damaged in the major snowfall in 2008²⁶; and additional artificial afforestation²⁷ using the surplus of reserve funds and management costs until 2012. Because of the additional artificial afforestation and supplemental planting, the total extended period was 25 months, which was equivalent to 36% of the planned project period. However, afforestation area during the extended period was less than 10% of the total. Therefore, the extension exceeded the addition in outputs.

²⁵ The definition of the project completion was agreed as when the total area of the project pass the third growing year inspection on survival rate.

²⁶ The snow damaged 78,700 ha, which was equivalent to 10% of the afforestation area. Especially bamboo forests, 60% of the total, 29,300 ha damaged. Number of seedling for supplemental planting reached to 3,936,000 in total.

²⁷ The artificial afforestation area added was 1,093 ha in total, included Economic and Protection Forests.

3.2.3. Results of Calculations of Economic Internal Rates of Return

Since the main objective was to restore forests' multi-dimensional functions such as conservation of ecological environment and erosion control, a quantitative analysis of the internal rate of return was not developed at the time of appraisal. During the project execution, EIRR was not calculated, thus the ex-post withheld EIRR analysis.

As above mentioned, the project cost was within the plan, though the project period exceeded the plan. Therefore, efficiency of the Project is fair.

3.3. Effectiveness²⁸ (Rating: ②)

3.3.1. Quantitative Effects (Operation and Effect Indicators)

The main component of the project was afforestation. Therefore the effectiveness was to be evaluated by the quantitative indicators set at the appraisal, forests condition at the field study, forest coverage ratio and stock volume. Regarding the impacts, in addition to the reduction of erosion and ecological conservation, economic and social impacts that were to be the motivation for the participants to plant trees and provide maintenance work to the forests, and also to secure the sustainability, as the part of "restoration of the multi-dimensional functions of the forests." Since training was not the main component of the project, its effects were to be evaluated, not in the effectiveness and the impacts, but at the technical aspect of operation and maintenance in the sustainability section.

(1) Survival Rate, Preservation Rate²⁹, Forest Density³⁰

The calculation methods differed between the targets for the survival rate³¹, preservation rate³², and forest density set at the time of the appraisal and the results provided by the executing agency. Thus it was not possible to compare the targets with the results and use the comparison as an indicator of the effectiveness of the Project. However, the field study³³ for this ex-post evaluation revealed that, in forests five to ten years after planting, all the figures exceeded the standards, i.e.,

²⁸ Sub-rating for Effectiveness is to be put with consideration of Impact.

²⁹ China's Forestry Law sets the following definitions: [Survival rate] number of survived trees divided by the number of planted trees at the first growth period; [Preservation rate] the equivalent value in the third growth period.

³⁰ The forest density measures the density of woods. "1" means that the forest is wholly covered with trees. "0" means that there is no tree at all.

³¹ The target survival rate in the first growing period was 85% for both Protection and Economic Forests, and 95% for Timber Forests. No forest density target was set for Mountain Closure.

³² The target survival rate in the third growing period was 80% for Protection, and 85% for Economic Forests and Timber Forests. The target forest density was 0.2 for Mountain Closure.

³³ Number of the planted trees was judged comprehensively by the data provided at interviews to the implementation bodies, and by observing the spaces in forests where died trees used to be.

minimum preservation ratio of 85%, average preservation rate 96.4%, and forest density of 0.4 for Mountain Closure. The preservation ratio usually goes down as years pass after planting. However, the field study revealed a high preservation ratio in forests that were two to five years after planting. Therefore, based on the data from the field study, it is fair to say that the Project attained the targets in the survival rate, preservation rate, and forest density.

In the field study, the evaluation team observed that more number of trees planted in the Project's Protection and Timber Forests than the plan, and necessary thinning work were not executed. The adequate plantation density was 167 plants/mu³⁴ for Protection Forests and 146 plants/mu for Timber Forests. Then at tree age of 8-year, the forests' density is to be controlled to 106 plants/mu by thinning. In reality the density kept higher than the standards. The density of the Chinese fir forest was at 193 plants/mu in average, and the one of pine forests was 161 plants/mus. To confirm the facts more in depth, the team interviewed engineers and managers of the provincial government that were responsible for on-site inspection. The provincial technical regulations set the formula for the survival and preservation rates as "ratio of the number of trees in the area to the number of trees planted," but the actual inspection used "ratio of the number of trees in the area to the prescribed number of trees to plant" for calculating the density.

Survival/Preservation Rate = # of trees in the area / # of trees planted x 100

Actual Calculation Method = # of trees in the area / prescribed # to plant x 100

Here is a hypothetical situation: in a forest where the technical regulation sets 167 as the appropriate number of trees, 200 trees are planted in the forest, and 160 trees remain in the area at the time of the inspection. In a regulation-based calculation, the survival and preservation rates are $160/200 = 80\%$. In the calculation method employed by the actual inspection, the result is $160/167 = 95.8\%$. Because the forests passed the inspection by having more than the prescribed number of trees, many implementation bodies planted more trees in the forests, raised the forest density, and disturbed the growth of the trees. Such dense planting of trees became a cause of the deterioration in the forests' quality.

³⁴ Mu is a common Chinese unit of measure for land. 15 mu is equivalent to 1 ha.



Photo 2: Bamboo Forest recovered from snow damage (Jiangxi Province, Fenyi County)



Photo 3: Protection Forest of Slash Pine. (Jiangxi Province, Fengxin County)

3.3.2. Growth Situation in the Project Sites

The evaluation team conducted field study at 20 project sites³⁵ of 6 counties in total. The sites included Protection Forests, and Mountain Closures. The team examined forest design, maintenance status, and preservation rate for the planted trees. Also the height, circumference and so on measured so to inspect the growth of the trees. Summary of the result is as following, and the detail and the measurement data are mentioned in the attachment.

(1) Protection, Timber Forests

This section does not differentiate Protection Forests from Timber Forests because the former were grown practically as the latter. Needle-leaved trees (Chinese fir, pine) occupied 70% of all the forests, broad-leaved trees (liquidambar, oak, paulownia, Chinese tulip trees) 20%, and other species 10%. At the time of the ex-post evaluation, the average preservation rate was 96.4%, which exceeded the target rate for the third growth year.

The project plan aimed to enrich biodiversity, and recommended creating mixed forests by planting more than one species. However, 95% of the visited sites were simple forests³⁶. The major reason was that the selection of tree species was left to implementation bodies who avoided mixed forests that cost more for plantation and maintenance than simple ones. In addition, nursing and thinning were not done properly, weeds and shrub trees were not removed from the forest beds, and the forest density was not kept at the adequate level. However, the climate of Jiangxi Province is favorable for afforestation, and the high forest

³⁵ The field study concentrated on visiting forest sites with designs of larger percentages because the area of the Economic Forests was less than 1% of the total.

³⁶ The species and the varieties planted in the forests were confirmed by interviews with the implementation bodies, their records, and visual observation.

density did not affect the growth of the trees with regard to their heights and diameters. To build and maintain quality forests, mixed forests of needle-leaved and wide-leaved trees that promote stable growth of trees are desirable. However, the fact that most of the project's forests ended up as simple ones may have a negative impact on the project's effect on forest quality improvement in the future.

Four-side afforestation³⁷, a type of Protection Forest, needed better management and concrete countermeasures because damage from human activities with malicious intent was observed (refer to the Photo 4). Bamboo forests were maintained and fertilized appropriately. The forests yielded not only bamboos for industrial material but also edible bamboo shoots in a stable manner.

(2) Mountain Closure

Forest density³⁸ improved from 0.2 before the project to 0.4 after 9 years of closure. Water and soil erosion effects confirmed.



Photo 4: A tree in a Protection Forest, which damaged from human activities. (Jiangxi Province, Dexing city)



Photo 5: Mountain Closure area for erosion control purpose. (Jiangxi Province, Guangcheng city)

3.3.3. Forest Coverage Ratio and Stock Volume

As shown in Table 5, all the province, and project counties and sites achieved the targets in the forest coverage ratio. Regarding the stock volume, no target was set, but in comparison to the baseline figure at the time of the appraisal, the results in the province exceeded 154% and project counties did 120% as shown in Table 6). Thus it is fair to say that the intended project effect was attained.

³⁷ A type of Protection Forest with trees surrounding a farmland or house, or on roadsides. In the site visited, which was rented by a farm household, poplar trees were planted on both sides of a major road.

³⁸ Mountain Closure is a method to improve forest coverage ratio and increase ecological effects such as reducing water and soil erosion and increasing forestry resources. Forest density is used to measure the difference between the original status and the growth one after the Project.

Table 5: Forest Coverage Ratio

	Baseline	Target	Result
	Appraisal (1998)	One year after Completion (2010)	One year after Completion (2013)
Province	53 %	61 %	63.1 %
Project Counties	58 %	62 %	66.9 %
Project Sites	—	Increase 0.9 %	Increase 3.7 %

Sources: Target refer to JICA document at appraisal, Provincial result refer to Jiangxi Province Statistical Year Book, the project counties and sites result provided by Jiangxi Province Forestry Bureau Foreign Funds Afforestation Project Office.

Note 1: Forest coverage ratio: Forest area for the total area

Note 2: Project site Forest coverage ratio: Ratio of forestry area passed the Project's inspection / area of the administrative area×100

Table 6: Stock Volume³⁹ (unit: million m³)

	Baseline	Target	Result
	Appraisal (1999)	One year after Completion (2010)	One year after Completion (2013)
Province	289.927	N/A	445.3055
Project Counties	173.14	N/A	208.44

Sources: Target figure referred to JICA document at appraisal, Jiangxi Province Forestry Bureau Foreign Funds Afforestation Project Office provided the result

3.4. Impacts

3.4.1. Contribution to Erosion Reduction

In Jiangxi Province, erosion control projects were implemented in the total area of 1,340 thousand ha between 2004 and 2012 by such means as biological methods of afforestation and Mountain Closure, and riverbank reinforcement. The project's afforestation area in the same period was 236.5 thousand ha, i.e., 18% of the total area of the provincial projects above. Thus it is fair to say that the project contributed significantly to erosion control (Table 7).

The ratio of the water and soil erosion area to the entire area of Jiangxi Province was 21% before the project implementation, but decreased to 16% after the project. The ratio of the water and soil erosion area to the district area also decreased from 17.4% to 16.3% (Table 8).

Regarding the erosion area by severity level, the area of strong erosion decreased from 22.2% to 9.6%, super strong one from 7.5% to 2%, and Hyper-strong from 4.8% to 0.3%, respectively (Table 9).

³⁹ The JICA appraisal documents listed the target figures in project sites but did not describe the basis for calculating them. Thus in the ex-post evaluation, the evaluation team removed the figures from the indicators to analyze the project's effectiveness.

Table 7: 2004-2012 Water and Soil Erosion Control Measured Area and the Project's Afforestation Area (unit: thousand ha)

Jiangxi Province	W&S Erosion Control Measured Area	The Project's Afforestation Area
2004-2012	1,340	236.5

Source: Jiangxi Province Statistical Yearbook

Table 8: Comparison of Water and Soil Erosion Area

	year	W&S Erosion Area (million ha / year)	% of W&S Erosion Area to the territory
Province	Before (1996)	3.52	21 %
	After (2013)	2.65	16 %
Project Area	Before (1996)	1.075	17.4 %
	After (2013)	0.966	16.3 %

Sources: Target refer to JICA document at appraisal, Provincial result refer to Bulletin of The First National census for soil and water conservation, the project area result provided by Jiangxi Province Forestry Bureau Foreign Funds Afforestation Project Office.

Table 9: Water & Soil Erosion Area in the Project's Area by Severity Level (unit: 10,000 ton/ha/year)

	Mild 500-2,500	Moderate 2,500-5,000	Strong 5,000-8,000	Super Strong 8,000-15,000	Hyper Strong >15,000	Total
Before (1996)	41.4	27.7	24.7	8.4	5.3	107.5
Ratio to the Total	37.2%	28.3 %	22.2 %	7.5 %	4.8 %	100.0 %
After (2013)	57.4	27.5	9.4	2	0.3	96.6
Ratio to the total	58.9%	28.3 %	9.6 %	2.0%	0.3%	100.0 %

Sources: Jiangxi Province Forestry Bureau Foreign Funds Afforestation Project Office

3.4.2. Contribution to Ecological Conservation

In the Project plan at the time of the appraisal, enrichment of forest resources and biodiversity was the expected impact on ecological conservation. Regarding enrichment of forest resources, no logging was done because the forests were not fully grown by the time of the ex-post evaluation. In the future, a drastic ecological change may occur if the Protection Forests are logged in a wide area. However, the risks that forest resources will be lost by excessive logging are low because of the existence of the logging quantity limits and permit system in accordance with the governmental logging plan.

About enrichment of biodiversity, in order for achieving diversity of species by afforestation, the appraisal plan recommended to build mixed forests with about 40 species. The diversity ended up to be limited, because the selection of species was left to the participants preference, the planted species were mostly pine and fir trees, about 10 species in the overall project. At the field study, 95% of the forests were simple forests. If forest diseases or pests occurred in simple forests, chances of spreading the damage to the same species and varieties are higher.

In interviews, both the provincial forest bureau and the six counties targeted in the on-site field study stated that the Project helped enrich the diversity of animals and plants, but cited no specific data or species.

3.4.3. Economic and Social Impact by Afforestation

(1) Economic Impact by Afforestation

In the beneficiary survey as shown in Table 9, to the question comparing the income from the forests before and after the Project, 94% of the respondents answered “Income increased.” To the question on the comparison of their income and expenditure, 47% answered “expenditure exceeded the income.” Thus the answers indicate that the participants increased their forest area and production scale, and in some parts of bamboo reforestation area production of bamboo shoots increased successfully. About half of the participants’ expenditure exceeded their income because the cost for forest maintenance including labor cost and material raised, repayment has started, and most of the Project’s Economic Forests had not reached the tree age for stable production, and the Protection and Timber forests would take more years until the trees were to be ready for logging. According to the interviews in the field study, the farmers who did not have stable income from the forests covered the maintenance costs from their other revenue. They considered the maintenance costs for future investment.

In the survey on forestry farm managers⁴⁰, all the respondents said that both the income of the employees in all the farms and employment opportunities increased by taking part in the project. The average income became more than double the level before the project (Table 10). In addition, 25 out of the 28 surveyed farms said that the project helped improve the farms’ management.

The project brought about such economic and social impacts by afforestation as an increase in income and employment opportunities. In five to ten years, Economic Forests will reach the tree age that allow farmers to earn stable income; Protection Forests will reach such tree age in 20 to 30 years. Accordingly, it is likely that the project would bring about economic impacts as expected.

⁴⁰ The questionnaire survey was conducted to the forest farm managers in the 6 counties for the field-study. Sampling was done by the county government, and sample farms were chosen from the list of forest farms.

Table 9: Result of the Beneficiary Survey (100 samples)

Has your income increased since participatory of the Project?	
Income increased significantly.	32 %
Income increased in some extent.	62 %
No change.	6 %
Income did not increase much.	0 %
Income did not increase at all.	0 %
Are you earning or spending more for the Project's forest?	
Income is more than Expenditure.	50 %
Income and Expenditure are about the same.	3 %
Expenditure is more than Income.	47 %

Table 10: Changing of Forest Farm Employee's Income (average of 28 Forest Farms)

	Baseline (2004)	Target at Project Completion (2010)	Income at Ex-post Evaluation (2013)
Average Income	10,935 yuan/year	17,161 yuan/year	22,523 yuan/year
Ratio to 2004	-	157 %	206 %

Source: Survey on Forest Farm Manager

(2) Social Impacts from Afforestation

Small-scale farmers who had been expected to be the main implementation bodies at the time of the appraisal did not participate in the Project, but large-scale farmers, collective forest farms, and private firms did. The small-scale farmers chose to participate in the Project by renting their forest tenure to the implementation bodies or providing labor for wages. They became the indirect beneficiaries of the Project. It is thus assumed that expected social impacts from the Project materialized.

