Ex-Post Project Evaluation 2015: Package IV-1

(Guatemala, Nicaragua)

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JAPAN INTERNATIONAL COOPERATION AGENCY

GLOBAL GROUP 21 JAPAN, INC.

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Republic of Guatemala

FY2015 Ex-Post Evaluation of Japanese Grant Aid Project
"Project for the Promotion of Productive Activities with the Use of Clean Energy in the Northern Villages of the Republic of Guatemala"

External Evaluator: Hiromi Suzuki S. Global Group 21 Japan, Inc.

0. Summary

The Project for the Promotion of Productive Activities with Use of Clean Energy in the Northern Villages of the Republic of Guatemala (hereinafter referred to as "the Project") was implemented with the aim of improving the access of local residents to electricity by constructing micro hydroelectric power plants and distribution facilities in three sites located in the poorest area of Alta Verapaz Department in Guatemala where electrification by extension of the electricity grid was difficult, as well as by providing technical assistance for the operation and maintenance of these facilities and to promote productive activities using electricity, thereby contributing to the promotion of productive activities and the improvement of livelihood.

The Project has been relevant to Guatemala's development policies of proceeding with electrification by independent systems utilizing renewable energies in areas to which extension of the electricity grid is difficult; to Guatemala's development needs in terms of a strongly required electrification in Alta Verapaz Department because the electrification rate of this department has been the lowest in the country; and to Japan's ODA policy of assisting developing countries to promote reduction of CO_2 emissions and other measures to combat climate change. Therefore, the relevance of the Project is high.

Although the project cost was exactly as planned, the project period exceeded the plan. Therefore, the efficiency of the Project is fair.

Both power generation and power consumption have been steadily increasing. The targets in terms of number of electrified households and electrified persons have been achieved and the target in terms of household electrification rate has largely been achieved. Although the peak load has not reached the target, it is expected to increase in the coming years due to the increasing demand for electricity. The intended impacts have been realized in regard to improvement of the educational and healthcare environments and improvement of living conditions. In addition, the Project has contributed to improve the quality of living through electrification and to the empowerment of women through productive activities using electricity. Therefore, the effectiveness and impact of the Project are high.

The conditions of both the power generation and distribution facilities are generally good although some require repair or the replenishment of spare parts. The Development Associations are in charge of the electric enterprise as well as the operation and maintenance of the facilities in their

respective villages. One of them has no problems at all, another one has some problems with the financial aspects and remaining one has some problems with the institutional, technical and financial aspects of operation and maintenance. It is necessary for the Ministry of Energy and Mines which is the implementing agency, to provide active assistance for the Development Associations of these three villages. Therefore, the sustainability of the Project is fair.

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

1. Project Description

Project Location

Power Generation Facility (Seasir)
The penstock entering the facility can be seen in the front

1.1 Background

Since 2004, the Government of Guatemala has been promoting sustainable development, including the creation of employment through the use of renewable energies and poverty reduction. The national electrification rate in 2008 when the Project was planned was 83%. In contrast, the electrification of poor areas in the Northern Region has been extremely slow due to the difficulty of extending the power grid to those mountainous areas dotted with small villages. The electrification rate of Alta Verapaz Department where the three sites of the Project are located was 41% which was the lowest in the country. Even though the National Institute for Energy Development (*Instituto Nacional de Desarrollo Energético*; hereinafter referred to as "INDE") who is in charge of electrification in rural areas was proceeding with the rural electrification through the construction of distribution lines, it was expected that electrification through the extension of distribution lines could only cover up to 90% of the national land area of Guatemala, making independent electricity supply systems essential for the electrification of the remaining 10%. In Alta Verapaz Department, since 2004, other donors[1] had been implementing various projects for the selection of priority sites for

[1] In 2004, the United States Agency for International Development (USAID) conducted the "*Social Study on 74 Villages in Poverty Areas of the Northern Region*". The number of target villages was reduced from 74 to 50 villages in 2005 by the "*Renewable Energy Programme under the Global Village Energy Partnership for Guatemala*" of the United National Development Programme (UNDP). This was followed by the formulation of the "Productive Uses of Renewable Energy (PURE)" in 2007. In 2008, the "*Energy Project for Poverty Reduction in Rural Areas of Guatemala*" of the Inter-American Development Bank (IDB)" selected 10 target villages for electrification from among these 50 villages and the Feasibility Study for three priority sites (Las

rural electrification and suitable projects through the Solar Foundation[2], a local NGO. The plan of the Project was based on the findings of the "*Feasibility Study on Micro-Hydropower Plants in Las Conchas, Seasir and Jolom Ijix sites in Alta Verapaz Department*" which was conducted by the Inter-American Development Bank (hereinafter referred to as "IDB") in 2008 at the three target sites of the Project. Even though electrification using renewable energies as solar, wind power and hydropower was thought to be effective to facilitate rural electrification, especially electrification using independent systems, the high cost of these alternatives posed a major financial challenge for the government. The Project was implemented as a response by the Government of Japan to a request for a grant aid made by the Government of Guatemala for the construction of micro hydroelectric power plants and distribution network in three unelectrified villages located in the poor areas of the Northern Region and to provide assistance for productive activities using electricity, thereby contributing to the livelihood improvement of local residents.

1.2 Project Outline

The objective of this Project is to improve the access of local residents to electricity in three sites (Las Conchas in the city of Chahal, Seasir in the city of Cahabón and Jolom Ijix in the city of Panzós) located in the poorest area of Alta Verapaz Department in Guatemala, where electrification through connection to the electricity grid was difficult by constructing micro hydroelectric power plants and distribution facilities, as well as by providing technical assistance for the operation and maintenance of these facilities and the promotion of productive activities using electricity, thereby contributing to the promotion of productive activities and improvement of the livelihood in the target villages.

E/N Grant Limit or G/A Grant Amount/Actual Grant Amount		1,003 million yen/1,003 million yen
Exchange of Notes Date Grant Agreement Date		January, 2010 January, 2010
Implementing Agency		Ministry of Energy and Mines (Ministerio de Energía y Minas, MEM)
Project Completion Date		March, 2014[3]
Project Implementation	Main Contractors	Calsa S.A. & Silva Equipos de Construcción S.A Joint Venture

Conchas, Seasir and Jolom Ijix) which are the target villages of the Project was carried out in the same year.

[2] The Solar Foundation is a local NGO in Guatemala which is implementing renewable energy and environmental conservation projects in the country. It is active nationwide with the assistance of such international organizations as the UNDP, the Organization of American States, and private enterprises, etc.

[3] The Project completion date is considered to be March 2014, when the technical assistance was completed. The starting of operations of the power generation and distribution facilities was July 2012.

