

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

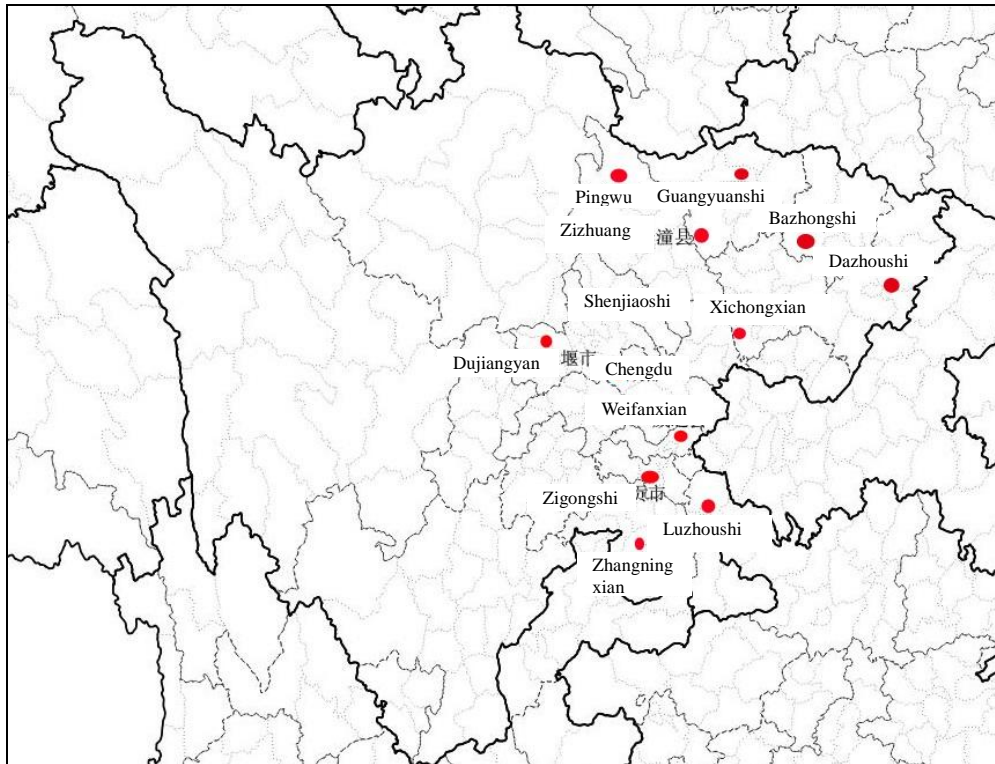
Since its founding in 1949, China has made national land afforestation as one of its basic policy programs, developing arrangements and carrying out large-scale afforestation projects. However, to satisfy demand for wood amid economic growth, the country has for a long time been cutting down

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.

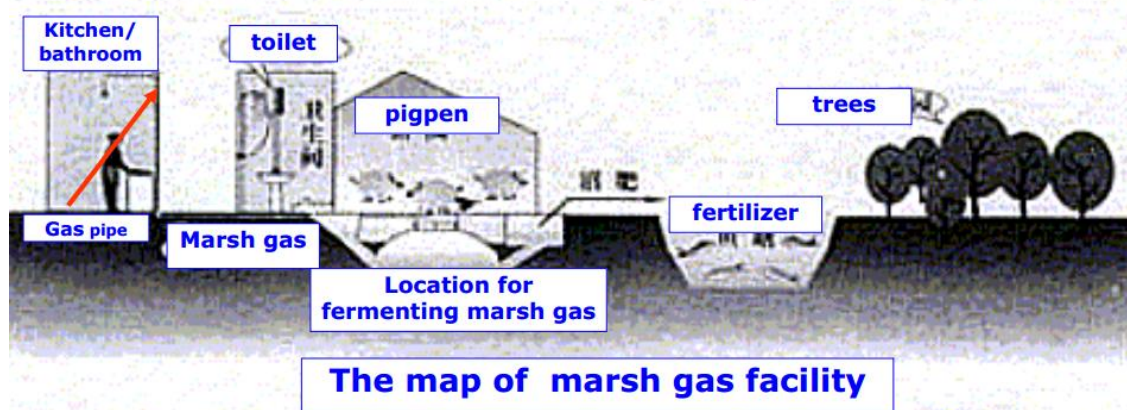
- 1) Protection forests: Intended mainly to conserve water and soil, protect water sources, and preserve farmland.
- 2) Mountain closures: Primeval forests where people are prohibited from entering in the hope that it will help trees and plants grow by themselves.
- 3) Economic forests: Intended to raise 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] <ul style="list-style-type: none"> • 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

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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 (Duijiangyan 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 Settlement	24,880 15	33,187 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