3.4.4. Other Impacts

(1) Impacts on the Natural Environment

No negative impact on the natural environment has been found. This is partly a result of careful consideration and measures by the Provincial Forestry Bureau. To avoid a negative impact on the environment, the bureau prohibited mountain burning to protect indigenous vegetation when the implementation bodies planted new forests. Also for ground leveling, rather than removing all the plants, the bureau suggested leaving existing vegetation to the maximum possible extent, and planting new trees in pits dug for new planting. The bureau encouraged the use of organic fertilizer for Economic Forests.

(2) Land Acquisition and Resettlement

No land acquisition or resettlement occurred because the Project

implementation bodies were owners of the forest tenure. When large-scale farmers or companies rented forests from farmers, rental agreements were concluded based on the afforestation period and the current land price, and suitable rental fees were paid.

As mentioned above, the Project covered a larger area for afforestation equivalent to 18% of the one covered by the provincial water and soil control measures, and contributed to improving the forest coverage ratio and the stock volume. However, because the plantation and management of forests were not executed as planned, forest quality improvement and ecological conservation effects were limited. Therefore, the effectiveness and impact of the Project are fair.

3.5. Sustainability (Rating: ②)

3.5.1. Institutional Aspects of Operation and Maintenance

(1) Executing Agency

The Jiangxi Province Forestry Bureau Foreign Funds Afforestation Project Office⁴¹ was responsible for supervising city and county project offices, and for managing funds for repayment. In addition, in cooperation with the bureau sections in charge of forest management and forest disease and pest control, the Project Office operated and maintained forests. Table 11 shows the numbers of human resources of the 37 project-participating counties' forestry bureaus and project offices. Among the counties, the project offices of six counties were disbanded because of the project's completion. Supervision and monitoring the forests were carried out by forest bureaus at the county level, and forest stations at the township level.

Between at the time of the appraisal and the ex-post evaluation, no major change occurred in the institutional structure of the Provincial Forestry Bureau, the executing agency. The sections of the Bureau had a good partnership with the county bureaus, and the responsibilities of the sections were clearly defined. Therefore no problem was found in institutional aspects.

⁴¹ Project Office is in charge of general administrative work of the Project.

Table 11: Number of Human Resources in Project Offices and Forestry Bureaus' Engineer of the participated 37counties (unit: persons)

	County Project Office					County Forestry Bureau Engineer				
	Total	Manager	Engineer	Finance	Other	Total	Senior	Middle	Entree	Assistant
Plan (2003)	357	123	150	71	13	279	19	114	106	31
Actual (2014)	176	31	91	22	30	109	24	62	18	0

Source: Jiangxi Province Forestry Bureau Foreign Funds Afforestation Project Office

(2) Implementation Bodies

In selecting implementation bodies, economic guarantees such as repayment capacity and collateral were requirements.⁴² Thus large-scale farmers, collective farms, and firms with economic capacity became implementation bodies of the Project. The project plan at the time of the appraisal expected that the implementation bodies would provide manpower to maintain the forests. However, the implementation bodies employed necessary workers for operation and maintenance of forests because the scale of afforestation became larger than planned.

The implementation bodies were in charge of the maintenance of forests. They hired forest protection patrol for preventing fires and controlling diseases and pests. For tree planting and nursing, the implementation bodies hired neighboring farmers. Labor shortage was observed in a few large-scale Economic Forests because farmers chose to work in distant locations for higher pay or prioritized work in their own farm in a busy farming season.

In the state-owned forest, employees rotate shifts to conducted patrolling for preventing forest fires and controlling diseases and pests according to the manuals prepared by the farms.

Between at the time of the appraisal and the ex-post evaluation, the executing agency and its subordinating bodies had good coordination, and defined their scope of work and responsibilities clearly. Also, implementation bodies with economic resources managed the Project in a well-organized fashion. Therefore no problem was found in institutional aspects of the operation and maintenance of the Project.

⁴² Project implementation bodies such as farmers, collective forest farms, and state-owned forest farms had to meet a few conditions. Although the conditions varied somewhat depending on the county, they were essentially as follows: (1) The implementation body owns land for afforestation (land of more than 50 mu, i.e., 3.3 ha, was required); (2) The implementation body can repay debts; and (3) The implementation body has a collateral such as forest tenure certificate, land, building, property, and salary from a farm.

3.5.2. Technical Aspects of Operation and Maintenance

Training for the engineers, whose mandate was to provide technical training and guidance to the implementation bodies, was conducted for those of the provincial, county, township, and state-owned forest farms. According to the survey for engineers who took part in the training (Table 12), 90% of the respondents took the course on afforestation techniques, and more than 60% took the ones on nursery and forest management, but about half took the ones on disease and pest control and nursing and thinning techniques. The probable reason for this imbalance in the courses taken is that the engineers were not interested in nursing and thinning because the forests had not reached the thinning stage at the time of the training.

Table 12: Result of Survey for Engineers (38 samples)

What subject(s) did you learn at the training(s)?		How the training affected to your skills?	
Afforestation Technique	92 %	Afforestation Technique improved.	90 %
Nursery	61 %	Tree planting skills improved.	55 %
Forest Management	61 %	Managed forest appropriately	63 %
Forest Diseases and Pests Control	55 %	Prevented and cured forest diseases and pests	50 %
Nursing and Thinning Technique	55 %	Nursing and Thinning appropriately implemented.	58 %
Fertilizer	42 %	Use fertilizer appropriately.	42 %
		Motived to plant more trees	58 %
		Managed funds appropriately.	29 %

As shown in Table 13, the beneficiary survey revealed that 90% of the respondents took the course on afforestation techniques, 70% took seedling and plants handling. But only 16% took the course on forest products and thinning-cut sales. The training was held just before planting, and the implementation bodies may have had little interest in thinning and forest products at the time because thinning and production would take five years or more after plantation. In addition, no respondents credited thinning course with any practical benefit.

The provincial government has noticed the problem that farmers planted trees in high density because of the misconception, and they have not executed necessary thinning and nursing work. To address the problem, the government has been providing additional trainings and technical guidance to the farmers. Lack of scientific knowledge on maintenance and management work has been causing the problems, thus dissemination of accurate knowledge and technology to the farmers and ensuring forests management are necessary.

Table 13: Result of the Beneficiary survey on Technical Training (100 samples)

What subject(s) did you learn from the training?		How the training affected to your afforestation skills?	
Afforestation technique	90 %	Afforestation technique improved	87 %
Seedling and plants handling	72 %	Seedling and plants handled appropriately	62 %
Forestry diseases and pests prevention	57 %	Prevented and cured forest diseases and pests	58 %
Fertilizer usage	30 %	Fertilizer used appropriately	39 %
Forest management	43 %	Managed forest appropriately	46 %
Funds management	22 %	Managed funds appropriately	31 %
Products and thinning cut sales	16 %	Sold products and thinning cut appropriately	0 %
		Motived to improve afforestation technique	40 %

According to interviews in the field study, training and technical guidance were provided before planting and until the time of inspection at the third growth year of forests, but were hardly done afterwards. As a result, the implementation bodies had poor knowledge and practice on maintaining young growing forests, thinning, and selling forest products. Not only farmers but also local engineers had a scientific misconception that dense plantation was effective in raising the preservation rate and stock volume. In its replies to the questionnaire survey, the provincial forestry bureau said that 20 among the 25 counties that had many farmers participating in the project faced “partial shortage of training,” and two counties had “considerable shortage of training.” The bureau saw such situation as a problem. To address the problem, the bureau provided additional training to county-level engineers even after the project completion in order to have them disseminate knowledge and implement technical guidance to farmers. Thus it would be desirable to disseminate accurate knowledge to the farmers and implement nursing and thinning soon because the time of the ex-post evaluation coincided with the time when the forests needed thinning.

Regarding the response to the case of emergency such as mountain fire, state owned forest farms prepared patrolling shifts and manuals. The state farms, from the view point of forests protection, are also prepared to respond to the fire in neighboring farmers’ forest. Farmers employed their own forest patrol individually, but no manual or maintenance reports existed.

Not only the farmers but also the local engineers had inaccurate knowledge on forest maintenance, and did not implement appropriate young forest nursing and thinning. Additional training and technical guidance would be desirable because some problems were observed in technical sustainability.

3.5.3. Financial Aspects of Operation and Maintenance

According to the provincial forestry bureau’s project office, the forestry budget

increased year by year, and, in 2012, became more than five times the 2004 budget. At the county level, the independent foreign-funded afforestation budgets decreased because the project offices were gradually assigned other sections' work as well. However, the budgets for forest maintenance and fire, disease and pest control were secured at the provincial level, and distributed to the county (city and district) level based on the needs. Therefore, necessary amounts were secured every year.

The budget covered national programs such as the Program of Converting Steep-Farmland Back to Forest, the Natural Forest Resource Protection Program, and the Schistosomiasis Prevention Forest Program, and subsidies for afforestation and nursing. The provincial bureaus in charge undertook forest maintenance, fire protection, and disease and pest control, and secured necessary budgets. The budget at the country bureau level was distributed from the province based on the needs, and the necessary amount was secured every year.

Table 14: Annual Funding for Forestry and the Sources (unit: 10,000 yuan)

Year	Annual Funding	Budget from National	Domestic Loans	Foreign Investment	Self-raising funds	Other Funds
2004	137,207	79,187	15,189	15,792	6,093	20,946
2005	103,703	64,635	10,375	8,395	6,360	13,938
2006	164,764	104,747	10,805	20,216	8,237	20,759
2007	132,861	93,786	6,307	7,763	10,937	14,068
2008	269,632	153,068	38,691	8,504	7,488	61,881
2009	339,813	161,587	18,702	4,976	18,009	155,241
2010	472,986	203,121	3,000	2,016	56,215	208,634
2011	570,649	373,401	14,585	7,487	66,893	108,283
2012	763,176	499,087	32,856	12,119	141,008	78,106

Source: Jiangxi Province Statistical Yearbook (2013)

Meanwhile, there were a few challenges. For the funding source of forest maintenance, state-owned forest farms and collective forest farms depended on their operating profit, and farmers relied on their independent revenue. At the time of the ex-post evaluation, neither Economic nor Timber (Protection) Forests were at the tree age to generate a sufficient amount of income. Thus maintenance costs including labor costs and repayment that started in 2013 were covered by income from selling farm products or other businesses. Regarding forest products whose production was increased based on the national policy, there are risks that their prices may fall drastically because of overproduction.

In the field study, the evaluation team found that thinning and nursing of Protection Forests were not executed in proper frequency because of the higher maintenance costs caused by increased labor wages and labor shortage in farms. Since similar problems were common in all of China, the national government launched the Young Forest Nursing Project in 2014 to provide a subsidy of 100 yuan/mu to

ecological forests more than three years after planting. If a forest were covered by the subsidy, thinning and nursing would be promoted. However, the subsidy was not used much in the Project because the area of ecological forests to be covered was limited and Timber and Economic Forests were not eligible for the subsidy.

The Project expected that revenue from forests would cover the costs for maintaining them and did not expect any shortage of funds. At the time of project planning, it was necessary to consider the maintenance costs based on necessary maintenance tasks, and examine prospects after the completion of the project in accordance with the governmental policies and the availability of subsidies.

Table 15: Loan and Repayment Status

Total Loaned Amount	Rate	Starting date for Repayment	Amount Repaid
100,476 yuan	0.75 %	March 2014	3,782 yuan

Source: Beneficiary Survey

Repayment has started from March 2013. At the time of the ex-post evaluation, repayment for one to two times have completed. The average amount per repayment was 3,782 yuan, and problems such as delinquency or insolvency have not occurred. If implementation bodies were unable to pay back the loan, the provincial (or city or county) forestry bureau would shoulder the repayment. Therefore no problem was found.

Although income from the forest for future is expected, the implementation bodies cover the operation and maintenance costs with their revenues from businesses other than the forests. The failure of those businesses could negatively affect the financial sustainability of the project. Because of the insufficiency of income from the forests, problems that tree thinning and nursing were not done properly were observed at the time of ex-post evaluation. Accordingly, the financial sustainability of the project has a few problems.

3.5.4. Current Status of Operation and Maintenance

As mentioned in the effectiveness section, at the time of ex-post evaluation, the evaluation team observed that trees were not planted in the planned density or mixed, nor necessary nursing or maintenance executed in many forests. In this section, the recognition of the engineers who are responsible for monitoring the forests and provide guidance, and the one of the implementation bodies who are responsible for the operation and maintenance, are to be analyzed. The purpose of the analysis is to find if the forests built by the Project are to be operated and maintained sustainably.

(1) Operation and Maintenance of Forests

According to the survey to the engineers (Table 16), with regard to the condition of their forests, 87% answered “fine,” while 13% said “there are a few problems.” Among the cited were “the survival and preservation rates were low,” “forest diseases and pests occurred,” “production amount is low,” “fertilizer amount is insufficient,” and “the forest suffered damage from a natural disaster.” Regarding the maintenance status, 80% thought that it was “fine” while 20% answered that “there are a few problems.” The reasons for the problems were “shortage of maintenance budget,” “shortage of manpower for maintenance,” “periodical maintenance was not provided,” and “frequent natural disasters prevent continuous maintenance.”

Table 16: Result of Survey to the Engineers on Forest Maintenance (38 samples)

How is the condition of the forest?		How is the status of forest maintenance?	
Fine	87 %	Fine	80 %
There are a few problems.	13 %	There are a few problems.	20 %
There are many problems.	0 %	There are many problems.	0 %

In the beneficiary survey on the forest condition (Table 17), 90% of the respondents said that the condition of their forests was “fine” while 3% said that “there are a few problems.” They said that the main cause of the problems was “insufficient nursing.” About the status of forest maintenance, 94% of the respondents considered it “fine” and 2% said “there are a few problems.” The problems cited include “insufficient manpower” and “lack of funds for maintenance.”

Table 17: Result of Beneficiary Survey on Forest Maintenance (100 samples)

How is the condition of the Forest?		How is the status of forest maintenance?	
Fine	90 %	Fine	94 %
There are a few problems.	3 %	There are a few problems.	2 %
There are many problems.	0 %	There are many problems.	0 %
Not answered.	7 %	Not answered.	4 %

About the forest condition, 13% of the engineers were aware that there were a few problems while only 3% of the implementation bodies had the same perception. Regarding the forest maintenance status, 20% of the engineers thought that there were a few problems, but only 2% of the implementation bodies did. Thus there was a perception gap between the engineers and the implementation bodies on the problems in the forest and maintenance status. It is possible that the implementation bodies did not grasp the existence of problems in forest maintenance.

As mentioned in the passages on technical aspects, the forest maintenance status needed improvement. Technical transfer on disease and pest prevention and control, nursing, and thinning was insufficient. In addition, accurate knowledge on nursing and thinning was lacking. The provincial government already started addressing these problems, but it is necessary to strengthen training and technical guidance and implement appropriate maintenance tasks such as nursing and thinning.

(2) Sustainability of the Project’s Effects in Longer Term

In the long term, Mountain Closure and Economic Forests stay in the forests, and their erosion reduction effects will be preserved. However, if Protection Forests are cut, their erosion reduction effects will decrease. According to a JICA staff member, at the appraisal screening, erosion reduction effects were considered to be the same regardless of the type of forest or species, and as long as the forests had some vegetation, no problem would occur on the erosion reduction effects.