System[4]	Main Consultant[5]	NEWJEC Inc. (*Including technical assistance)
	Procurement Agent	Japan International Cooperation System
Basic Design		November, 2009
Detailed Design		August, 2010
Related Projects		[Other Organizations] USAID: "Social Study on 74 Villages in Poverty Areas of the Northern Region" (2004) UNDP: "Productive Uses of Renewable Energy (PURE) in Guatemala" (2007) IDB: "Feasibility Study on the Micro-Hydropower Plants in Las Conchas, Seasir and Jolom Ijix Sites in Alta Verapaz Department" (2008)

2. Outline of the Evaluation Study

2.1 External Evaluator

Hiromi Suzuki S, Global Group 21 Japan Inc.[6]

2.2 Duration of Evaluation Study

The ex-post evaluation study for the Project was conducted over the following period.

Duration of the Study: October 2015 to February 2017

Duration of the Field Study: February 28 to March 19, 2016 and June 20 to 27, 2016

3. Results of Evaluation (Overall Rating: B[7])

3.1 Relevance (Rating: ③[8])

3.1.1 Relevance to the Development Plan of Guatemala

The "*National Development Plan 2007-2013*" of Guatemala at the time of the planning of the Project (2009) emphasized the promotion of social development based on the needs of indigenous people as well as the poor with the aim of achieving a nation building through dialogue. The basic policies of the Plan included reduction of poverty and economic gap, and improvement of social infrastructure. The Ministry of Energy and Mines (hereinafter referred to as "MEM") who was the implementing agency of the Project, prepared the "*Energy Policy 2008-2015*" based on this Plan, adopting such targets as enhanced production, employment creation and poverty reduction in local

[4] The Project was implemented under the procurement agent system of JICA's Program Grant Aid for Environment and Climate Change. Under this system, a non-profit corporation with professional knowledge and know-how of international procurement who can act as a neutral third party plays the role of the "procurement agent" for the government of the recipient country based on a contract with the said government to manage and supervise a series of procurement processes concerning the selection and procurement of equipment and services along with fund management. The main contractor is a local corporation.

[5] The local consultants (*Alvarado & Monzón Ingeniería Civil, S.A.* (hereinafter referred to as AIMSA) and Solar Foundation) worked under a contract with the Japanese main consultant.

[6] Suzuki is affiliated to IC Net Limited. In this ex-post evaluation she participated as a reinforcement of Global Group 21 Inc.

[7] A: Highly satisfactory; B: Satisfactory; C: Partially satisfactory; D: Unsatisfactory.

[8] ①: Low; ②: Fair; ③: High.

areas through the use of energy. The concrete activities envisaged included electrification with renewable energy. For mountainous areas where the extension of distribution lines was difficult, the Global Village Energy Partnership Board[9] of the UNDP and the World Bank took the initiative in the planning of independent electrification using renewable energies, including micro hydroelectric power generation. In addition, in 1998, the "*Rural Electrification Program*" was prepared as a program devoted to rural electrification. The target of this plan was to achieve a national electrification rate of 90% by 2005 through the realization of electrification for 1.5 million new beneficiaries with the INDE heading the electrification drive in those rural areas where investment by a private enterprise was difficult. Therefore, the relevance of the Project to the development plans and policies of Guatemala is high.

The relevant development plan of Guatemala at the time of ex-post evaluation is the "*National Development Plan 2014-2032*". The relevance of the Project to this plan is high as the plan calls for (i) the reduction of economic gap and rectification of poverty and extreme poverty, (ii) comprehensive rural development (promotion of improvement of the necessary infrastructure for productive activities in rural areas) and (iii) sustainable economic development (response to climate change and promotion of renewable energies, including micro hydroelectric power, wind power and biomass). The "*Energy Policy 2013-2027*" as the strategy for the energy sector adopts sustainable development as its objective and lists five pillars of development, ranging from energy saving and the effective use of energy to reduction of wood as fuel to improve the national electrification rate from 85.6% to 95%.[10] Moreover, the "*Rural Electrification Program 2012-2016*" calls for the electrification of 28,000 households to improve the living conditions of poor households in rural areas. The actual measures envisaged is facilitation of the connection of rural areas to the existing electric power system, and proceeding with the development of independent power supply systems utilizing micro hydroelectric power generation and other renewable energy sources.

As described above, the Project was consistent with such targets as sustainable development, elimination of poverty and diversification of energy sources through the use of renewable energy called for by the National Development Plan, Energy Policy and Rural Electrification Program at the time of both ex-ante evaluation and ex-post evaluation. Therefore, the relevance of the Project to the development policies is high.

3.1.2 Relevance to the Development Needs of Guatemala[11]

While the national electrification rate of Guatemala in 2008 was 83%, the electrification of mountainous areas with scattered villages as well as poor areas in the Northern Region which were

[9] The Global Village Energy Partnership is a 10 year program established in 2002 by the UNDP and the World Bank. It was composed of 70 member countries; and it aimed to promote the provision of modern energy services to those areas with low access to energy services.

[10] Based on MEM's "*Energy Policy 2013-2027*".

[11] The sources are reference materials provided by JICA for the relevance at the time of project planning, and MEM's 2015 Annual Report for the relevance at the time of ex-post evaluation.

difficult to reach by the extension of the power grid lagged behind. The electrification rate of Alta Verapaz Department, the target area of the Project inhabited by many indigenous people, was the lowest among all departments at 41%. Similarly, the poverty ratio of Alta Verapaz Department in 2008 was very high at 80% compared to the national poverty ratio[12] of 51%. In these poor areas of the Northern Region, the introduction of independent electricity sources using such renewable energies as solar power, wind power and hydroelectric power was necessary to facilitate electrification. Because of shortage of funds, however, the prospect was that approximately 10% of households in these areas would remain unelectrified even after the implementation of the "*Rural Electrification Program*". Therefore, there was a strong need for the Project.

At the moment of the ex-post evaluation, it was found the national electrification rate had improved to 90% in 2014. The electrification rate in Alta Verapaz Department had slightly improved to 44% however it remains as the region with the lowest electrification rate in the country due to the geographical conditions of this department which make electrification through extension of the power grid difficult.

As can be seen, the electrification rate of Alta Verapaz Department was the lowest in the country at the time of both ex-ante and ex-post evaluation. Moreover, because of the geographical conditions, etc., there is a strong local need for electrification through independent systems using renewable energy. Therefore, the relevance of the Project to Guatemala's development needs is high.

3.1.3 Relevance to Japan's ODA Policy[13]

At the time of planning, the priority areas for Japan's ODA for Guatemala were rural development, sustainable economic development and establishment of democracy with the objective of alleviating the gap between indigenous and non-indigenous people and between urban and rural areas. The Project has been particularly relevant to rural development and sustainable economic development while also contributing to decrease the gap between indigenous and non-indigenous people.

In addition, since 2008, as part of its overall efforts to combat climate change, Japan has been providing assistance to developing countries engaged in the reduction of emissions and other measures to combat climate change, as well as to those developing countries which are vulnerable to the adverse impacts of climate change. In fact, in 2008, Japan announced the establishment of the Program Grant Aid for Environment and Climate Change as a form of Grant Aid, in order to support

[12] Ratio of population with equivalent disposable income below the poverty line (6,574 quetzal, approximately 78,000 yen at the time of planning, and 10,218, quetzal, approximately 165,000 yen, at the time of ex-post evaluation) determined as the annual cost of basic food consumption (Guatemala National Statistics Institute). Exchange rates at the moment of planning was 1 quetzal=11.89 yen (according to Preliminary Study Report, June 2009), and 1 quetzal=16.110 yen at the moment of the ex-post evaluation (according to JICA exchange rates as of December 2015, JICA website).

[13] Based on the results of the ODA Policy Consultation Meeting held in June, 2008 between the ODA Task Force for Guatemala of the Ministry of Foreign Affairs, Japan and the Government of Guatemala (Source: ODA Data Book for Guatemala, 2009).

these efforts. This Project was implemented under this new scheme, from where it is possible to see that the Project which aimed at promoting the use of renewable energy was in conformity with Japan's ODA policies.

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

The outputs of the Project were the development of micro hydroelectric power plants and distribution facilities; technical assistance for the operation and maintenance of these facilities, and also for the promotion of productive activities using electricity.

Micro hydroelectric power plants and distribution facilities

Table 1 shows the planned and actual output of the micro hydroelectric power plants and distribution facilities.

The current generating capacity (power output) is as planned at each site even though some changes took place, including a change in the location of the power generation facilities at Las Conchas site and minor changes of the headrace, penstock and length of the distribution line at each site (Table 1). All the changes were relevant from the technical point of view and were finalized through due procedure based on the E/N and G/A.

As for the change in location of the power generation facilities at Las Conchas site, because part of the originally planned facilities was located inside a national park, the location of these facilities was moved approximately 50m upstream in order to minimize noise and any adverse impacts on the scenery of the national park.

Technical assistance

As part of the Project, four technical assistance activities shown in Table 2 were implemented as planned for the purpose of establishing a proper operation and maintenance system for the power plants, distribution facilities and electricity business; securing the financial as well as technical capacity to manage these facilities, and creating organizations to conduct productive activities using electricity to improve livelihood.[14]

[14] For the technical assistance, the Solar Foundation, a local NGO which had been working continuously since 2004 in the Project sites, acted as the local consultant (see "1.1 Background").

Table 1 Micro Hydroelectric Power Plants and Distribution Facilities (Plan and Actual)

	Las Conchas	Seasir	Jolom Ijix
Water intake weir	NA	No1: Height 1.3m, Length 5.5m No 2: Height 0.4m, Length 2.4 m No. 3: Height 0.4m, Length 1.2m	Height 1.05m, Length 13.8m
Intake	Width 2.0m, Height 1.4m	NA	NA
Headrace	Box culvert Length 684m, Width 2m, Height 1.4m (Length after change 906m)	No 1: PVC pipe Length 626m, Inner diameter 30cm (Length after change 590m) No 2: PVC pipe Length 498m, Inner diameter 30cm No 3: PVC pipe Length 765m, Inner diameter 30cm	PVC pipe Length 761m Inner diameter 46cm
Open Channel	Length 534m Width 2m Height 1.4m	NA	NA
Head tank	Width 2.56m Height 2.7m Length 13.6m	Width 2.5m Height 1.4m Length 5.8m	Width 5.0m Height 3.0m Length 20.0m
Penstock	Steel pipe: Diameter 1,350mm Length 6.8m (Length after change 3.3m)	PCV pipe: Diameter 200mm Length 1,120m Steel pipe: Diameter 200mm Length 151m (Length after change 269m)	PCV pipe: Diameter 250mm Length 148m (Length after change 184.5m) Steel pipe: Diameter 250mm Length 158m (Length after change 80.7m)
Power house	Total floor space: 58.7m^2	Total floor space: 30m^2	Total floor space: 36m^2
Water Turbine Generator	Propeller turbine (Kaplan turbine) 1 unit	Pelton turbine 1 unit	Pelton turbine 1 unit
Power Output	94kW	59kW	98kW
Tailrace	Length 15.5m Basin: Width 3.0m, Length 4.0m Height 3.15m	Length 7.2m	Length 8.8m
Power distribution installations	High-voltage electric wire system 13.8/7.97kV Length 21.0km Low-voltage electric wire system 240/120V Length 13.40km (Length after change 10.45km)	High-voltage electric wire system 13.8/7.97kV Length 7.37km (Length after change 5.95km) Low-voltage electric wire system 240/120V Length 6.0km (Length after change 3.70km)	High-voltage electric wire system 13.8/7.97kV Length 12.88km (Length after change 11.50km) Low-voltage electric wire system 240/120V Length 9.78km (Length after change 8.59km)

Source: Reference materials provided by JICA and findings of the interview with and materials provided by the MEM.
With the exception of those parts indicated with “length after change” the actual output was as planned.

Table 2 Planned Technical Assistance and Actual Results

Plan	Actual
Activity 1: Establishment and strengthening of a proper operation and maintenance system for the power plants and distribution installations Establishment and strengthening of an operation and maintenance system; establishment of operation and maintenance systems for civil engineering facilities, hydroelectric power generation and distribution installations; periodic review of operation and maintenance methods	As planned
Activity 2: Establishment and strengthening of a proper management organization for the electricity business Establishment of a business management systems and methods; electricity demand forecast and electricity supply management; formulation of plans to increase electricity demand and effective use of electricity; development of a capable organization and strengthening of organizational functions	As planned
Activity 3: Strengthening and establishment of the capacity improvement of activities related to the improvement of livelihood Appointment of a leader and members of a livelihood improvement group; convening of workshops on participatory development; convening of seminars on improvement of knowledge of basic living and livelihood; environmental conservation and management activities of the basin; planning and convening of livelihood improvement workshops; implementation and evaluation of livelihood improvement mini-projects	As planned
Activity 4: Strengthening, establishment and capacity improvement of organizations for productive activities aiming to improve livelihood using electricity Appointment of a leader and members of a production group; analysis of the present situation of local resources; examination of viable concrete productive activities; capacity improvement in preparation for corporatization; formulation of a productive activities plan and preparation for its implementation	As planned

Source: Documents provided by JICA, Solar Foundation, and interviews conducted to consultants.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The Project was implemented using the procurement agent method. As the grant limit agreed in the E/N and G/A was fully disbursed to Guatemala, no funds had to be reimbursed to the Japanese side on completion of the Project[15]. Because of this, both the planned and actual project costs for the Japanese side were the same as the grant limit of 1,003 million yen. From the project cost for the Japanese side, 194.63 million yen (actual) was spent for the technical assistance.