In normal forest management techniques, deliberate afforestation is implemented in parallel to a logging plan. If deliberate logging and afforestation are not executed, and a Protection Forest is logged in a large scale, the forest’s erosion control effects and ecological conservation may be greatly endangered. However, there are ecological forest protection regulations, and a Timber Forest logging permission system in accordance to the governmental logging plan. They control the amount and area of logging so to avoid excessive logging from a few sites. As shown in Table 18, the actual fell has been less than 30% of the annual allowable cutting amount allocated to the province by the national government. The Jiangxi Province Forestry Bureau said that deliberate afforestation was executed in parallel to logging. Because of the existence of the ecological forest protection regulations and the governmental regulations to prevent excessive logging, the Project’s effectiveness is likely to be secured.

Table 18: Annual Allowable Cut and Actual Fell (unit: 10,000 m³/year)

	the 10th Five-Year Plan (2001-2005),	The 11th Five-Year Plan (2006-2010),	The 12th Five-Year Plan (2011-2015),
Allowable Cut	1,529	1,815	1,997
Fell	About 30% of the annual allocation		663 m ³ /year in 2014 (33.2 % of the upper limit)

Source: Jiangxi Province Forestry Bureau Foreign Funds Afforestation Project Office.

The project plan recommended building mixed forests with multiple species for ecological environment conservation, but the vast majority of the forests ended up as simple ones. If an outbreak of forest diseases or pests occurs, simple forests

have a higher risk of spreading the damage to the same species and varieties. However, according to the provincial forest bureau, it had the system to control diseases and pests depending on the damage, and took preventive measures according to the severity of the damage. Therefore, no problem was found that would have a negative impact on the sustainability of the effects of the project, and it is fair to say that, given the current status, the risk that any problem will be out of control is low.

(2) Operation and Maintenance of Facilities and Equipment

The project constructed the training center within the premises of the Jiangxi province Forestry Bureau. Since the project completion, the center has been used for 100 meetings and training sessions a year. The Jiangxi Province Forestry Bureau Service Center undertakes all the maintenance work of the training center.

All the office equipment (87 pieces) and environment monitoring devices (22 pieces) were installed in the city forestry bureaus, county project offices, and forestry farms. The installation sites bought a few new equipment and devices at their own expense to replace the ones that exceeded their service life.

Nursery facilities including irrigation systems were built at four nurseries and Ji'an Forestry Science Technology Model Garden, and each institution maintains the facilities on its own. At the time of the ex-post evaluation, the nursery houses completed their functions and were dismantled because they were simple ones like plastic greenhouses.

Forty vehicles, eight motorcycles, and four farm vehicles were used and maintained at the institutions where they were delivered such as forestry bureaus, project offices, and state-owned farms. The vehicles were maintained regularly and no problem such as breakdown did occur.

The training center built in the project, the nursery facilities and equipment installed, and the vehicles delivered were used for the purposes intended at the time of the appraisal.

Accordingly, the Project's effects are likely to be sustained. By contrast, forest operation and maintenance were executed with inaccurate knowledge, and nursing was not done in the proper frequency because of such reasons as the rising labor costs. Thus a few problems were found in the operation and maintenance status.

As mentioned above, some minor problems have been observed in terms of technical, financial aspects, and the operation and maintenance status. Therefore sustainability of the project effects is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1. Conclusion

The Jiangxi Province Afforestation Project aims to improve the quality of forests in Jiangxi Province, and to restore their multi-dimensional functions by afforestation and Mountain Closure. The Project was prompted by the increase in the importance of afforestation because of the escalation of flood damage in the Yangtze River basin area. The Project's relevance is high because its aim is consistent with the Chinese Government's development policies, development needs and Japan's aid policy. Affected by the Forest Tenure Reform, the main project implementation body was changed from small-scale to large-scale farmers. The change was positive one for assuring forestation and for setting the sustainable system for forest management, while benefitting the small-scale farmers. By contrast, a problem at the time of the appraisal is that erosion control effects by forest type were not examined. The afforestation plan should have been drawn in accordance with the flood and erosion damages based on examination of effects. However, the problem is not taken into consideration for the relevance rating because, regardless of the forest type, a certain amount of ecological conservation effects exist, and the risk of a significant decrease in the Project's sustainability is low.

The project planted trees in the area equivalent to 18% of the water and soil erosion control area of Jiangxi Province between 2004 and 2012, and contributed to improving the forest coverage ratio and forest stock volume. The forests are still growing but expected to bring about economic impacts in the future. However, because tree planting and forest management did not follow the afforestation design, the improvement in the quality of forests and ecological conservation effects are limited. Thus the effectiveness and the impacts of the project are fair.

With regard to efficiency, although the cost of the Project was within the planned limit, the project period was longer than planned because of the supplemental planting and additional forests building. Thus the efficiency of the Project is fair.

There was no major change in the Project's executing agency, and the funds for the operation and management of the Project were secured by subsidies and forestry bureau's budget. However three years after the planting, forests were not maintained properly because of the rising employment costs and lack of relevant knowledge. It is necessary to upgrade technology on forestation, nursing, and thinning among engineers and farmers and disseminate accurate knowledge to them. The sustainability of the Project is fair because a few problems were observed in technical and implementation bodies' financial aspects and the maintenance status.

In light of the above, the Project is evaluated to be partially satisfactory.

4.2. Recommendations

4.2.1. Recommendations to the Executing Agency

The evaluation team observed that, in many farmers' forests that were three years after being planted or older, nursing and thinning were not appropriately executed. Behind the problem lies the farmers' misconception that a high forest density saves their work on nursing and enables them to produce more timber from thinning. The farmers need to know that high-density forests have a greater risk of outbreak and spread of diseases and pests, may delay timber growth and cost more for maintenance until the trees are ready to be cut, and degrade the quality of the forests. The executing agency, has started additional training and guidance for farmers, needs to disseminate accurate knowledge on planting, nursing and thinning, and to promote appropriate forest maintenance. For this purpose, it is essential to increase the number and frequency of training for and strengthen the capacity of local engineers at the county and township levels who provide technical guidance to farmers. In many project sites, Chinese fir and pine trees were shifting from the young growing period to the first thinning period (8th to 10th growth year) at the time of the ex-post evaluation. Thus it would be desirable to implement the measures discussed above as soon as possible. Afforestation of protection forests (four-side afforestation) is encouraged for the greening of the province. Trees were often damaged by human undertakings with malicious intent especially in farmlands used for afforestation because the planted trees hindered the convenience of farm work and the trees took nutrients away from the soil and affected the growth of farm products. To address this problem, it is necessary to strengthen the management of farmlands and devise measures to avoid conflicts with farmers who offer farmlands. In the sites visited by the evaluation team, the following measures are possibilities: the landscaping firms responsible for maintaining forest lands issue warnings to the farmers about the tree damages; including in the land rental contract provisions on tree protection to avoid trouble in advance; or making the rental contract provisions favorable for the growth of farm products.

4.2.2. Recommendations to JICA

None

4.3. Lessons Learned

(1) The executing agency needs not only to monitor the operation and effect indicators, but also provide guidance and supervision on if the trees are planted and maintained according to the Project's plan.

At the time of the acceptance inspection of the Project, the data on the survival and preservation rates, and the main indicators for afforestation, were not correctly recorded. The inspectors gave a forest passing rate if it had more trees than specified in the afforestation regulations. This was a major cause that implementation bodies planted and maintained trees in a higher-than-appropriate forest density, then the growth of trees is inhibited, and then the forest's quality, that the Project was aiming at, is degraded. During the course of the project, the executing agency needed to not only monitor the achievement of inspection figures such as afforestation area and survival and preservation rates, but also provide guidance and supervision on if the planting and maintenance of forests were done according to the Project's plan so that the quality of the forests would have been improved.

(2) Regarding the ecological conservation standards, JICA needed to determine if the executing agency set appropriate appraisal and forest inspection criteria on implementation bodies and monitored them, and take measures for promoting the Project's effects if necessary.

In the plan at the time of the appraisal, from the perspective of the diversity of animals and plants and the stability and sustainability of forests, the Project was to plant 40 species. However, the selection of species was left to the implementation bodies who prioritized the species that they thought would be profitable. As a result, the number of species was limited to about 10 such as Chinese fir, pine, and poplar. Also, in forest design, a mixed forest using several species had been recommended, but most of the project sites ended up as simple forests, the forest density became higher than planned, making the forests vulnerable to environmental changes or forest diseases and pests. To restoration of multi-dimensional functions of forests, the executing agency needed to set criteria for selecting implementation bodies that included not only economic resources but also those pertaining to erosion control and ecological conservation such as forest design and tree species. In addition, the executing agency needed to confirm the extent of achievement of the criteria above for acceptance inspection of the Project. At the same time, JICA needed to confirm the

Project's status and prospects for realizing the Project's effects through progress reports from the executing agency and mid-term supervision, and consider taking measures such as dispatching additional experts to promote the Project's effects if necessary.

(3) Based on the differences in erosion control effects by forest type, it is necessary to set the afforestation area and consider the executing agency's request for a change in the Project plan.

At the time of the appraisal, erosion control capability, which is the main effect of afforestation, was regarded as the same regardless of the forest type (Protection Forest, Economic Forest, Timber Forest, or Mountain Closure), and any afforestation method would bring about the same result. Based on this perception, JICA approved the project plan submitted by the Chinese side and a request for changing the forest area and type during the project implementation. In reality, erosion control effects differ by forest type. At the time of the appraisal, differences in ecological effects by forest type should have been examined. In addition, any change in the project plan should have been considered on the basis of the differences in the effects. Also from the viewpoint of the Project's sustainability, governmental policies and prospects on ecological conservation and logging plans should have been confirmed at the time of the appraisal.

(4) To sustain the effects of afforestation in the long term, while making the project plan, JICA and the executing agency need to examine carefully the maintenance costs after the project completion.

In the plan at the time of the appraisal, the completion of the project was defined as acceptance upon inspection in the third growth year, and the maintenance afterwards was entrusted to the implementation bodies. The timing of the ex-post evaluation was five to eight years after planting, and the implementation bodies were responsible for maintenance. However, in most of the project sites, appropriate nursing and thinning for young trees were not provided. This was partly because accurate knowledge on nursing and thinning was not disseminated among not only the farmers but also the engineers who were to guide them. However, the main cause was the shortage of the maintenance budgets. Lack of nursing for young growth forests was a pressing problem in China as a whole. The Chinese government set up a new subsidy for nursing Ecological Forests, but it was not used much for the project forest sites because the subsidy's target areas were limited. In the plan at the time of the appraisal, implementation bodies were to have covered the maintenance costs by income from

the forests, and such maintenance budget shortage was not envisaged. At the planning stage of similar projects in the future, JICA and the executing agency need to examine the work plan according to the maintenance needs in the mid- to long-term perspective, and to consider the maintenance costs after the completion of the project based on the relevant government's policies and the existence of subsidies.

END.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs		
Afforestation	219,203 ha	235,890 ha
Timber Forest	65,637 ha	87,389 ha
Economic Forest	5,350 ha	2,077 ha
Protection Forest	148,180 ha	146,424 ha
Mountain Closure	52,167 ha	42,411 ha
Afforestation Material		
Seedling	167.97 million	370.84 million
Seed	151.8 ton	Import 3.43 ton Domestic N/A
Fertilizer	20,498 ton	Cancelled
Facilities and Equipment		
Vehicle		
Forest Monitoring Vehicle	44	40
Motorcycle	90	8
Farm Vehicle	None	4
Office Equipment	167 pieces	87 pieces
Environment Monitoring	36 pieces	22 pieces
Tools		
Nursery Facility		
Small (350m ³)	5 places	3 places
Middle (600m ³)	5 places	Canceled
Large (800m ³)	2 places	2 places
Irrigation	30 hm ²	20 hm ²
Sprinkler	3 sets	1 set
Battery for nursery	3 sets	As planned
Construction	6,446 m ²	3,000 m ²
Dam	None	2,500 m
Leveling	None	70 hm ²
Training Center	4,000 m ²	built in the premises of the provincial forest bureau
Training		
Overseas Training	3 times 60 persons	3 times 45 persons
Province (Manager/Engineers)	N/A	15 times 1,560 persons
City (Manager/Engineers)		21 times 150 persons
County(Manager/Engineers/ Forest Farm Engineers/ participants)		186 times 25,000 persons
Technical Guidance (participants)	N/A	29,000 persons
2. Project Period	March 2004 -December 2009 (70 months)	March 2004-June 2012 (95 months)
3. Project Cost		
Foreign currency	206 million yen	2,851 million yen
Domestic currency	9,859 million yen (766.6 million yuan)	7,211 million yen (240.8 million yuan)
Total	10,065 million yen	10,062 million yen
Yen loan	7,507 million yen	7,506 million yen

Exchange rate	1 yuan=14.3 yen (as of September 2003)	1 yuan=13.623 yen (the average rate used by the executing agency 2005-2012)
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Attachment: Growth Situation in the Project Sites

1. Protection/Timber Forests

1-1 Simple/Mixed Forests (Species: Chinese fir, Slash pine and others)

- The main species employed were Needle-leaved trees (Chinese fir, pine), which occupied 70% of all the forests. While broad-leaved trees (liquidambar, oak, paulownia, Chinese tulip trees) occupied 20%, and other species 10%. At the time of the ex-post evaluation, the average preservation rate was 96.4%, and all the Project sites exceeded the target for the third growth year. Protection Forests and Timber Forests were not distinguished because the former were grown practically as the latter.
- The main species, Chinese fir and pine planted in the Project sites were growing normally. The average height, circumference and the stock volume of Chinese fir forests between 5th to 9th growth-year, measured as 7.2m, 8,3cm and 4.400m³/mu. Also the average size and the stock volume of Slash pine forests between 5th to 10th growth-year measured as 6.1m, 9.7 cm, 5.579m³/mu. It is predictable that 20 to 25 years after the planting the forests of the species are to be ready for cut as timbers. The Jiangxi province has climate and precipitation favorable for afforestation, thus high income from thick timbers can be expected. Pine trees produce resin from 7th growth-year, which also yield high economic effects.
- The evaluation team found that thinning and young forest nursing were not executed in proper frequency, also weeds in the forest beds and density were not maintained in appropriate condition. According to the forest design at the Project plan, the adequate density at planting was 146 plants/mu, then in 8th growth year, the density should be reduced to 106 plants/mu by thinning. In reality, the average density of the Project sites was 193 plants/mu in the forests of Chinese fir, and 161 plants/mu in the pine forests, which were higher than the adequate standards.
- 95% of the Project sites ended up to be simple forests. Simple forests have contributed less to the intended biodiversity. Also, their durability to diseases and pests is lower than the one of mixed forests. Thus the contribution to the Project's aim, restoration of the multi-dimensional functions of forests, ended up to be limited.