The project cost for the Guatemala side was 957 million quetzal[16] (approximately 111 million yen) at the time of planning. The Guatemala side was mainly responsible for the payment of value added tax and other taxes, installation work for the low voltage distribution lines and improvement

[15] The fund that remained was distributed to the Electricity Administration Unit of the Development Association at each site to be used as part of the budget for the procurement of spare parts.

[16] 1 quetzal=11.89 yen (June 2009, Preliminary Study Report).

of the access road to each site. The actual amount was not available; however the scope of work remained the same.

3.2.2.2 Project Period

The planned project period was from January 2010 to May 2013 (41 months) but the actual project period was stretched from January 2010 to March 2014 (50 months, 122% of the planned period), longer than planned.

The actual length of the delays or extensions and the reasons by project stage are described below.

- Up to the signing of the contractor agreement: After signing of the G/A, the plan was to immediately sign the contracts with the procurement agency and the consultant. However, it actually took over 6 months to sign the contract with the consultant. In addition, the period from the tender to the signing of the contractor agreement was seven months instead of the planned five months, with the contractor agreement being signed in March 2011.
- Civil engineering and construction work, procurement and installation of equipment and distribution line installation[17]: The actual period to complete this work was 16 months compared to the originally planned 13.5 months. Construction and installation of the generation and distribution facilities at each site were completed in July 2012, starting operations at the same time. The main reasons for the extension of this process were (i) a long time was required for the transportation and installation of the equipment at the Seasir and Jolom Ijix sites as these two sites have difficult access, and (ii) a long time was required to complete customs clearance for the generators imported from Germany and Austria.
- Technical assistance: Because of the delay in signing the contractor agreement, starting of technical assistance had to be delayed until April 2011. However, the actual period of the technical assistance itself was 36 months as originally planned and it ended in March 2014.

Based on the above, it is safe to conclude that the generating capacity (power output) at each site is as planned despite some changes regarding the length of the headrace, penstock and/or distribution line at each site.

Although the project cost was exactly as planned, the project period exceeded the plan. Therefore, the efficiency of the Project is fair.

[17] At the time of planning, starting time of each process differed from one site to another. However, everything was actually implemented in parallel.

Table 3 Planned and Actual Values of the Operation and Effect Indicators

		Target	Actual			
		2016 Target to be achieved (3 years after project completion)	2012 Starting operations	2013 1 year after starting operations	2014 2 year after starting operations	2015 3 year after starting operations (target achievement rate)
MAIN INDICATORS						
1 Total number of electrified households		1,017 households	945	984	977	1,155 (114%)
Total number of electrified person		Approx. 6,200	4,862	5,671	6,279	7,173 (116%)
Breakdown	Las Conchas	416 households 2,500 persons	397 1,985	411 2,466	424 2,968	433 3,031
	Seasir	204 households 1,300 persons	209 1,250	218 1,430	217 1,430	362 2,200
	Jolom Ijix	397 households 2,400 persons	339 1,627	355 1,775	336 1,881	360 1,942
2 Household electrification rate		100%	81%	89%	91%	90 %
Breakdown	Las Conchas	100%	100%	100%	100%	100%
	Seasir	100%	96%	100%	100%	92%
	Jolom Ijix	100%	61%	75%	77%	78%
3 Peak Load (kW)		251 kW	81kW	93kW	106kW	125kW
Breakdown	Las Conchas Ratio to planned peak load	94 kW	28kW	32kW	45kW	50kW (53%)
	Seasir Ratio to planned peak load	59 kW	28kW	32kW	32kW	40kW (68%)
	Jolom Ijix Ratio to planned peak load	98 kW	25kW	29kW	29kW	35kW (36%)
AUXILIARY INDICATORS						
4 Plant utilization rate (%) Las Conchas Seasir |Jolom Ijix		No target values are set as these were added for the ex-post evaluation	- 37% 26%	41% 44% 67%	49% 56% NA	52% 68% NA
5 Operating hours (hrs/year) Las Conchas Seasir |Jolom Ijix			- - 3,906	7,560 8,734 8,435	8,420 8,704 7,979	8,385 8,739 8,704
6 Unplanned plant outage by cause (hrs/year)						
Lass Conchas	a. Equipment failure b. Human error c. Other causes (natural disaster, etc.)		- - -	1,104 9 72	55 41 68	25 30 148
Seasir	a. Equipment failure b. Human error c. Other causes (natural disaster, etc.)		-	0	26	0
Jolom Ijix	a. Equipment failure b. Human error		508 0	168 23	625 19	5 13
7 Planned plant outage for maintenance (hrs/year)						
Breakdown	Las Conchas		-	15	80	172
	Seasir		-	26	30	21
	Jolom Ijix		6	24	24	24
8 Annual power generation (kWh/year)						
Breakdown	Las Conchas		-	336,813	406,502	429,335
	Seasir		190,150	226,512	291,128	353,046
	Jolom Ijix		221,105	572,485	NA	NA
9 Annual power consumption amount (kWh/year)						
Breakdown	Las Conchas		-	43,759	66,574	83,105
	Seasir		6,988	18,752	51,465	65,264
	Jolom Ijix		18,356	47,741	41,141	47,304
10 Annual Power consumption per household (kWh/household)						
Breakdown	Las Conchas		-	106	157	192
	Seasir		33	86	237	180
	Jolom Ijix		54	135	123	131

Source: Questionnaire survey and interviews to each of the Electricity Administration Units.
2: Household electrification rate = (number of electrified households ÷ number of households enrolled with the Development Association) x 100
4: Plant utilization rate = annual power generation (kWh) ÷ rated output (kW) x annual operating hours (hrs) x 100
* On the ex-ante evaluation document, May 2013 was set as the project completion date (completion of technical assistance) and the timing of ex-post evaluation was set for 2016, three years after project completion. In this ex-post evaluation, the level of achievement of the project effect indicators was judged based on the actual values in 2015 which was three years after completion and starting of operations of power generation facilities in 2012. In setting the targets for 2016 of the number of households and population for the electrified households and electrified persons indicators respectively, these are the same as the values set in 2006.
** The years in this table are calendar years (i.e. from January to December).

3.3 Effectiveness[18] (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

The assumed effect of the implementation of the Project was "improved residents' access to electricity". To quantitatively assess this effect, three main indicators were established at the time of ex-ante evaluation. These are "number of electrified households and number of persons", "household electrification rate" and "peak load". In addition to these, several auxiliary indicators used as reference data relating to the operation of facilities were introduced (see Table 3).

Achievement level of the main indicators

1. Number of electrified households and persons: At the time of planning, one target value was set for the sum of the three sites, with 1,017 households and approximately 6,200 persons for 2016. The actual values three years after the starting operations in 2015 were 1,155 households and 7,173 persons, exceeding the planned values by 14% and 16% respectively. At Las Conchas, 12 villages were electrified under the Project as planned.[19] At Seasir, the number of electrified villages was three as planned until 2014, but one village was added in 2015, bringing the number of electrified villages to four at the time of the ex-post evaluation. At Jolom Ijix site, electrification commenced at nine villages and two further villages were electrified in June 2015, resulting in a total number of 11.

2. Household electrification rate[20]: The household electrification rate at Las Conchas and Seasir in 2015, three years after project completion, was as high as 100% and 92% respectively, mostly achieving the target. On the other hand, the rate at Jolom Ijix was much lower at 78%, partly because of a large number of non-payers and partly because of the non-completion of service connection to some households in two newly joined villages. The average rate for the three sites of 90% means that the target was basically achieved. According to interviews with municipal

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18 The effectiveness is rated in consideration of not only the effects but also the impacts.

19 At the time of planning, the number of villages to be electrified was set at 11 but one village has since split into two, resulting in a total number of electrified villages of 12, although there are no changes in the target households. At the Las Conchas site, a private mobile phone service provider has installed a mobile phone tower and has become a new business user of the locally generated electricity.

20 The household electrification rate is usually the proportion of electrified households in the total number of households. In case of this Project however, the target households for electrification were those which have paid the membership fee to the Development Association of each village. As such, the household electrification rate in the Project was defined at the time of planning as the electrification rate of the households that became members of the Development Associations. To be more precise, the total number of households functioning as the denominator is the number of member households of each Development Association, excluding non-member households and/or those households which dropped out during the project period from the scope of calculation. Meanwhile, the electrification rate record includes those households to which electricity supply has been suspended due to non-payment of the electricity bill for more than three months. Therefore, any percentage short of 100% represents non-paying households plus households waiting service connection in a newly joined village. According to the findings of the interview survey with the Electricity Administration Unit of the Development Association for each site, the number of non-member households or households dropping out from the Association is extremely limited and there have been many cases of households which were not interested in joining the Association at the beginning of the Project but have later joined after the Project started.

officials, the electrification rate of those municipalities to which the target villages of the Project belong in 2015 was 20% for Chahal (Las Conchas), 44% for Panzós (Jolom Ijix) and approximately 35% for Cahabón (Seasir). As the electrification rate at each target site of the Project is higher than the electrification rate of the corresponding municipality, the Project has contributed to improvement of the electrification rate in these sites.

3. Peak load: The target achievement rate is low at all of the sites (57% at Las Conchas with an actual peak load of 50 kW compared to a target of 94 kW; 68% at Seasir with an actual peak load of 40 kW compared to a target of 59 kW; 36% at Jolom Ijix with an actual peak load of 35 kW compared to a target of 98 kW). In the feasibility study, the peak demand was determined based on the assumption that the consumption by each household would increase along with the development of local industries using electricity. In reality, however, even though the number of electrified households and persons increased, the power consumption level at each household was less than planned. Support to business start-ups and attraction of businesses to the project sites was not enough, resulting in a failure to create medium to large-scale electricity users. Consequently, the target peak load was not achieved. Especially at Jolom Ijix where the maximum output is low, the original assumption was that a maize mill, cardamom and coffee drying plants and a chocolate plant would be created as production facilities using electricity.[21] Of these, only a small maize mill and cardamom drying plant had been established at the time of the ex-post evaluation.

Actual results of the auxiliary indicators

4. Plant utilization rate in 2015: The plant utilization rate in 2015 was 52% in Las Conchas and 68% in Seasir. The rate has steadily increased and is expected to continue to increase based on the prediction that there will be more service connections to villages and an increase of the consumption per household. In the case of Jolom Ijix, a total reshuffle of members of the Board of Directors and the coordinator of the Electricity Administration Unit of the Development Association had taken place as described later (see "3.5.1 Institutional Aspect of Operation and Maintenance" for details), thus, there was no accurate data for the annual power generation. Consequently, plant utilization data for 2014 and 2015 could not be obtained.

5. Operating hours, unplanned outages and planned maintenance and repair: Las Conchas site experienced a number of outages, including mechanical breakdown, immediately after the plant started operating due to malfunctioning of the turbine propeller and breaker of the control panel.[22] By 2015, however, the number of outage hours had fallen to 25 hours a year.

[21] "*Feasibility Study on Micro-Hydropower Plants at Las Conchas, Seasir and Jolom Ijix Sites in Alta Verapaz Department*" (IDB, 2008).

[22] As these breakdowns occurred during the warranty period, the repair work for replacement of the parts concerned

Meanwhile, because a water leakage from the valve that connects to the generator turbine had started since 2014, the number of planned outage hours increased to 80 in 2014 and further to 172 in 2015. As this worsening situation required an urgent solution, the Las Conchas Development Association in charge of the operation and maintenance requested for a quotation for repair work to the supplier. At Seasir, unplanned outages occurred only in 2014 for a total of 26 hours and planned outages were put into place as indicated by the manual. At Jolom Ijix, while planned outages were put into place each year in accordance with the manual, considerable unplanned outages due to equipment failure occurred in 2014, totalling 625 hours. This was because a lengthy time was required to repair the breakdown of the alarm on the control panel, burning out of the power unit and deformation of the penstock connectors. As these problems were solved in due course, the unplanned outage hours fell to five hours in 2015.

6. Annual power consumption and annual power consumption per household: These show an upward trend in general. When a community that had originally no access to electricity is for the first time supplied with it, the residents are often initially reluctant to use electricity. In the case of the Project, it appears that the residents of the target villages have been steadily incorporated electricity into their lives.

As seen above, the targets for the "number of electrified households and persons" were achieved as the figures steadily increased from 2012 to 2015. The "household electrification rate" mostly achieved its target as well. In contrast, the "peak load" has not achieved its target, primarily because of failure to foster productive activities using electricity contrary to the initial assumption. Nevertheless, the peak load is expected to increase in the coming years due to an increase of the number of electrified persons as a result of new connections to hitherto unelectrified villages; increase of power consumption per household, and increase of the power demand by new productive activities. Both the annual power generation and annual power consumption have been steadily increasing and other auxiliary indicators offer a similar conclusion to that described above. Therefore, the project objective of "improved access to electricity of residents" is judged to have been mainly achieved.