Measured data of Simple Forest (Species: Chinese fir)

Species	Tree Age (year)	Preservation Rate (%)	Height (m)	Circumference (cm)	Density (#of tree/mu)	Stock Volume (m ³ /mu)	Note
Chinese fir	5	100.0	5.0	6.2	167	2.664	
	6	100.0	6.4	8.1	296	3.507	
	7	98.4	7.9	8.4	195	4.946	
	8	95.3	7.1	9.6	167	4.426	
	9	100.0	9.6	9.2	142	6.456	
Average	5-9	98.7	7.2	8.3	193	4.400	

Measured data of Simple Forest (Species: Slash pine)

Species	Tree Age (year)	Preservation Rate (%)	Height (m)	Circumference (cm)	Density (#of tree/mu)	Stock Volume (m ³ /mu)	Note
Slash pine	5	100.0	5.1	7.1	166	1.992	
	7	100.0	5.3	9.5	166	4.974	
	8	90.6	5.1	10.0	167	3.507	
	9	95.0	7.8	11.0	166	7.464	
	10	90.5	7.4	11.0	140	9.960	
Average	5-10	95.2	6.1	9.7	161	5.579	

Measured data of Simple Forest
(Species: Empress Tree, Masson's pine, Japanese Oak)

Species	Tree Age (year)	Preservation Rate (%)	Height (m)	Circumference (cm)	Density (#of tree/mu)	Stock Volume (m ³ /mu)	Note
Empress tree	6	85.0	8.0	12.9	111	5.001	Protection Forest (four-side afforestation)
Masson's pine	10	90.0	8.2	10.5	111	3.596	Mountain Closure
Japanese Oak	10	—	13.8	16.9	111	14.306	Natural broad-leaved. Young forest nursing

Measured data of Mixed Forest
(Species: Chinese fir, Slash pine and others)

Species (ratio)	Tree Age (year)	Preservation Rate (%)	Height (m)	Circumference (cm)	Density (#of tree/mu)	Stock Volume (m ³ /mu)	Note
Chinese fir (7)	4	100	3.5	4.5	117	0.266	
Slash pine (3)		100	2.8	4.4	50	0.952	
Chinese fir (8)	9	100.0	6.5	8.1	133	1.987	
Slash pine (2)		95.0	9.0	10.9	34	2.25	
Chinese fir (7)	10	85.0	7.6	9.2	96	2.592	
Chinese tulip tree (2)		100.0	9.7	9.6	40	1.200	
Liquidambar(1)		100.0	9.9	9.3	21	0.630	
Slash pine (6)		100.0	9.7	10.2	78	2.586	
Liquidambar(4)	10	100	9.2	9.3	60	1.53	

Model Forests Reference Data for Simple Forests

Species	Tree Age (year)	Preservation Rate (%)	Height (m)	Circumference (cm)	Density (#of tree/mu)	Stock Volume (m ³ /mu)	Note
Chinese fir	20	88.0	15.6	20.8	78	20.28	
Slash pine	23	—	14.8	18.1	78	13.416	Producing resin

1-2. Simple/ Mixed Forests (Species: Bamboo)

- Majority of the bamboo forests became simple forests. Broad-leaved trees mixed partially in some bamboo forests.
- Bamboo forests were maintained in good condition. Twice in a year, the implementation bodies dug the ground for the purpose to soften the forest beds. The forests were fertilized, and controlled the density appropriately.
- Bamboo forests (8th growth-year) yielded 25 bamboos/mu as industrial material. Also the same forests yielded edible bamboo shoots in a stable manner, which amounted 100 kg/mu in winter season and in 350 kg/ mu spring season.
- Heavy snow damaged 90% of the bamboo forests area. Supplemental plantation executed at 59 bamboo/ mu in 2008. In 2014, the forest restored to the level at 200 bamboo/mu. In order to restore the damaged bamboos, the implementation bodies took measurements such as nutrition injection and pouring fertilizer into bamboo stumps.

1-3. Simple Forest (Four-side afforestation, Species: Populous)

- Empress tree and poplar were the main species. Landscape companies planted and have been maintaining the four-side afforestation sites. The road side trees were planted in farm lands located on the both sides of an arterial road. The afforestation area (30m width) were borrowed from farmers. The farmers preferred to use the lands for farming rather than renting for afforestation because the trees were obstructions for farming, also trees take nutrition from other farm products. The trunks were bound with wires and the growth were disturbed. There were similar human activities damages reported at other four-side afforestation sites. To address this problem, it is necessary to strengthen the management of farmlands and devise measures to avoid conflicts with farmers.

2. Mountain Closure (Species: Masson’s Pine)

- Before the implementation of the Project, farmers cut the trees for fuel, thus the growth of trees in the area was disturbed. After the Project started in 2005, the state owned forestry farms have been blocking the area and prohibiting tree cutting. Also

the farms executed aerial spread of seeds, and planted Masson's pine seedlings.

- At the time of ex-post evaluation, the area did not yield any forestry products, but in 5 to 10 years, the pine trees would be cut for timbers.
- The Project site used to be heavily damaged area by erosion. Since implementation of the Project, the plant coverage ratio improved from 20% to 40%, it is fair to say that the Project contribute to reduce the erosion damage significantly.

END.

People's Republic of China

Ex-Post Evaluation of Japanese ODA Loan

“Hubei Province Afforestation Project”

External Evaluator: Shima HAYASE / Yuko KISHINO, IC Net Limited

0. Summary

The Hubei Province Afforestation Project (hereinafter referred to as the “Project”) aims to improve the quality of forests in Hubei Province, and restore their multi-dimensional functions by afforestation and Mountain Closure. The Project was prompted by the increase in the importance of afforestation because of the escalation of flood damage in the Yangtze River basin area. The Project’s relevance is high because its aim is consistent with the Chinese Government’s development policies, development needs and Japan’s aid policy. Affected by the Forest Tenure Reform¹, the main project implementation body was changed from small-scale to large-scale farmers. The change was a positive one for assuring forestation and for setting the sustainable system for forest management while benefitting the small-scale farmers. In contrast, a problem at the time of the appraisal is that erosion control effects by forest type were not examined. However, the problem is not taken into consideration for the relevance rating because, regardless of the forest type, a certain amount of ecological conservation effects exist, and the risk of a significant decrease in the Project’s sustainability is low.

The Project’s afforestation area exceeded the annual area of water and soil erosion control of Hubei Province, and contributed to improving the forest coverage ratio and the forest stock volume². The forests are growing, and future economic impacts are expected. However, since tree plantation and management did not follow the afforestation plan, most of the forests became simple forests and a delay in tree growth was observed. Consequently, the effects on forest quality improvement and ecological conservation are limited. Thus the effectiveness and impact of the Project are fair. With regard to efficiency, although the cost of the Project was within the planned limit, the Project period was longer than planned because of the supplemental planting and additional forest building. Thus the efficiency of the Project is fair. There was no major change in the Project’s executing agency, and the funds for the operation and management were secured by subsidies and the forestry bureau’s budget. However, three years after the planting, forests were not maintained properly because of the rising employment costs and lack of relevant knowledge. It is necessary to upgrade technology on forestation, nursing, and thinning among engineers and farmers and disseminate accurate knowledge to them. The sustainability of the Project is fair because a few problems were observed in technical and project implementation bodies’ financial aspects and the maintenance status.

¹ The Forest Tenure Reform was meant to allocate ownership of forest lands to individual farm households. In Hubei Province, the reform was launched in 2006, and completed in 98% of the relevant area by 2011.

² The forest stock volume is an indicator to measure the quantity of a forest by cubic volume of the timbers in the forest. It shows the status of a forest per unit area.

In light of the above, the Project is evaluated to be partially satisfactory.

1. Project Description



Project Site



Photo 1: Protection forest built on the riverbank (Hubei Province Jianli County)

1.1. Background

Since 1949, afforestation has been one of the main policies of the Government of China. The major deforestation to meet the demand for timbers due to the economic growth led to the deterioration of the quality of forestry resources, an increase in the damages of natural disasters such as floods, the degradation in the natural environment, and the rural poverty due to lower productivity in cultivated and pasture lands. After the devastating flood in 1998, the Government implemented the National Plan for Ecological Construction. The plan set prioritized programs for natural environment improvement, their target areas and quantitative goals, and launched large-scale afforestation projects. Hubei Province was a part of the target area of the Yangtze River Basin Shelter Forest Program. At the time of the appraisal, the forest coverage ratio in Hubei Province was about 30%, which was higher than the national average of 17%. However, the quality of the forests in the province deteriorated because they were not maintained properly. The erosion area amounted to one-third of the province. The drained soil that raised the river bed also exacerbated the damages by floods and other natural disasters. Under such circumstances, the Hubei provincial government requested the Government of Japan for an afforestation project to recover the multi-dimensional functions of forests such as ecological conservation and water and soil erosion control. The Government of Japan approved the request as a yen-loan project.

1.2. Project Outline

The objective of the Project is to increase the forest coverage ratio and enrich forest resources by afforestation and Mountain Closure³, thereby contributing to restoring the multi-dimensional functions of forests such as ecological conservation and erosion control in

³ Mountain Closure is a measure to promote natural growth of trees and vegetation in the area by prohibiting the entry of people and livestock.

Hubei Province.

Loan Approved Amount/ Disbursed Amount	7,536 million yen / 7,484 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2004/ March 2004
Terms and Conditions	Interest Rate 0.75% Repayment Period 30 years (Grace Period) (10 years) Conditions for Procurement: General Untied
Borrower / Executing Agency	Government of People's Republic of China/ Hubei Province People's Government
Final Disbursement Date	October 2012 (original date: October 2011)
Main Contractor (Over 1 billion yen)	None
Main Consultant (Over 100 million yen)	None
Feasibility Studies, etc.	“Feasibility Study Report” Forestry Prospect and Design Institute of Hubei Province, June 2003
Related Projects	<ul style="list-style-type: none"> ● Gansu Afforestation and Vegetation Cover Project (L/A 2003) ● Jiangxi Province Afforestation Project (L/A 2004) ● The Japan-China Cooperation Science and Technology Center for Forest Tree Improvement Project (Technical Cooperation 2001–2006) ● Forestry Development in Poor Areas Project (World Bank 1999–2005) ● Afforestation Project I-IV (World Bank 1990–2009) ● Sino-German Cooperated Afforestation Project (German Government 2005–2012)



Figure 1: Location of the 10 Project Cities and the Major Rivers

2. Outline of the Evaluation Study

2.1. External Evaluator

Shima HAYASE, IC Net Limited

Yuko KISHINO, IC Net Limited

2.2. Duration of Evaluation Study

The ex-post evaluation study was carried out as follows:

Duration of the Study: August, 2014 – November, 2015

Duration of the Field Study:

1st Field Study: November 23, 2014 – December 4, 2014

2nd Field Study: April 20, 2015 – April 24, 2015

2.3. Constraints during the Evaluation Study

As this ex-post evaluation was carried out two years after the project completion, it was premature to observe the Project's mid- to long-term effects and to analyze future prospects conclusively. Accordingly, the ex-post evaluation focused on analyzing basic effect indicators, prospects for the development and sustainability of the Project's effects, and the status of the institutional, financial and technical environments to realize the prospects. Also, because of the following constraining factors, the Project's effectiveness had to be provisionally evaluated by using the sampling data collected through the field survey⁴. Firstly, the forests were still growing and not ready for an observation of their fully developed status. Secondly, the Project covered a vast area consisting of 37 counties, and it was impossible to visit all the project sites within the allocated study period. Moreover, the survival rate, i.e., the main operational indicator, was not measured by the method agreed at the time of the appraisal. Thus the evaluation team did not compare the target figure and the actual one provided by the provincial government, but made a judgment based on the results of the field survey.

3. Results of the Evaluation (Overall Rating: C⁵)

3.1. Relevance (Rating: ③⁶)

3.1.1 Relevance to the Development Plan of China

(1) Development Policy at the Time of the Appraisal

At the time of the appraisal, in the National Plan for Ecological Construction

⁴ The Project was implemented in 37 counties, which is a vast area. It was impossible to conduct a field study in all the counties during the evaluation study period. To address this problem, the evaluation team asked the Hubei Province People's Government, the executing agency, to collect operation and effect indicators in all the counties. In addition, the evaluation team chose six representative counties to conduct questionnaire, site-visit, and beneficiary surveys in order to grasp the overall picture. The first field study did not capture information on the southwest area. Thus, in the second field study, the evaluation team visited two additional counties in the area.

⁵ A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

⁶ ③: High, ② Fair, ① Low

(1998–2050), the Government of China set four target areas for natural environment protection and restoration. Hubei Province was included in the Yangtze River Basin area where soil loss reduction and afforestation were the priorities.

(2) Development Policy at the Time of the Ex-post Evaluation

Under the 12th Five-Year Plan (2011–2015), Hubei Province was a target area of the Yangtze River Basin Shelter Forest Program to reduce soil loss, the Natural Forest Resource Protection Program, and the Steep Farmland Conversion to Forestland. The Hubei Province 12th Five-Year Plan (2011–2015) also set the policies to protect natural forests, to promote afforestation and reforestation by converting steep-farmlands to forests, and to encourage tree planting in mountains and fields, and reduce erosion. At the same time, the province aimed to promote economic effects by using forest resources. To implement the policies, the Hubei provincial government encouraged the use of foreign loans. Since the 1990s, the government has executed afforestation projects funded by the World Bank and the Government of Japan. A large-scale project is needed to attain the policies' goals in a vast area. As shown in Table 1, the Project is larger in both the afforestation area and the budget than other projects implemented around the same period, and thus the implementation of the Project is relevant.

Table 1: Foreign Funded Afforestation Projects

Project	Donor	Duration (year)	Afforestation Area (ha)	Cost (10,000 yuan)
Forestry Development in Poor Areas Project	World Bank	1999-2005	52,885	23,919
Afforestation Project IV	World Bank	2003-2009	13,782	5,492
Sino-German Cooperated Afforestation Project	German Government	2005-2012	12,000	12,000
This Project	Japan	2004-2012	313,378	78,175

Source: Hubei Province Forestry Bureau Foreign Fund Afforestation Project Office

Note: The Project's cost was calculated by applying the following exchange rate provided by the Hubei provincial government: 1 yuan = 13.8343 yen (average rate from 2004 to 2013).

3.1.2 Relevance to the Development Needs of China

(1) Relevance to the Development Needs at the Time of the Appraisal

At the time of the appraisal, forests in Hubei Province were not maintained properly, and their quality deteriorated. The average forest stock volume in Hubei Province was 33.1m³/ha, which was far below the national average of 83.9 m³/ha. Thus the forests did not fully perform their multi-dimensional functions such as retention of water and soil. It is estimated that 1.4 hundred million tons of soil flows into Yangtze River annually. The soil inflow raised the river bed, and made the river basin vulnerable to natural disasters such as floods. It also caused the flood damage that cost more than 10 billion yen per year. The Hubei provincial government prioritized the improvement of the forest quality, and aimed to implement afforestation in a total area of 530,000 ha through the Hubei 10th

Five-Year Plan (2001–2005).

(2) Relevance to the Development Needs at the Time of the Ex-Post Evaluation

At the time of the ex-post evaluation, the average forest stock volume in Hubei Province was 40.1 m³/ha, which was still far below the national average of 70.2 m³/ha⁷. The forest coverage ratio reached 38.4%, which is above the national average of 20.4%⁸, and the forest area kept increasing. However, the forests' multi-dimensional functions such as water and soil retention were still at a low level because the forests consisted mostly of newly-planted young trees. According to the National Ministry of Water Resources, the water and soil erosion area in Hubei Province in 2010 reached nearly 55.8 thousand km², which is more than 30% of the provincial territory, and the annual erosion amount was 1.78 hundred million ton. Therefore the situation remained serious⁹. Out of the 2,466 thousand-ha crop-damaged area in the province, 1,999 thousand ha, more than 80% of the area, was damaged by erosion. The 12th Five-Year Plan (2011–2015) laid out the goals to increase the forest area to 7.6 million ha, the forest coverage ratio to 41%, and the forest stock volume to 47.4 m³/ha by executing afforestation in an area of 461 thousand ha. Thus, at the time of the ex-post evaluation, the development needs for improving the forest quality were high.