3.4 Impacts

3.4.1 Intended Impacts

The expected impacts of the Project were the promotion of productive activities and contribution to the improvement of livelihood. To be more precise, five concrete impacts which are discussed below were assumed. These have been analysed through a beneficiary survey[23] and focus

was conducted by an engineer of the manufacturer who was dispatched from Austria.

[23] The beneficiary survey was conducted during February 2nd and 20th, 2016. Sample size was 48 persons at Las Conchas (nine villages), 51 persons at Seasir (four villages) and 51 persons at Jolom Ijix (five villages), totalling 150 persons (54% female and 46% male). Sampling was conducted selecting villages by population distribution

group discussions. The state of realization of the impacts of the Project is described here. The beneficiary survey found a high level of satisfaction with the Project as 96% and 4% of the respondents stated that the Project was "highly satisfactory" and "satisfactory" respectively.

1. Improvement of the educational environment, such as enabling of residents to study at night using electric lighting[24] both at home and at evening schools: The expected impact has fully been realized.

A primary school in Jolom Ijix: with the introduction of a computer, new educational material can now be used

The beneficiary survey found that 67% of the respondents believe that the educational environment has improved. In the focus group discussions held at each site, there were some common comments, including "prior to the Project, the time to do school homework was limited but this can now be done in the evening" and "prior to the Project, the use of candles or a kerosene lamp to study at home was a health concern regarding eyesight, respiratory system, etc. but the use of electric lamps since the Project has eradicated such concern". However, none of the sites yet have an evening school for literacy. By site, students at the Las Conchas site used to pay 20 quetzal (about 322 yen) [25]before the Project for a return trip to Chahal where the computer school is located in order to learn computing. Since the Project, personal computers have been introduced at three secondary schools, enabling students to learn computing at their own schools. This is one example of general improvement of the educational environment resulting from the Project. At Seasir, an American NGO opened a vocational training school in 2015 and a total of 85 trainees have acquired certification for woodworking, plastering and cooking. A residential electrical engineer[26] course was added in March, 2016 with a trainer dispatched from the Technical Training and Productivity Institute (*Instituto Técnico de Capacitación y Productividad*, INTECAP). It is hoped that this school will contribute to the training of engineers required to ensure the sustainability of the Project which is described later in "3.5.2 Technical Aspect of Operation and Maintenance". At

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and accessibility. As a result, nine villages were selected from among 12 villages in Las Conchas, five villages from 11 villages in Jolom Ijix and all four villages in Seasir. In the case of those villages with difficult access, focus group discussions and interview surveys were separately conducted from the questionnaire survey. The information obtained from these activities suggests that the level of satisfaction of the residents with the Project do not differ significantly from that of the residents who participated in the beneficiary survey. As such, there should be no bias originating from the non-inclusion of certain villages in the beneficiaries survey.

24 In the beneficiary survey, 97% of the respondents replied that lighting was the main use of electricity. The top five household electrical appliances used are mobile phones (61%), televisions (45%), refrigerators (31%), satellite antenna (31%) and radios (14%). The field survey found that electric fans and radios are also used.

25 1 quetzal=16.110 yen (December 2015, JICA exchange rates (JICA website)).

26 A trainee completing the residential electrical engineer course acquires an INTECAP certificate which is acknowledged throughout the country. INTECAP is in charge of vocational training in Guatemala and offers 75 vocational training courses at 29 training centres (as of 2015). The training implemented under the technical assistance of the Project was also carried out by INTECAP.

Jolom Ijix, one personal computer has been introduced at a primary school, enabling the use of new teaching media, such as CD-ROM and DVD. It is said that these new media have enhanced the interest of students for learning.[27]

2. Improvement of the medical environment, such as the refrigeration of vaccines, etc.: The expected impact has been partially realized.

At Seasir, the previously mentioned American NGO and a local company have jointly established and operate a health clinic in 2015 with one full-time doctor and two full-time nurses, examining an average of 100 to 120 patients per month. In addition to these full-time staff members, a medical mission consisting of volunteers is regularly sent from the United States to this hospital. These missions have examined a total of 1,200 patients as of October, 2015. These facts indicate that the Project has greatly contributed to improvement of the medical environment at this site.[28] However, at the time of ex-post evaluation, the clinics at the Las Conchas and Jolom Ijix sites were closed due to shortage of doctors, nurses, medicines and medical equipment. Therefore, the expected effect of the Project of improving the medical environment at the project sites has not yet been fully realized.

3. The activities for livelihood improvement using micro hydroelectric power generation contribute as a model case for other regions: The expected impact has not been realized.

Up to the time of ex-post evaluation, no livelihood improvement activities have been conducted in other regions using the Project as a model. Also the implementing agency has not promoted the Project as a model case. However, at Las Conchas the number of requests by other local public bodies and universities to conduct visits to the micro hydroelectric power plant has been increasing every year.

4. Contribute to household income increase: The expected impact has been partially realized.

The ex-post evaluation has found that while the living conditions have generally improved at the target sites, the level of income increase varies from one household to another.[29] The income of those households which have procured a refrigerator, freezer, copying machine and/or personal computer to establish a new business has increased, however, income of other households has not

[27] Prior to the implementation of the Project, audio equipment such as radios and CD players were used to assist teaching (battery operated as there was no generator).

[28] At the time of the field survey, about 20 dentists dispatched from the US were treating patients. The availability of infrastructure for electricity supply was cited as a decisive factor for the opening of a clinic at Seasir. The operation of the hospital has been steady as electricity with stable quality is supplied using a transformer procured and installed by the Electricity Administration Unit of Seasir's Development Association.

[29] The beneficiary survey found a change of lifestyle in addition to changes in education and medical care due to the introduction of electricity. Compared to before the Project, the time used for farming, housework and sleeping has decreased with watching television taking up a lot of time after the Project. Especially it was found that watching television appears to be the principal reason for the reduction of sleeping time.

changed so much since before the Project. In addition, the level of living has improved at Las Conchas where a local industry (tourism) exists and where access to the site is relatively easy compared to that of the other two sites, which lack a notable local industry as well. Many women's groups which received technical assistance for livelihood improvement and productive activities has reinvested all of the profits gained through the Project in their businesses or have loaned them to other members. As they have learned through the technical assistance, majority of the groups mainly re-invest all their profits to expand their businesses instead of distributing part of it among members. Apart from the group which loan its profits to the members, productive activities have not yet directly increased the household income (see "Column: Empowerment of Women through Productive Activities Using Electricity" for details).

5. Reduction of CO_2 emissions due to less use of firewood and kerosene: The CO_2 emission reduction has been limited.

Because the use of kerosene lamps has decreased, the emission of CO_2 should have fallen proportionally. However, as firewood is still the main fuel for cooking, the overall CO_2 emission reduction is likely to have been limited.

The educational environment is an area where the expected impact has been sufficiently realized while improvement of the medical environment and increase of the household income have been realized at some sites but not at all sites. The impact on the emission of CO_2 has been limited and the impact as a model for livelihood improvement using electricity has not been realized. In short, of the five expected impacts, three have been partially or sufficiently realized and the quality of living has definitely been improved due to the use of electrical appliances, such as electric lamps, televisions and refrigerators, among others.

A group of housewives preparing an evening meal under an electric lamp (Las Conchas)

3.4.2 Other Impacts

Impacts on the natural environment

At the time of planning, there was concern in regard to impacts on the natural environment during the construction work such as air pollution by vehicles, turbidity of rivers due to work in the river channels, land pollution due to oil and/or grease spillage, construction waste, noise, bad odour and others, urging the adoption of appropriate work procedures and other measures. For these possible adverse impacts, appropriate measures were implemented in accordance with the check list of the

monitoring plan[30] which in turn was in line with the relevant JICA guidelines.[31] The beneficiary survey found that 95% of 150 respondents replied that there were either "no problems at all" or "hardly any problems" for every category of possible adverse impact, confirming the very limited nature of impacts on the natural environment.[32] The field survey as part of the ex-post evaluation found no adverse impacts on the natural environment in terms of the restoration of pastoral land, reforestation and noise, etc.

Resettlement and land acquisition

No resettlement of residents was necessary at Las Conchas and Seasir sites. At Jolom Ijix, however, one family (three members) residing at the planned construction site of the head tank required relocation. Through negotiations with the Development Association and land owner, the family was relocated with the cooperation of the local residents to a new house constructed on different land within the village. After relocation the family continued working as farmers and there were no negative impacts in regard to reduction of income and living conditions. On the other hand, in regard to land acquisition, there had been an understanding that land acquisition meant the acquisition of permanent land use rights from the time of project planning. Letters of approval of permanent land use rights were prepared between representatives of the Development Associations and land owners with the assistance of MEM. These letters had been exchanged between all stakeholders as official documents in all the sites by 2008 and MEM considered that the exchange of these official documents implied the completion of land acquisition. The process of securing land for the Project was actually completed without any significant problems and the evaluator confirmed the existence of these official documents concerning permanent land use rights. However, as long as the land ownership is not transferred to MEM, the facilities and equipment of the Project which are owned by MEM cannot be registered as state assets. This means that if any large-scale breakdown or accident occurs due to an unexpected natural disaster (flooding or lightening, etc.), MEM cannot provide the assistance required for their repair.[33]

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[30] As part of the project site (the Las Conchas Municipal Natural Recreation Park) is located in the Las Minas Mountains Biosphere Protection Buffer Zone, an EIA (Environmental Impact Assessment) was required under the environmental law of Guatemala. However, because of the small scale of development, it was decided that the submission of an IEE (Initial Environmental Evaluation) report and a monitoring plan would be approved as an EIA. The IEE report was prepared on July 31, 2009 and was approved on October 15, 2009. As this report covers most of the subject items for assessment listed in JICA's Guidelines for Environmental and Social Considerations, its relevance is high. Due to the insufficient content regarding a monitoring plan in this report, the MEM prepared a monitoring plan (check list and monitoring form) in line with JICA's Guidelines and monitoring was conducted on the basis of this plan.

[31] Concerns in regard to impacts on the natural environment during the construction work which were addressed at the moment of project planning were (1) exhaust gas and dust, (2) turbidity of rivers and land pollution due to civil works, (3) construction waste and bad odour among others. The measures taken were: for (1) water was sprinkled periodically in the construction area and trucks received a periodical maintenance. For (2) measures such as putting portable toilets were taken in order to minimize the impact to the environment. For (3) construction waste were collected and treated in specific places indicated by the Municipal government.

[32] The remaining 5% of the respondents did not answer the question.

[33] In regard to land use rights, MEM was expected to submit a schedule for the concrete procedure of registering state assets to JICA in October, 2014 according to the review conducted in August, 2014 at the time of the

Other impacts

- Promotion of poverty reduction: A questionnaire survey was conducted with the Development Association at each site, asking them to grade the effect of the Project on poverty reduction on a scale from 1 to 5. Las Conchas and Jolom Ijix sites answered that "the effect was slightly low" while Seasir answered "an effect can be recognize to some extent". These results were lower than the comparable results of the beneficiary survey. During the focus group discussions, their opinion was that even though the quality of living had improved due to electricity supply, the situation did not lead to a tangible income increase and livelihood improvement. The "quality" of life has improved but an increase in income is yet to be seen. In addition, some households have been able to start their own businesses using electricity while other households have not done so. Income of the former had increased but not so for the latter, who even responded that the increase in expenses was greater than the income increase. In general, there was no clear impact of the Project in terms of promoting poverty reduction.
- Empowerment of women[34] (see Column for details): The Project had an impact on reduction of women's workload in household chores as the use of electric appliances such as refrigerators and fans, as well as light can be used. In addition to this, as part of the technical assistance, support was offered under the Project for the productive activities of women's groups. These groups decided their preferred productive activities themselves and learned the necessary knowledge and know-how to implement the selected activities. Each group collectively determined such matters as how to manage their businesses. As 13 groups (approximately 80 women) are still in operation at the time of ex-post evaluation, it is fair to say that the Project has contributed to the empowerment of women.[35]

completion of JICA's technical assistance. However, no progress has been made up to the time of ex-post evaluation although MEM stated that the registration of lands as state assets should be completed by August, 2016. Land ownership and land use rights in Guatemala are often not clearly distinguished and the question of land ownership is extremely complicated because of its historical background. Obtaining an official document concerning land use rights is customarily regarded as constituting the completion of land acquisition. The Government of Guatemala has established a body responsible to solve the issue of land ownership. It should be noted that MEM, as a policy making institution, cannot provide financial assistance directly to the Development Associations, however it would arrange assistance from other institutions.

[34] Apart from productive activities, the participation of women in plant operation and maintenance has been quite limited as only one woman works as a book-keeper in the Las Conchas Electricity Administration Unit. However, the rules of the Development Association state that residents can only become members of the Association if both a man, as the head of the household, and a woman, as the spouse, apply for membership. Both men and women have voting rights to decide various issues of the Association. This means that the activities of the Association indirectly reflect women's opinions to some extent.

[35] Each Development Association is expected to follow up the activities of women's groups after the completion of the Project but such follow-up is only observed at Las Conchas at the time of ex-post evaluation.