3.1.3 Relevance to Japan's ODA Policy

Both the Economic Cooperation Plan for China issued by the Government of Japan in October 2001 and Japan's Medium-Term Strategy for Overseas Economic Cooperation Operations (2005–2008) gave priority to addressing global environmental issues, and cited the following means to do so: cooperation to environmental conservation, forest conservation and management. The Country Assistance Policy for China (2003) set its main targets as environmental conservation and human resource development in the inner part of China, because environmental problems in China might have a direct impact on Japan. The Project targeted afforestation in Hubei Province in inland China, and contributed to environmental conservation. Therefore its relevance to Japan's ODA policy is high.

3.1.4 Appropriateness of the Project Plan and Its Approach

The project's documents provided by JICA explained the Project was aiming for "restoration of forests' multi-dimensional functions," and the main effect of the Project as "ecological conservation and reduction of erosion"¹⁰. By contrast, the draft project plan

⁷ The stock volume at the time of the ex-post evaluation is lower than the one at the appraisal time. This is because the ratio of the area with growing trees became larger although afforestation projects increased the total forest area.

⁸ 8th National Forestry Resource Census (2013)

⁹ The water and soil erosion area was 60.8 thousand km², accounting for 32.7% of the province's area. The annual sediment yield volume was 2 hundred million ton.

¹⁰ The Project's effect, "restoration of forests' multi-dimensional functions" was determined as ecological

prepared by the Chinese Government cited “social and economic effects by enriching forest resources,” and expected that income earned from the forest resources would be a motivation for taking part in the Project and a funding source for forest management. The Government of Japan also recognized that, although the social and economic effects were not the main objective, the revenue from forests was a necessary resource to make the Project sustainable¹¹. It is undeniable that the two sides’ interpretations differed on the main effect of “restoration of forests’ multi-dimensional functions.” The difference became apparent after the Project commencement through the major modifications in the Project plan at the time of the appraisal and project approaches. The following are the modifications and their relevance.

(1) Substantial Change in the Project’s Implementation Bodies

The Project planned to take the participatory approach in which small-scale farmers planted trees for improving the ecological environment of their farms and reducing poverty. Therefore, the participating farmers would have been to build a Protection Forest, an Economic Forest, would set a Mountain Closure area in their own lands¹², and would provide manpower for nursing and forest maintenance. They would have been also to earn income from the timber from thinning and forest products. In reality, a much smaller number of farmers took part in the Project, and the average afforestation per participant¹³ became more than 10 times the planned one.

Table 2: Number of Participants and Afforestation Area for One Participant (Unit: ha)

	Plan (2004)				Result (2012)			
	Individual Farmer	Collective Farm	State Owned Forest Farm	Total	Individual Farmer	Collective Farm	State Owned Forest Farm ¹⁴	Total
# of participant	185,305	3,576	231	189,112	15,599	252	76	15,927
Afforestation Area	157,397	86,816	46,066	290,281	177,596	76,722	59,059	313,378
Average afforestation area per participant	0.85	24.3	199.4	1.53	11.4	304.5	777.1	19.7

Source: Hubei Province Forestry Bureau Foreign Funds Afforestation Project Office

Note: The category, “Individual Farmer” includes individual farmers, associational-farms, and business enterprises.

conservation and reduction of erosion. According to the JICA documents, ecological conservation can be interpreted as “enrichment of forest resources and biodiversity by securing plant coverage.” However, the Project’s appraisal did not mention the development needs of “enrichment of forest resources and biodiversity,” or any indicator for reduction of erosion. The JICA official in charge at the time of the appraisal said that the Project’s main effect was determined as reduction of soil erosion.

¹¹ The project documents provided by JICA have no direct reference to what “social and economic effects by enriching forest resources” mean. The evaluation team confirmed the meaning of the term through an interview with the JICA official in charge.

¹² At the time of the appraisal, the planned average afforestation area per farm household was 0.85 ha.

¹³ The actual average afforestation area per farm household was 11.4 ha.

¹⁴ Mountain Closure is a method to restore plants and woods by restricting the entry of people or livestock in a forest. This method was applied only to state-owned forest farms that were for the public interest because it incurs a cost for management but earns no revenue.

The change was partly due to the Forest Tenure Reform that was implemented nationally after the start of the Project. The reform allocated forest tenure to individual farm households. Small-scale farmers who were allocated small areas chose one of the following options: taking part in the Project by organizing an association with other farmers; renting their lands to large-scale farmers or enterprises to earn rental fees; or providing manpower to earn wages.

The farmer or farm wishing to participate in the Project applied to their county forestry bureau and signed a loan agreement. Large-scale farmers, farmers belonging in associations, and enterprises became the main project implementation bodies because the bodies had to meet a few preconditions such as financial capability for maintaining forest lands and repaying loans.

Afforestation projects require inputs including materials for planting and maintenance costs before a forest is fully grown to generate sufficient income. Because of the change in the conditions of the loan agreement, the implementation bodies were able to manage with their own financial resources the entire process from leveling before planting, securing costs for management and repayment, and employing necessary manpower for forest management. Thus the change was a good choice for enhancing the Project's effects as well as securing the Project's financial sustainability. The change had no negative impact on social aspects because small-scale farmers became secondary beneficiaries by earning rental fees and labor wages.

(2) Appropriateness of Appraisal and Change by Project Purpose and Afforestation Method

The main objective of the Project was the improvement of the quality of forests through the effects of soil erosion reduction and ecological conservation. As explained in ① and ② below, JICA should have provided supervision and guidance to the Project through the executing agency on the following: whether the Project examined the appropriateness of the appraisal and change regarding afforestation methods, selection of tree species, and forest design based on differences in effects on the Project objectives. However, a certain amount of effects were realized in erosion reduction and ecological conservation regardless of afforestation methods, and the risk of significant deterioration was low in the sustainability of the Project's effects. Thus the points mentioned above were not taken into consideration in rating the relevance of the Project.

① Effects on Water and Soil Erosion Control

At the time of the appraisal, it was determined that erosion control effects yielded by afforestation were the same regardless of forest type (Protection Forest¹⁵, Economic

¹⁵ According to the Forestry Law of China (other definitions below are also based on the same law), Protection Forests include those for water conservation, water and soil retention, engineering sand fixation, farmland

Forest¹⁶, Timber Forest¹⁷, or Mountain Closure¹⁸). Based on the recognition above, the Project plan set afforestation methods and areas according to the Chinese needs. During the implementation of the Project, the executing agency requested to switch a few Economic Forests to protection ones. At that time, the difference on erosion control effect by afforestation method was not considered. In an afforestation project that aims to control soil erosion, the location of a Protection Forest shall be decided first depending on the needs to control soil erosion, and then the area of Economic and Timber Forests shall be decided according to the economic needs. The Project did not follow the procedure above and prioritized the needs of the Chinese side.

② Effects on Ecological Conservation

At the time of the appraisal, ecological conservation was defined as the enrichment of forest resources and biodiversity. The forest design of the project plan aimed to build mixed forests by planting multiple species. However, in reality, selection of type and species fell under the operation of the participants, they prioritized economic effects over ecological conservation. The forest inspection did not have criteria for if the participants successfully build mixed-forest as designed. As the result, majority of project sites, which supposed to be mixed forests, ended up to be simple forests. Simple forests do not help realize the intended biodiversity because they use a limited number of tree species. In addition, simple forests have low durability because they have a high chance of spreading the damage of diseases and pests to the same species and varieties. According to the Chinese forest sector expert, it is important to promote stable growth of trees in order to build and maintain quality forests, and a mixture of broad-leaf and needle-leafed trees are desirable for that purpose. The Project's contribution to improving the forest quality, as required in the development needs, was limited because most of the Protection Forests ended up being simple forests.

The Project has been highly relevant to the development policies and needs of the Chinese and Hubei Governments, and Japan's ODA policy. The appropriateness of the Project approach had a problem because the Project plan was designed at the time of the appraisal without considering differences in erosion control effects by forest type. However, regardless of the forest type, certain ecological effects observed, and this problem did not compromise the Project's relevance seriously. Therefore, it is fair to say that the relevance of the Project is high.

protection, revetment forests, and roadside trees.

¹⁶ Economic Forests are those that aim to produce fruits, oil, drinks, seasoning, industrial materials, and medicine.

¹⁷ Timber Forests are mainly for timber production and include bamboo forests.

¹⁸ Mountain Closure is a method to protect forests. According to the "Technical Regulations for Afforestation," the method is taken to restore the vegetation by half or fully blockading the target area, so to prohibit tree cutting for energy and livestock access.

3.2. Efficiency (Rating: ②)

3.2.1 Project Output

At the time of the appraisal, the Project's envisioned outputs consisted of afforestation, facilities and equipment, building the Training Center, and technical training. Table 3 shows the plans and results of the outputs of the Project.

Table 3 Output

Item	Plan (Target year 2009)	Result (Project completion 2012)
Afforestation	290,281 ha	313,378 ha
Economic Forest	20,903 ha	21,764 ha
Protection Forest	269,379 ha	291,614 ha
Protection Forest I	47,575 ha	49,716 ha
Protection Forest II	71,518 ha	88,902 ha
Mountain Closure	152,996 ha	152,996 ha
Afforestation Material		
Seedling and Plants	324.10 million	322.37 million
Fertilizer	29,003 ton	N/A
Pesticide	589 ton	N/A
Vehicle	3	As planned
Office Equipment	275 pieces	244 pieces
Environment Monitoring Tools	48 pieces	44 pieces
Training Center	2,000 m ²	2,171 m ²
Training for Managers/Engineers	N/A	618 persons
Technical Training for Farmers	90,422 persons	100,781 persons

Source: Hubei Province Forestry Bureau Foreign Funds Afforestation Project Office

(1) Scope of the Project

It had been planned to implement the Project in 10 cities and 37 counties. However, national afforestation projects started before the Project and used provisional forest lands for the Project. As a result, Xishui and Yingshan counties withdrew from the Project, and Songzi¹⁹ city joined it. In addition, as a result of the further split of a few administrative divisions, 10 cities and 42 counties executed the Project. However, the scope of the Project as a whole remained unchanged.

(2) Forested Area

The actual afforestation area was 313,378 ha in total, which is 108% of the planned 290,281 ha. The area breakdown consisted of 21,764 ha of Economic Forests, and 291,614 ha of Protection Forests that amounted to 93% of the total area. Furthermore, the Protection Forests were made up of Protection Forest I (49,716 ha), Protection Forest II (88,902 ha), and Mountain Closure (152,996 ha). Protection Forest II occupied more than 90% of the area increased from the plan at the time of the appraisal.

¹⁹ Songzi city is a county-level jurisdiction district.

The documents provided by JICA show no clear difference between Protection Forest I and II, and define them as the Ecological (Protection) Forests that aim to secure water and soil, conserve water sources, and protect farmlands. According to the interview with the provincial forestry bureau, Protection Forest I was to be conserved because it was planted near water sources for the public interest. By contrast, Protection Forest II was planted and maintained practically as a Timber Forest for logging and paying back debts. In addition, in Protection Forest II, since the implementation bodies were in charge of selecting forest type and tree species, economic effects were prioritized, and the area of practical Timber Forests increased. The Project was a participatory one financed by borrowings. However, the executing agency's involvement would have been necessary in finalizing forest type and species. The sections on effectiveness and sustainability will discuss the effects and influence on future forests caused by switching Ecological (Protection) Forests to Timber ones.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The planned project cost was 10,977 million yen in total (of which the ODA loan portion accounted for 7,536 million yen). The actual project cost was 10,815 million yen (of which the ODA loan portion was 7,484 million yen), which was 98.5% of the planned amount. In the planned project cost, the afforestation cost was to be 9,632 million yen. However, the actual afforestation cost was 10,027 million yen, i.e., 104% of the planned one. This was because the afforestation area increased to 108% of the plan. The labor cost, which was about 20 yuan per day at the time of the appraisal, increased to 100 to 120 yuan per day during the project period. However, the increase in the labor cost was partially canceled out by a decrease in the afforestation material cost, and the actual total labor cost was 104% of the planned one. At the time of the appraisal, the province was to purchase in bulk such afforestation materials as plants, seeds, fertilizer, and pesticide. However, bulk purchase turned out to be inefficient and costly. Accordingly, the Project decided to have each implementation body purchase fertilizer and pesticide from nearby vendors depending on its needs and switch chemical fertilizer to organic one. Eventually, the province purchased only seedlings and seeds²⁰.

3.2.2.2 Project Period

Although the planned Project period at the time of the appraisal was 68 months from March 2004 to October 2009²¹, the actual period was 92 months from March 2004 to March 2012, i.e., 135% of the planned one. The Project period was extended for the following reasons.

²⁰ The Hubei Province Forestry Bureau applied to the former JBIC for a budget change in September 2008, and JBIC approved the change.

²¹ The following definition of the project completion was agreed upon: when the project area passes the third growth year inspection on the survival rate.

- In 2009, the originally planned project completion year, the afforestation area fulfilled the planned scope although supplemental planting continued in the areas that failed the inspection.
- Heavy snow in 2008²² and drought in 2010²³ forced the Project to carry out supplemental planting in areas where young Chinese fir trees and bamboos were affected.
- The surplus from contingency and management fees was spent on build new forests by 2012 with the total area of 1,093 ha.

3.2.3 Economic Internal Rate of Return

At the time of the appraisal, the economic internal rate of return (EIRR) of the Project was not calculated because the main objective of the Project was to restore forests' multi-dimensional functions such as conserving the ecological environment and erosion control, and the method to calculate the EIRR in a way that suited the Project did not exist. This ex-post evaluation does not implement an analysis based on the EIRR because it was not calculated during the Project execution either.

As mentioned above, although the project cost was within the planned limit, the project period was longer than planned. Therefore, the efficiency of the Project is fair.

3.3. Effectiveness²⁴ (Rating: ②)

The main component of the Project was afforestation. Therefore, the Project's effectiveness was to be evaluated by the quantitative indicators set at the time of the appraisal, and by forest condition, forest coverage ratio, and stock volume, all of which were to be based on the field studies. The impact of the Project was to be evaluated based on the following elements: reduction of erosion and ecological conservation; and economic and social impacts that were to be the motivation for the implementation bodies to plant trees and maintain forests and secure sustainability, which can be categorized together as "restoration of the multi-dimensional functions of the forests." Incidentally, because training was not a main component of the Project, its effects were to be evaluated in the technical aspect of operation and maintenance in the section on sustainability, but not in the sections on effectiveness or impact.

²² Heavy snow in 2008 damaged 2,290,000 ha of forests in Hubei province.

²³ Drought in 2010 damaged 2,314 ha of forests in 9 project counties.

²⁴ The rating for Effectiveness is to be made in consideration of Impact.

3.3.1 Quantitative Effects (Operation and Effect Indicators)

(1) Survival Rate, Preservation Rate²⁵, Forest Density²⁶

The calculation methods differed between the targets for the survival rate²⁷, preservation rate²⁸, and forest density set at the time of the appraisal and the results²⁹ provided by the executing agency. Thus it was not possible to compare the targets with the results and use the comparison as an indicator of the effectiveness of the Project. However, the field study for this ex-post evaluation³⁰ revealed that, in forests five to eight years after planting, all the figures exceeded the standards for the third-year inspection, i.e., preservation ratio of 85% for Economic Forests, 80% for Protection Forest³¹, and forest density of 0.2 for Mountain Closure. The preservation ratio usually goes down as years pass after planting. However, the field study revealed a high preservation ratio in forests that were two to five years after planting. Therefore, based on the data from the field study, it is fair to say that the Project attained the targets in the survival rate, preservation rate, and forest density.

In the field study on Protection Forests (Chinese fir, pine), the evaluation team observed that forests were not planted as planned. The adequate plantation density was 167 plants/mu³², but almost all Protection Forests' density was 197–400 plants/mu, which was too high. To confirm facts more in depth, the team interviewed engineers and managers of the county forestry bureau and the company that were responsible for on-site inspection. The provincial technical regulations set the formula for the survival and preservation rates as “ratio of the number of trees in the area to the number of trees planted,” but the actual inspection used “ratio of the number of trees in the area to the prescribed number of trees to plant” for calculating the density.

Survival/Preservation Rate = # of trees in the area / # of trees planted x 100

Actual Calculation Method = # of trees in the area / prescribed # to plant x 100

²⁵ China's Forestry Law sets the following definitions: [Survival rate] number of survived trees divided by the number of planted trees at the first growth period; [Preservation rate] the equivalent value in the third growth period.

²⁶ The forest density measures the density of woods. “1” means that the forest is wholly covered with trees. “0” means that there is no tree at all.

²⁷ The target survival rate in the first growing period was 85% for both Protection and Economic Forests, and 95% for Timber Forests. No forest density target was set for Mountain Closure.

²⁸ The target survival rate in the third growing period was 80% for Protection, and 85% for Economic Forests and Timber Forests. The target forest density was 0.2 for Mountain Closure.

²⁹ Measures for inspection: The county forestry bureau inspected all the first and third growth-year forests. The bureau took 10% of the forests as samples, and assigned a private firm to inspect the samples further. The inspection records had no detailed measurement data, but listed only the achievement ratios, areas that passed the inspection, and the passing ratio. Thus the inspection records did not reveal the basis of the survival and preservation rates.

³⁰ Number of the planted trees was judged comprehensively by confirming the number of the planted trees to the implementation bodies in interviews, and observation the spaces in forests where died trees used to be planted.

³¹ At one Protection Forest site (popular), the preservation rate was lower than the reference. It was because of the local damage from a tornado in the previous year. Thus as a whole, the Project attained the reference.

³² Mu is a common Chinese unit of measure for land. 15 mu is equivalent to 1 ha.

Here is a hypothetical situation: in a forest where the technical regulation sets 167 as the appropriate number of trees, 200 trees are planted in the forest, and 160 trees remain in the area at the time of the inspection. In a regulation-based calculation, the survival and preservation rates is $160/200 = 80\%$. In the calculation method employed by the actual inspection, the result is $160/167 = 95.8\%$. Because the forests passed the inspection by having more than the prescribed number of trees, many implementation bodies planted more trees in the forests, raised the forest density, and disturbed the growth of the trees. Such dense planting of trees became a cause of the deterioration in the forests' quality.

In addition, the inspection company stated in the interview that Mountain Closure was acceptable with the following conditions: ① forest patrol personnel are appointed, a patrol system exists, and signs to notify the Mountain Closure area are built; ② no damage to forests is incurred by people or livestock. Here is the reason that forest density was not applied in inspecting Mountain Closure: in Hubei province, forest density was higher than 0.5 to begin with before any measures including Mountain Closure were taken, and it was not a practical indicator to observe effects. Also, the measurement method varied depending on counties: some counties included shrub trees while others did not. Thus forest density itself is not a reliable resource of data.

3.3.2 Growth Status in the Project Sites

The evaluation team conducted a field study in 20 project sites in total in six counties. The sites included Economic Forests, Protection Forests, and Mountain Closures. The team examined forest design, maintenance status, and preservation rates for the planted trees. In addition, the team measured the height, circumference and other benchmarks to inspect the growth of the trees. The following is a summary of the study results. The details and measurement data of the study are mentioned in the attachment.



Photo 2: Economic Forest (Oiltea Camellia) planted on the steep ground where severely eroded. (Hubei Province, Tongcheng County)



Photo 3: Individual Farmer's forest where planting and thinning were not appropriately done. (Hubei Province, Gucheng County)

(1) Economic Forest (Species: Oil-tea Camellia, Walnut, Yellow Peach)

In all the species in Economic Forests, the preservation rate exceeded 95%. The heights, diameters, and base circumferences were normal for the tree age. The planted varieties were appropriate for the environment. No major damage by forest diseases or pests was observed. In all the sites, tree planting, fertilization, and maintenance were done properly.

(2) Protection Forest (Species: Slash Pine, Chinese Fir, Poplar, Bamboo)

The planted varieties were selected properly. The preservation rate of all the species exceeded the target rate of 80%. The project plan aimed to enrich biodiversity, and recommended making mixed forests by planting more than one species. However, all the 19 sites visited for the field study except one were simple forests³³. The implementation bodies that took initiative in selecting varieties avoided mixed forests that cost more for planting and maintenance than simple forests. Needle-leaved trees were planted at 133% to 277% of the appropriate density, and no thinning was done. As a result, a negative impact was observed on the growth of tree diameter and stock volume. Forest beds were covered with weeds and shrub trees, and appropriate maintenance and nursing were not provided. Poplar trees grew well and were maintained properly. A few poplar forests had the preservation rate of 60% because of the damage from a tornado, but the other forests exceeded the standard preservation ratio of 80%. Bamboo forests were not thinned to the appropriate level, and did not grow enough to be cut and used as industrial materials.

(3) Mountain Closure

Forest density³⁴ improved from 0.2 to 0.6–0.7 after five years of Mountain Closure. Ecological effects such as reduction of water and soil erosion and enrichment of forest resources were also confirmed.

³³ The evaluation team confirmed the varieties planted at the sites by interviews to the implementation bodies and by viewing.

³⁴ Mountain Closure is a method to improve forest coverage ratio and increase ecological effects such as reducing water and soil erosion and increasing forestry resources. Forest density is used to measure the difference between the original status and the growth one after the Project.



Photo 4 :Confirming growth situation at a project site. (Hubei Province, Laohekou city)



Photo 5: A sign to notify entrée limitation for Mountain Closure. (Hubei Province, Gucheng county)

3.3.3 Forest Coverage Ratio and Stock Volume

As shown in Table 4, all the province, and project counties and sites achieved the targets in the forest coverage ratio. Regarding the stock volume, no target was set, but in comparison to the baseline figure at the time of the appraisal, the results in both the province and project counties exceeded 158% as shown in Table 5. Thus it is fair to say that the intended project effect was attained.

Table 4: Forest Coverage Ratio

	Baseline	Target	Result
	Appraisal (1998)	One year after Completion (2010)	One year after Completion (2013)
Province	32 %	35 %	38.4 %
Project Counties	33 %	37 %	37.6 %
Project Sites	—	Increase 2.3 %	Increase 3.18 %

Sources: Target figure referred to JICA document at appraisal, Hubei Province Forestry Bureau Foreign Funds Afforestation Project Office provided the result

Note 1: Forest coverage ratio: Forest area for the total area

Note 2: Project site Forest coverage ratio: Ratio of forestry area passed the Project's inspection/area of the administrative area×100

Table 5: Stock Volume³⁵

	Baseline	Target	Result
	Appraisal (1999)	One year after Completion (2010)	One year after Completion (2013)
Province	132.3 million m ³	N/A	209.4 million m ³
Project Counties	0.669 million m ³	N/A	1.06 million m ³

Sources: Target figure referred to JICA document at appraisal, Hubei Province Forestry Bureau Foreign Funds Afforestation Project Office provided the result

³⁵ The JICA appraisal documents listed the target figures in Project sites but did not describe the basis for calculating them. Thus in the ex-post evaluation, the evaluation team removed the figures from the indicators to analyze the Project's effectiveness.

3.4. Impacts

3.4.1 Contribution to Erosion Reduction

As shown in Table 6, in Hubei Province, erosion control measures were implemented in nearly 200 thousand ha per year. The measures included biological methods such as afforestation and Mountain Closure, and construction works on riverbank reinforcement. Table 7 shows that the water and soil loss area in Hubei Province was on the decreasing trend: 6.08 million ha in 2005, 5.58 million ha in 2010, and 3.69 million ha in 2013. Table 8 indicates that, in Chibi City, a field study site, both the sediment yield and the water and soil erosion area decreased year by year from 2003. Among the 73 water and soil erosion monitoring stations in the province, three are located in the project area. As shown in Table 9, the soil erosion amount decreased every year in all the three stations. The afforestation area of the Project between 2004 and 2010 was 310 thousand ha, which greatly exceeded the annual water and soil control measure area by the province. Thus it is fair to say that the Project contributed significantly to water and soil erosion control.

Table 6: Water and Soil Erosion Control Measured Area in Hubei Province

Hubei Province	W&S Erosion Control project Area (thousand ha/year)
2009	206
2010	225
2011	215

Source: Hubei Provincial Department of Water Resources, Soil and Water Conservation Gazette

Table 7: Sediment Yield and Water and Soil Erosion Area in Hubei Province

Hubei Province	Sediment Yield (million ton / year)	W&S Erosion Area (million ha / year)
2005	200	6.08
2010	178	5.58
2013	N/A	3.69

Source: Hubei Provincial Department of Water Resources, Soil and Water Conservation Gazette

Table 8: Sediment Yield and Water and Soil Erosion Area in Chibi City

Chibi City	Sediment Yield (10 thousand ton /year)	Ratio to 2003	W&S Erosion Area (10 thousand ha/ year)	Ratio to 2003
2003	292	100 %	10.3	100 %
2010	269.3	92.2 %	9.6	93.0 %
2011	263	90.1 %	9.58	92.9 %
2012	261	89.4 %	9.34	90.5 %
2013	248	84.9 %	8.16	79.1 %

Source: Documents provided by Chibi City

Table 9: Sediment Yield at Monitoring Stations (Unit: kg/ha)

Name of Location (tree species)	Songzi City (Pine tree)	Macheng city (Chestnuts)	Guangshui city (Jujube)
2006	5,434.3	2,949.2	3,416.2
2007	5,192.9	2,782.3	3,297.7
2008	3,716	2,621.2	3,139.7
2009	2,775.8	2,492	2,941.5
2010	2,075.8	2,193	1,941.5

Source: Hubei Province Forestry Bureau Foreign Funds Afforestation Project Office

3.4.2 Contribution to Ecological Conservation

In the project plan at the time of the appraisal, enrichment of forest resources and biodiversity was the expected impact on ecological conservation. Regarding enrichment of forest resources, no logging was done because the forests were not fully grown by the time of the ex-post evaluation. In the future, a drastic ecological change may occur if the Protection Forests are logged in a wide area. However, the risks that forest resources will be lost by excessive logging are low because of the existence of the logging quantity limits and permit system in accordance with the governmental logging plan.

With regard to enrichment of biodiversity, to achieve diversity of species by afforestation, the plan at the time of the appraisal recommended building mixed forests with about 40 species. However, the diversity ended up being limited because the selection of species was left to the implementation bodies: the planted species were about 10 kinds including pine, Chinese fir, poplar, camphor, bamboo, and oil-tea camellia. The field study revealed a few mixed forests of pine and liquidambar planted in a Chinese fir forest for fire control. However, almost all the forests were simple forests. If forest diseases or pests occur in simple forests, risks of spreading the damage to the same species and varieties are high.

In interviews, both the provincial forest bureau and the six counties targeted in the on-site field study stated that the Project helped enrich the diversity of animals and plants, but cited no specific data or species.

3.4.3 Economic and Social Impact by Afforestation

(1) Economic Impact by Afforestation

In the beneficiary survey³⁶ as shown in Table 10 to the question comparing the income from the forests before and after the Project, 86% of the respondents answered “Income increased.” To the question on the comparison of their income and expenditure, 47% answered “expenditure exceeded the income.” Thus the answers indicate that the

³⁶ The beneficiary survey was conducted on 100 project participating farmers in the six target counties of the field study. The questionnaire included questions on such matters as motive to participate in afforestation, project implementation status, status of training and technical guidance, income and expenditure for afforestation, status of debt payment, and level of satisfaction with the Project. The county government took samples from the county’s participant list, but the respondents were limited to the farmers who were able to come to the local county office on the day of the survey. While 15,599 farmers took part in the Project, this evaluation study collected 100 replies. The beneficiary survey results do not represent all the beneficiaries because the sample size was small, but the evaluation team used the results to analyze the tendency of the sample sites.

participants increased their forest area and production scale. About half of the participants' expenditure exceeded their income because the cost for forest maintenance including labor cost and material raised, repayment has started, and most of the Project's Economic Forests had not reached the tree age for stable production and would take more years until they are ready for logging. According to the interviews in the field study, the farmers who did not have stable income from the forests covered the maintenance costs from their other revenue. They considered the maintenance costs for future investment. Table 11 shows the prospective expenditure and income. In the future, the participants' income would exceed their expenditure; they would gain expected income from Economic Forests in five to ten years, and from Protection Forests in 20 to 30 years. Thus the Project is expected to have an economic impact.

Table 10: Result of the Beneficiary Survey (100 samples)

Has your income increased since the Project started?	
Income increased significantly.	13 %
Income increased in some extent.	73 %
No change.	6 %
Income did not increased much.	6 %
Income did not increased at all.	2 %
Are you earning or spending more for the Project's forest?	
Income is more than Expenditure.	50 %
Income and Expenditure are about the same.	3 %
Expenditure is more than Income.	47 %

Table 11: Maintenance Cost and Expected Income (Unit: yuan / mu)

Species	Afforestation	Maintenance	Expected Income	Net Income
Chinese Fir	1,500	4,900	13,000	6,600
Poplar	300	1,500	6,000	4,200
Oil-tea Camellia	2,500	800/year	2,400/year	1,600/year

Source: interviews at the project sites

(2) Social Impacts from Afforestation

As stated in the section on relevance, small-scale farmers who had been expected to be the main implementation bodies at the time of the appraisal did not participate in the Project, but large-scale farmers, collective forest farms, and private firms did. The small-scale farmers chose to participate in the Project by renting their forest tenure to the implementation bodies or providing labor for wages. They became the indirect beneficiaries of the Project. In addition, in selecting project sites, the province gave priority to counties with mountainous terrains and poor population³⁷ and those with a large population of ethnic minorities. It is thus assumed that expected social impacts from the Project materialized.

³⁷ A poverty county is defined as one that average household income is less than 3,000 yuan.

3.4.4 Other Impacts

(1) Impacts on the Natural Environment

No negative impact on the natural environment has been found. This is partly a result of careful consideration and measures by the Provincial Forestry Bureau. To avoid a negative impact on the environment, the bureau prohibited mountain burning to protect indigenous vegetation when the implementation bodies planted new forests. Also for ground leveling, rather than removing all the plants, the bureau suggested leaving existing vegetation to the maximum possible extent, and planting new trees in pits dug for new planting.

(2) Land Acquisition and Resettlement

No land acquisition or resettlement occurred because the project implementation bodies were owners of the forest tenure. When large-scale farmers or companies rented forests from farmers, rental agreements were concluded based on the afforestation period and the current land price, and suitable rental fees were paid.

As mentioned above, the Project covered a larger area for afforestation than the one covered annually by the provincial water and soil control measures, and contributed to improving the forest coverage ratio and the stock volume. However, most of the forests ended up being simple forests, and their growth was behind schedule, because the plantation and management of forests were not executed as planned. Forest quality improvement and ecological conservation effects were limited. Therefore, the effectiveness and impact of the Project are fair.

3.5. Sustainability (Rating: ②)

3.5.1 Institutional Aspects of Operation and Maintenance

(1) Executing Agency

The Hubei Province Forestry Bureau Foreign Funds Afforestation Project Office³⁸ of the Forestry Bureau was responsible for supervising city and county project offices, and for managing funds for repayment. In addition, in cooperation with the bureau sections in charge of forest management and forest disease and pest control, the project Office operated and maintained forests.

The human resources of the 42 Project-participating counties' forestry bureaus and project offices increased from the time of the appraisal. The number of senior engineers increased substantially from 69 to 160, and the one of engineers from 549 to 2,082. The county forestry bureau was responsible for monitoring and supervising the forests after the completion of planting. At the township level, forest stations were managing the

³⁸ The project office is a generic term for administrative office.

forests.

Between at the time of the appraisal and the ex-post evaluation, no major change occurred in the institutional structure of the Provincial Forestry Bureau, the executing agency. The sections of the Bureau had a good partnership with the county bureaus, and the responsibilities of the sections were clearly defined. Therefore no problem was found in institutional aspects.

Table 12: Number of Human Resources in Forestry Bureaus and Project Offices of the Participated 42 Counties (unit: person)

	Forestry Bureau			Project Office		
	Total	Senior Engineer	Engineer	Total	Project Management	Finance
Plan (2003)	1,323	69	549	215	141	74
Actual at ex-post evaluation (2014)	2,494	160	2,082	220	144	75
Difference	189 %	232 %	379 %	102 %	102 %	101 %

Source: Hubei Province Forestry Bureau Foreign Funds Afforestation Project Office

(2) Implementation Bodies

In selecting implementation bodies, economic guarantees such as repayment capacity and collateral were requirements.³⁹ Thus large-scale farmers, collective farms, and firms with economic capacity became implementation bodies of the Project. The project plan at the time of the appraisal expected that the implementation bodies would provide manpower to maintain the forests. However, the implementation bodies employed necessary workers for operation and maintenance of forests because the scale of afforestation became larger than planned.

The implementation bodies were in charge of the maintenance of forests. They hired forest protection patrol for preventing fires and controlling diseases and pests. For tree planting and forest maintenance, the implementation bodies hired neighboring farmers. Labor shortage was observed in a few large-scale Economic Forests because farmers chose to work in distant locations for higher pay or prioritized work in their own farm in a busy farming season.

Between at the time of the appraisal and the ex-post evaluation, the executing agency and its subordinating bodies had good coordination, and defined their scope of work and responsibilities clearly. Also, implementation bodies with economic resources managed the Project in a well-organized fashion. Therefore no problem was found in institutional aspects of the operation and maintenance of the Project.

³⁹ Project implementation bodies such as farmers, collective forest farms, and state-owned forest farms had to meet a few conditions. Although the conditions varied somewhat depending on the county, they were essentially as follows: (1) The implementation body owns land for afforestation (in Gucheng county, land of more than 100 mu, i.e., 6.7 ha, was required); (2) The implementation body can repay debts; and (3) The implementation body has a collateral such as forest tenure certificate, land, building, property, and salary from a farm.

3.5.2 Technical Aspects of Operation and Maintenance

Training for engineers, whose mandate was to provide technical training and guidance to the implementation bodies, was conducted to those of the provincial, county, township, and state-owned forest farms. The survey to the trained engineers⁴⁰, as shown in Table 13, indicates that more than half of the engineers took the courses on afforestation techniques, forest design, nursery and forest protection, and project management. In contrast, 34% took the course on thinning techniques, and 15% the course on forest products utilization. Thus not many engineers took these two courses. The total number of engineers who took part in the training was 198, which was less than 10% of those of counties and state-owned forest farms. In addition, the field study revealed that trees in most of the Protection Forests were not thinned as planned. It is reasonable to conclude that lack of training of the engineers caused lack of dissemination of relevant knowledge to the implementation bodies.

Table 13: Result of Engineer Training Attendants Survey (47 samples)

What subject(s) did you learn at the training(s)?	
Afforestation Technique	79 %
Forest Design	66 %
Nursery	66 %
Forest Protection	62 %
Project Management	55 %
Financial Management	40 %
Forest Thinning Technique	34 %
Forestry Products Utilization	15 %

Training to the implementation bodies was carried out for 96,548 farmers, 3,048 collective-farm forest workers, and 1,185 state-owned forest farm employees. As shown in Table 14, the beneficiary survey revealed that 99% of the respondents took the course on afforestation techniques. More than half the respondents took most of the other subjects, but only 27% took the course on forest products and thinning-cut sales. The training was held just before planting, and the implementation bodies may have had little interest in thinning and forest products at the time because thinning and production would take five years or more after plantation. In addition, only 22 % of the respondents credited the training with any practical benefit. Thus it is fair to say that the training was not particularly useful.

⁴⁰ The questionnaire survey was carried out in the six counties that the evaluating team visited for the field survey. Forty-seven engineers who took part in the Project's training answered questions on the content, timing, duration, and number of training courses, and the effects of the training.

Table 14: Result of the Beneficiary Survey on Technical Training (100 samples)

What subject(s) did you learn from the training?		How the training affected to your afforestation skills?	
Afforestation technique	99 %	Afforestation technique improved	99 %
Seedling and plants handling	89 %	Seedling and plants handled appropriately	71 %
Forestry diseases and pests prevention	94 %	Prevented and cured forest diseases and pests	92 %
Fertilizer usage	83 %	Fertilizer used appropriately	88 %
Forest management	89 %	Managed forest appropriately	89 %
Funds management	56 %	Managed funds appropriately	45 %
Products and thinning cut sales	27 %	Sold products and thinning cut appropriately	22 %
		Motived to improve afforestation technique	86 %

Technical guidance at project sites was provided by engineers of the county and township forestry bureaus. As shown in Table 15, all the respondents to the beneficiary survey replied that they received technical guidance at least once. Among the respondents, 45% replied that they received technical guidance more than 10 times.

Table 15: Result of the Beneficiary Survey on Technical Training (100 samples)

How many times have you received Technical Training?	
Once	1 %
Twice to Three times	24 %
Four to Six times	24 %
Seven to Nine times	6 %
More than 10 times	45 %

According to interviews in the field study, training and technical guidance were provided before planting and until the inspection at the end of the third growth year of forests, but were hardly done afterwards. As a result, the implementation bodies had poor knowledge and practice on maintaining young growing forests, thinning, and selling forest products. Not only farmers but also local engineers had a scientific misconception that dense plantation was effective in raising the preservation rate and stock volume. The timing of the ex-post evaluation was also the time when the forests needed thinning. Thus it would be desirable to implement additional training to cover subjects that engineers and farmers need to be familiar with.

Regarding responses to emergencies such as forest fire, state-owned forest farms prepared patrolling shifts and manuals. From the viewpoint of forest protection, the state farms are also prepared to respond to a fire in neighboring farmers' forests. Farmers employed their own forest patrol, but had no manual or maintenance reports.

The implementation bodies were lacking in accurate knowledge and practice on maintaining young growing forests, thinning, and selling forest products. Not only farmers but also local engineers had a scientific misconception that dense plantation was effective in raising the preservation rate and stock volume. Thus the technical sustainability of the Project faces a few problems, and additional training and technical guidance are needed.

3.5.3 Financial Aspects of Operation and Maintenance

According to the provincial forestry bureau's project office, a budget was prepared for planting in all the available forests in the three years between 2014 and 2016 at the annual amount of 130,000 yuan/ha. Funding for forestry increased year by year. In 2011, the forestry budget was four times the one in 2005. The budget covered national programs such as the Program of Converting Steep-Farmland Back to Forest, the Natural Forest Resource Protection Program, and the Schistosomiasis Prevention Forest Program, and subsidies for afforestation and nursing. The provincial bureaus in charge undertook forest maintenance, fire protection, and disease and pest control, and secured necessary budgets. The budget at the county bureau level was distributed from the province based on the needs, and the necessary amount was secured every year.

Table 16: Annual Funding for Forestry and the Sources (unit: 10,000 yuan)

Year	Annual Funding	State Budget	Domestic Loans	Bonds	Foreign Investment	Self-raising funds	Other Funds
2005	101,807	61,232	2,100	0	810	17,989	17,727
2006	143,784	98,498	682	0	6,467	24,645	12,787
2007	152,764	100,421	1,175	0	9,775	28,729	12,051
2008	195,895	142,573	500	0	2,515	23,794	24,645
2009	262,951	193,382	0	0	3,191	25,502	40,976
2010	280,082	207,950	16,000	0	1,604	14,406	40,122
2011	406,034	270,000	2,579	0	2,524	67,100	63,831

Source: National Bureau of Statistics of China Statistical Yearbook

Meanwhile, there were a few challenges. For the funding source of forest maintenance, state-owned forest farms and collective forest farms depended on their operating profit, and farmers relied on their independent revenue. At the time of the ex-post evaluation, neither Economic nor Protection Forests were at the tree age to generate a sufficient amount of income. Thus maintenance costs including labor costs and repayment that started in 2013 were covered by income from selling farm products or other businesses. Regarding forest products whose production was increased based on the national policy, there are risks that their prices may fall drastically because of overproduction. The businesses of the implementation bodies varied widely: they included poultry and hog farms, and businesses outside agriculture and forestry industry such as karaoke shops, hotel management, an advertising agency in Shanghai, and a brick factory. The Project's financial sustainability may be affected by those businesses' success and failure.

In the field study, the evaluation team found that thinning and nursing of Protection Forests were not executed in proper frequency because of the higher maintenance costs caused by increased labor wages and labor shortage in farms. While similar problems were common in all of China, the national government launched the Young Forest Nursing Project in 2014 to provide a subsidy of 100 yuan/mu to Ecological Forests more than three years after planting. If a forest were covered by the subsidy, thinning and nursing would be promoted. However, the subsidy was not used much in the Project because the area of Ecological Forests

to be covered was limited and Timber and Economic Forests were not eligible for the subsidy.

The Project expected that revenue from forests would cover the costs for maintaining them and did not expect any shortage of funds. At the time of project planning, it was necessary to consider the maintenance costs based on necessary maintenance tasks, and examine prospects after the completion of the Project in accordance with the governmental policies and the availability of subsidies.

Table 17: Loan and Repayment Status (average of the respondent)

Total Loaned Amount	Rate	Starting date for Repayment	Amount Repaid
149,690 yuan	0.75 %	March 2013	11,036 yuan

Source: Beneficiary Survey

At the time of the ex-post evaluation, repayment for one-year (twice) was completed. The average amount per repayment was 5,518 yuan, and problems such as delinquency or insolvency have not occurred. If implementation bodies were unable to pay back the loan, the county (or city or districts) forestry bureau would shoulder the repayment. Therefore no problem was found.

Although income from the forest for future is expected, the implementation bodies cover the operation and maintenance costs with their revenues from businesses other than the forests. The failure of those businesses could negatively affect the financial sustainability of the Project. Because of the insufficiency of income from the forests, problems that tree thinning and nursing were not done properly were observed at the time of ex-post evaluation. Accordingly, the financial sustainability of the Project has a few problems.

3.5.4 Current Status of Operation and Maintenance

As mentioned in the effectiveness section, at the time of ex-post evaluation, the evaluation team observed that trees were not planted in the planned density or mixed, nor necessary nursing or maintenance executed in many forests. In this section, the recognition of the engineers who are responsible for monitoring the forests and provide guidance, and the one of the implementation bodies who are responsible for the operation and maintenance, are to be analyzed. The purpose of the analysis is to find if the forests built by the Project are to be operated and maintained sustainably.

(1) Operation and Maintenance of Forests

According to an interview with the provincial forestry bureau, no problem was found in the condition of forests in the 42 counties (cities, districts), but a few maintenance problems were found in 13 counties. The problems were caused by delays in recovery from natural disasters and damage from forest fires. In the beneficiary survey, 12% of the respondents said “There are some problems” in the maintenance situation of their forests.

They said that the problems pertained to “shortage of manpower” and “shortage of maintenance budgets.”

Table 18: Result of Beneficiary Survey on Forest Maintenance (100 samples)

How is the maintenance condition of the Forest?	
Fine	85 %
There a few problems.	12 %
There are many problems.	0 %
Not answered.	3 %

In the six counties targeted in the field study, Economic Forests were maintained well. Poplar Protection Forests were appropriately maintained as necessary tasks such as weeding, removal of shrub trees, and fertilizing were performed. However, in needle-leaved tree forest sites, maintenance tasks such as weeding and shrub tree removal were not done sufficiently. In the Chinese fir forests between the 8th and 10th growth year in particular, the forest density was 0.8 or higher, requiring immediate thinning.

Farmers did not undertake thinning to maintain the forest density at a proper level because of a misconception that dense planting would increase the preservation ratio and raise income by yielding more trees for thinning. Another reason for the failure to perform thinning was that, because of the increase in labor wages, employment costs and revenues from selling timber from thinned were about the same and no profit could be expected.

Accordingly, for proper operation and maintenance of forests, it will be necessary to provide additional training to forestry engineers and farmers to improve their techniques on afforestation, nursing, and thinning, and disseminate accurate knowledge among them.

(2) Sustainability of the Project’s Effects in the Long Term

In the long term, Mountain Closure and Economic Forests stay in the forests, and their erosion reduction effects will be preserved. However, if Protection Forests are cut, their erosion reduction effects will decrease. According to a JICA staff member at the appraisal screening, erosion reduction effects were considered to be the same regardless of the type of forest or species, and as long as the forests had some vegetation, no problem would occur on the erosion reduction effects.

In normal forest management techniques, deliberate afforestation is implemented in parallel to a logging plan. If deliberate logging and afforestation are not executed, and a Protection Forest is logged in a large scale, the forest’s erosion control effects and ecological conservation may be greatly endangered. However, there are Ecological Forest protection regulations, and a Timber Forest logging permission system in accordance to the governmental logging plan. They control the amount and area of logging so to avoid excessive logging from a few sites. As shown in Table 19, the actual fell has been less than 30% of the annual allowable cutting amount allocated to the province by the national

government. The Hubei Province Forestry Bureau said that deliberate afforestation was executed in parallel to logging. Because of the existence of the Ecological Forest protection regulations and the governmental regulations to prevent excessive logging, the Project's effectiveness is likely to be secured.

Table 19: Annual Allowable Cut and Actual Fell in Hubei Province (unit: ten thousand m³/year)

Year	2000	2005	2008	2009	2010	2014
Allowable Cut	N/A	700				1,000
Fell	117	136	178	169	169	N/A

Source: Hubei Province Statistical Yearbook 2011, Amount of allowable cut was provided by Hubei Province Forestry Bureau Foreign Funds Afforestation Project Office.

The project plan recommended mixed forests with multiple species for conserving the ecological environment, but the vast majority of the forests ended up being simple ones. If an outbreak of a forest disease or pest occurs, simple forests have a higher risk of spreading the damage to the same tree species and varieties. However, the provincial bureau said that it had institutional readiness to address diseases and pests, and, as shown in Table 20, executed preventive measures between 65% and 90% of the areas that had encountered diseases and pests. Thus no problem had a negative impact on the sustainability of the project effects, and, based on the current status, possibilities of occurrence of such problem in the future are low.

Table 20: Prevention of Forest Diseases and Pests (Unit: 10 thousand ha)

	Area of Occurrence	Area of Prevention	Prevention Rate
2004	4.11	2.98	73 %
2005	4.28	3.25	76 %
2006	4.49	4.06	90 %
2007	5.43	4.36	80 %
2008	5.53	4.45	80 %
2009	4.69	4.22	90 %
2010	4.55	3.85	85 %
2011	4.23	2.79	66 %
2012	4.56	2.97	65 %
2013	4.09	2.82	69 %

Source: Hubei Province Forestry Bureau Foreign Funds Afforestation Project Office

(3) Operation and Maintenance of Facilities and Equipment

The training center whose construction was completed in 2006 in the Project has been utilized for forestry and social training, including the Project, for about 1,800 people annually. The training center was originally built in the premises of a middle school

specializing in forestry. However, the school's name was changed to the Hubei Ecological Conservation Vocational College because it was merged with a high school in 2013. Recently, the area where the training center built was designated as a redevelopment zone. At the time of the ex-post evaluation, a new training center (30,000 m²) was under construction in another location, and it would be completed in two years. The training functions will be moved to the new center as soon as the construction is completed.

All the office equipment pieces (244 in total) were maintained by the province, city, and county project offices as well as the training center. Environment monitoring equipment pieces (44 in total) were used by the Forestry Science Academy for monitoring. Some equipment pieces such as projectors and personal computers were discarded because they became obsolete or broke down.

Out of the three vehicles purchased, two were kept by the provincial project office, and the other one by the Forestry Science Academy. The vehicles were maintained regularly and problems such as breakdown did not occur.

Accordingly, the Project's effects are likely to be sustained. By contrast, forest operation and maintenance were executed with inaccurate knowledge, and nursing was not done in the proper frequency because of such reasons as the rising labor costs. Thus a few problems were found in the operation and maintenance status.

As stated above, minor problems were observed in technical and financial aspects as well as the operation and maintenance status. Therefore the sustainability of the project effects is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1. Conclusion

The Hubei Province Afforestation Project aims to improve the quality of forests in Hubei Province, and restore their multi-dimensional functions by afforestation and Mountain Closure. The Project was prompted by the increase in the importance of afforestation because of the escalation of flood damage in the Yangtze River basin area. The Project's relevance is high because its aim is consistent with the Chinese Government's development policies, development needs and Japan's aid policy. Affected by the Forest Tenure Reform, the main project implementation body was changed from small-scale to large-scale farmers. The change was a positive one for assuring forestation and for setting the sustainable system for forest management while benefitting the small-scale farmers. In contrast, a problem at the time of the appraisal is that erosion control effects by forest type were not examined. However, the problem is not taken into consideration for the relevance rating because, regardless of the forest type, a certain amount of ecological conservation effects exist, and the risk of a significant decrease in the Project's sustainability is low.

The Project's afforestation area exceeded the annual area of water and soil erosion control

of Hubei Province, and contributed to improving the forest coverage ratio and the forest stock volume. The forests are growing, and future economic impacts are expected. However, since tree plantation and management did not follow the afforestation plan, most of the forests became simple forests and a delay in tree growth was observed. Consequently, the effects on forest quality improvement and ecological conservation are limited. Thus the effectiveness and impact of the Project are fair. With regard to efficiency, although the cost of the Project was within the planned limit, the Project period was longer than planned because of the supplemental planting and additional forest building. Thus the efficiency of the Project is fair. There was no major change in the Project's executing agency, and the funds for the operation and management were secured by subsidies and the forestry bureau's budget. However, three years after the planting, forests were not maintained properly because of the rising employment costs and lack of relevant knowledge. It is necessary to upgrade technology on forestation, nursing, and thinning among engineers and farmers and disseminate accurate knowledge to them. The sustainability of the Project is fair because a few problems were observed in technical and project implementation bodies' financial aspects and the maintenance status.

In light of the above, the Project is evaluated to be partially satisfactory.

4.2. Recommendations

4.2.1 Recommendations to the Executing Agency

The evaluation team observed that, in many farmers' Protection Forests that were three years after being planted or older, nursing and thinning were not appropriately executed. Behind the problem lies the farmers' misconception that a high forest density saves their work on nursing and enables them to produce more timber from thinning. The farmers need to know that high-density forests have a greater risk of outbreak and spread of diseases and pests, may delay timber growth and cost more for maintenance until the trees are ready to be cut, and degrade the quality of the forests. The executing agency needs to provide additional training for farmers to disseminate accurate knowledge on planting, nursing and thinning, and to promote appropriate forest maintenance. For this purpose, it is essential to increase the number and frequency of training for and strengthen the capacity of local engineers at the county and township levels who provide technical guidance to farmers. In many project sites, Chinese fir and pine trees were shifting from the young growing period to the first thinning period (8th to 10th growth year) at the time of the ex-post evaluation. Thus it would be desirable to implement the measures discussed above as soon as possible.

4.2.2 Recommendations to JICA

None

4.3. Lessons Learned

(1) The executing agency needs not only to monitor the operation and effect indicators, but also provide guidance and supervision on if the trees are planted and maintained according to the Project's plan.

At the time of the acceptance inspection of the Project, the data on the survival and preservation rates, and the main indicators for afforestation were not correctly recorded. The inspectors gave a forest passing rate if it had more trees than specified in the afforestation regulations. This was a major cause that implementation bodies planted and maintained trees in a higher-than-appropriate forest density, then the growth of trees is inhibited, and then the forest's quality, that the Project was aiming at, is degraded. During the course of the Project, the executing agency needed not only to monitor the achievement of inspection figures such as afforestation area and survival and preservation rates, but also provide guidance and supervision on if the planting and maintenance of forests were done according to the project's plan so that the quality of the forests would have been improved.

(2) Regarding the ecological conservation standards, JICA needed to determine if the executing agency set appropriate appraisal and forest inspection criteria on implementation bodies and monitored them, and take measures for promoting the Project's effects if necessary.

In the plan at the time of the appraisal, from the perspective of the diversity of animals and plants and the stability and sustainability of forests, the Project was to plant 40 species. However, the selection of species was left to the implementation bodies who prioritized the species that they thought would be profitable. As a result, the number of species was limited to about 10 such as Chinese fir, pine, and poplar. Also, in forest design, a mixed forest using several species had been recommended, but most of the project sites ended up as simple forests, the forest density became higher than planned, making the forests vulnerable to environmental changes or forest diseases and pests. To restoration of multi-dimensional functions of forests, the executing agency needed to set criteria for selecting implementation bodies that included not only economic resources but also those pertaining to erosion control and ecological conservation such as forest design and tree species. In addition, the executing agency needed to confirm the extent of achievement of the criteria above for acceptance inspection of the Project. During the implementation of the Project, JICA should have considered carefully whether the implementation bodies who would take the lead in selecting forest design and tree species and the outside agency that would implement acceptance inspection had sufficient capacity. At the same time, JICA needed to confirm the Project's status and prospects for realizing the Project's effects through progress reports from the executing agency and mid-term supervision, and consider taking measures such as dispatching additional experts to promote the Project's effects if necessary.

(3) Based on the differences in erosion control effects by forest type, it is necessary to set the afforestation area and consider the executing agency's request for a change in the Project plan.

At the time of the appraisal, erosion control capability, which is the main effect of afforestation, was regarded as the same regardless of the forest type (Protection Forest, Economic Forest, Timber Forest, or Mountain Closure), and any afforestation method would bring about the same result. Based on this perception, JICA approved the project plan submitted by the Chinese side and a request for changing the forest area and type during the project implementation. In reality, erosion control effects differ by forest type. At the time of the appraisal, differences in ecological effects by forest type should have been examined. In addition, any change in the project plan should have been considered on the basis of the differences in the effects. Also from the viewpoint of the Project's sustainability, governmental policies and prospects on ecological conservation and logging plans should have been confirmed at the time of the appraisal.

END.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs		
Afforestation	290,281 ha	313,378 ha
Economic Forest	20,903 ha	21,764 ha
Protection Forest	269,379 ha	291,614 ha
Protection Forest I	47,575 ha	49,716 ha
Protection Forest II	73,518 ha	88,902 ha
Mountain Closure	152,996 ha	152,996 ha
Afforestation Material		
Seedling and Plants	324.10 million	322.37 million
Fertilizer	29,003 ton	N/A
Pesticide	589 ton	N/A
Vehicle	3 sets	As planned
Office Equipment	275 pieces	244 pieces
Environment Monitoring Tools	48 pieces	44 pieces
Training Center	2,000 m ²	2,171 m ²
Training		
Training for Managers/Engineers	N/A	618 persons
Technical Training for Farmers	90,422 persons	100,781 persons
2. Project Period	March 2004 -October 2009 (68 months)	March 2004-March 2012 (92 months)
3. Project Cost		
Foreign currency	15 million yen	7,484 million yen
Domestic currency	10,962 million yen (766.6 million yuan)	3,331 million yen (240.8 million yuan)
Total	10,997 million yen	10,815 million yen
Yen loan	7,536 million yen	7,484 million yen
Exchange rate	1 yuan=14.3 yen (as of September 2003)	1 yuan=13.834yen (the average rate used by the executing agency 2004-2013)

Attachment: Growth Situation in the Project Sites

1. Economic Forests (Species: Oil-tea Camellia, Walnut, Yellow Peach)

In all the species in Economic Forests, the preservation rate exceeded 95%. The heights, diameters, and base circumferences were normal for the tree age. The planted varieties were appropriate for the environment. No major damage by forest diseases or pests was observed. In all the sites, tree planting, fertilization, and maintenance were done properly.

Measured Data of Economic Forests

Species	Tree Age (year)	Preservation Rate (%)	Height (m)	Tree Crown (m)	Base Circumference (cm)	Density (#of tree/mu)	Project Site	Harvest /note
Oil-tea Camellia	3	95 %	1.3	0.8	2.6	130	Tongcheng	2019~
	5	95 %	1.8	1.3	4	130	Chibi	2016~
Walnut	5	100 %	3.5	3.1	9.6	33	Laohekou	2017~
Yellow Peach	7	95%	2.1	3.7	9.2	37	Laohekou	Started/ converted from Sichuan Pepper

2. Protection Forest (Species: Slash Pine, Chinese Fir, Poplar, Bamboo)

The planted varieties were selected properly. The preservation rate of all the species exceeded the target rate of 80%. The Project plan aimed to enrich biodiversity, and recommended making mixed forests by planting more than one species. However, all the sites except one were simple forests. The implementation bodies that took initiative in selecting varieties avoided mixed forests that cost more for planting and maintenance than simple forests. Since most of the sites are simple forests, the project forests have a higher chance of spreading the damage in case of diseases and pests.

2-1 Slash Pine

The planted varieties were suitable to the mountain area. Preservation rate exceeded 90%, and to some extent growing normally. Because the trees were planted higher than the appropriate density of 167 plants/mu, some negative impacts in growth status were observed. If the appropriate density was supposed to be 100%, the one in the Project sites was 177%. Because of the high density, the growth of trees is inhibited. The evaluation team visited a model forestry farm in the province and has taken data of 12 year old forests to find the normal growth level in the climate. In comparison with the data, the Project site where trees planted 10 years ago, the density was at 177% to the normal level, the trees' average circumference was at 69%, height at 56%, stock volume at 68% to the normal level of 100%. Also the Project site at seven year old, the forest density was at 133%, height and

circumference were about 60%, and volume 16% to the model farm.

Measurement Data of Protection Forest (Species: Slash Pine Mountains)

Tree Age (year)	Preservation Rate (%)	Height (m)	Circumference (cm)	Density (#of tree/mu)	Stock Volume (m ³ /mu)	Project Site	Note
10	90 %	6.9	10.7	296	10.41	Gucheng	
7	90 %	6.8	9.2	222	2.45	Gucheng	Fir:Pine 1:1 mixed
12	100 %	12.2	15.6	167	15.23	Gucheng Jiushan Forestry Farm	Model Farm

2-2. Chinese Fir

The planted varieties were suitable to the mountain area. Preservation rate exceeded 90%. At all the Project sites, trees were planted 133% to 277% to the normal density of 167 plants/per mu. The high-density deterred growth of the trees especially in circumference, which affects to the price of timber the most. Usually, in order for gaining the maximum economic effect, the forest density should be reduced to 100 plants/mu at the first thinning period, which is seven to eight years after planting. Because of the high density, it will take 20 years or more till the trees grow to the size for timbers. The young trees nursing condition differed by the sites. At most of the sites, weeds and shrub trees were not removed from the forest beds, and necessary maintenance and nursing were not executed.

The high planting density deterred growth of trees in circumference. Timber sales price fixed by the thickness of the diameter. Thus, it is predicted that Protection Forests where trees were planted in high density would yield lower economic effectiveness.

Measurement Data of Protection Forest (Species: Chinese fir)

Tree Age (year)	Preservation Rate (%)	Height (m)	Circumference (cm)	Density (#of tree/mu)	Stock Volume (m ³ /mu)	Project Site	Note
7	90 %	6.5	8.5	222	2.453	Gucheng	Fir:Pine 1:1 mixed
7	100 %	6.5	8.3	320	5.824	Gucheng	Average of 3 sites
7	90 %	5.0	5.7	400	2.920	Yangxin	
7	95 %	7.6	7.9	462	7.900	Chibi	
10	91 %	7.8	8.8	296	6.186	Yangxin	
35	80 %	28.3	26.9	70	31.647	Gucheng	Model Farm

2-3. Popular

One of the Project site was damaged by tornado, and the preservation rate was at 60%. Except the site, the preservation rate exceeded 80%. At some sites, plantation density was 30 trees per mu, and did not satisfy the minimum density of 41 trees per mu. Other than that, growth status and maintenance condition were fine. Among the 6 varieties planted in the field

study sites, some were slow-growing varieties. Most of the sites were simple forests, and the forests have higher risk of extermination in case of diseases or pests

Measurement Data of Protection Forest (Species: Popular Mountain)

Tree Age (year)	Preservation Rate (%)	Height (m)	Circumference (cm)	Density (#of tree/mu)	Stock Volume (m ³ /mu)	Project Site	Variety
10	90 %	18.3	15.3	74	10.00	Tongcheng	ZhongJia 7
10	90 %	14.5	13.6	74	6.92	Gucheng	Zhonglin 46

Measurement Data of Protection Forest (Species: Popular Plain)

Tree Age (year)	Preservation Rate (%)	Height (m)	Circumference (cm)	Density (#of tree/mu)	Stock Volume (m ³ /mu)	Project Site	Variety
6	80 %	18.1	21.0	56	14.78	Jianli	ZhongJian3
8	90 %	20.0	21.5	40	11.96	Jianli	ZhongJian3
9	85 %	22.1	23.4	40	15.25	Jianli	ZhongJian3
9	90 %	13.9	18.2	28	4.51	Laohekou	Nanlin 895
8	60 %	15.7	20.9	28	6.62	Laohekou	Nanlin 895 Damaged by tornado
8	85 %	15.7	20.0	42	9.05	Laohekou	Oumei 107
8	80 %	13.8	15.4	49	5.84	Laohekou	Oumei 107
9	85 %	13.3	15.0	37	3.98	Laohekou	Liaohe

2-4. Bamboo

Bamboo seedlings planted at 33 plants/mu in 2006, and they multiplied to 160 plants/mu in eight years after the planting. Another site of Moso-bamboo, seedlings were transplanted at 50 plants/mu in 2005, increased to 150 plants/mu. The bamboo forests were not thinned to the appropriate level, and did not grow enough to be cut and used as industrial materials.

3. Mountain Closure

Before the implementation of Mountain Closure, farmers cut the pine and oak trees for fuel, thus the growth of trees in the forests were prevented. After the implementation, new forest stations set by state-owned forest farms, have been managing the closure. After five year of closure, the forest density improved from 0.2 to 0.6—0.7, and ecological effects were confirmed. The stations have been closing the area by building fence and signs. Economic effects can be promoted by pruning trees in good growth.

END.