Column: Empowerment of Women Through Productive Activities Using Electricity

The technical assistance under the Project introduced two activities targeting women. Activity 1 was "assistance for the construction of organizations to conduct activities related to livelihood improvement and strengthening of the capacity for improvement". Activity 2 was "assistance for the construction of organizations for productive activities using electricity and strengthening of the capacity for improvement, aiming at livelihood improvement".

Livelihood improvement: maize flour milling (Las Conchas)

In Activity 1, various efforts for livelihood improvement at the community level in post-war Japan were introduced in a workshop. This was followed by the search for local resources in each community and three types of improvement were taught, i.e. "improvement not requiring money", "improvement requiring money" and "improvement generating money". Each woman's group then planned, implemented and evaluated a mini-project for "improvement not requiring money". The number of groups at one point was many as 48, from which 12 groups were selected based on their attitude while working on the mini-projects, the results, as well as their continuous participation in the workshops. Activity 2 was then conducted on these 12 selected groups. As part of Activity 2, workshops were held on the planning, implementation and book-keeping of productive activities using electricity. To launch the productive activity of each group, 3,000 quetzal (about 48,000 yen) was provided for each group as a start-up fund. At the time of project completion, as some groups decided to split there were 14 groups (five in Las Conchas, seven in Seasir, and two in Jolom Ijix) operating in chicken farming, pig farming, bread-making, maize cultivation and flour milling. All important group decisions, such as change in activity and business management policies, are discussed and decided among all the members. Although some groups have split or ceased activity, 13 groups are active at the time of ex-post evaluation, involving chicken farming, pig farming, maize cultivation and flour milling.[36]

The background for the continuous activities of the 13 groups despite a change of activity on the part of some groups is that the group members acquired the basic knowledge required for their productive activities through the technical assistance. Moreover, these women have gained confidence as human beings and now have the willpower and capacity to devise and implement different activities instead of simply giving up when hitting a wall as was the case before the assistance. These are significant outcomes of the technical assistance, illustrating the positive contribution of the technical assistance of the Project to the raising of awareness and empowerment of women. During the focus group discussions, many opinions were expressed to illustrate these positive outcomes. Some examples are: (1) knowing about livelihood improvement in post-war Japan made me believe that, as members of a community, we can achieve something if we work together, boosting our confidence; (2) before attending the workshop, I never thought that improvement would be possible without money because I believed that money was necessary for everything. Japan's technical assistance broadened my vision and imagination; (3) the acquisition of know-how on chicken and pig farming led to earning of real money, boosting my own confidence and showing the community that women can butcher pigs, and (4) learning book-keeping has enabled me to understand the flow of money not only in a group activity but also in my own household, making me more careful about how I spend money. Most men in these communities appear to understand why women involve themselves in productive activities and are supportive. Even though the status of women is rather low in Mayan society, JICA's technical assistance has boosted the confidence as well as capacity of women and facilitated the understanding of the importance of women's involvement in productive activities among men, thereby contributing to the improved status and empowerment of women.

[36] As of 2014, many groups were involved in chicken farming. At the time of ex-post evaluation, however, many of these groups have opted for pig farming. The background for this change is that many women who were not selected for group activities have independently learned how to raise chickens through visits to group activities and have started to raise their own chickens, creating strong competition. Because women not selected for "assistance for the strengthening, establishment and capacity improvement of organizations for productive activities aimed at improving livelihood using electricity" have obtained new knowledge and know-how, it is safe to say that JICA's technical assistance has achieved indirect effects.

The effectiveness and impact of the Project were to “improve access of residents to electricity” and “promote productive activities and contribute to the improvement of livelihood”. In regard to effectiveness, “total number of electrified households” and “total number of electrified persons” have achieved their respective targets. Although the “peak load” did not achieve the target, both the annual power generation and annual power consumption have steadily increased. A further increase of the number of electrified persons and annual power consumption per household is expected through new connection to hitherto unelectrified villages, and it is safe to conclude that the quantitative effects have been achieved. In regard to impacts, expected impacts have been recognized in terms of improvement of the educational environment, improvement of the medical environment and improvement of livelihood. The Project has also significantly contributed to the empowerment of women. In contrast, the actual impact is limited in terms of poverty reduction or income increase as the income level varies from one household to another. There have been no negative impacts on the environment or in terms of resident resettlement.

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

3.5 Sustainability (Rating: ②)

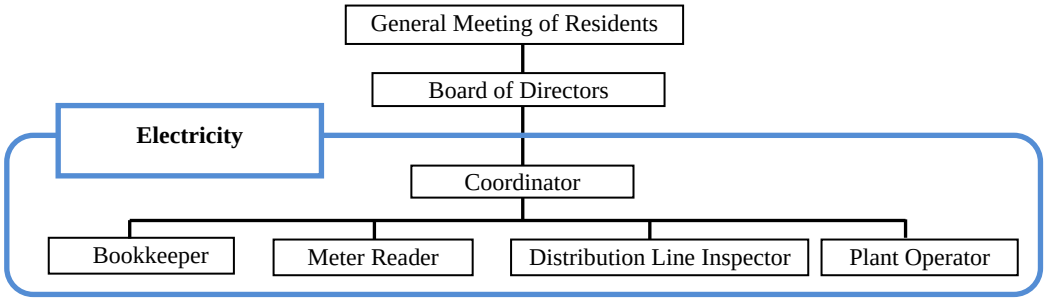
At the time of Project planning, with respect to operation and maintenance, it was pointed out that “routine inspection and simple maintenance would be conducted by operation and maintenance workers, however, if even minor problems are not properly dealt with, it can be expected that this could result in serious problems”. Thus in order to secure the sustainability of the Project, as the implementing agency, MEM was to sign an agreement with INDE who is in charge of rural electrification, so that INDE could provide technical support to the Development Associations. In addition, the necessity to establish and strengthen a comprehensive support system for operation and maintenance involving MEM, INDE and municipal authorities[37] was recommended in the midterm and project completion review reports [38] of the technical assistance. Moreover, another recommendation was made during the defect inspection conducted in July, 2014 regarding the necessity to promote cooperation between MEM and municipal authorities (in order to secure necessary budget; establish a cooperation system with electrical work companies, universities and NGOs that are active in the Project site; and monitor the Project, etc.) At the time of ex-post evaluation, however, there was no formal cooperation system between MEM, INDE and municipal authorities. There has been a commitment from INDE to provide technical assistance (which

[37] MEM is the administrative organization for the electricity sector and is responsible for the development of the legal framework and formulation of policies and electrification plans. Direct operation and management, as well as technical matters of electricity business are not among their functions.

[38] In this Project, with respect to the technical assistance conducted by the consultant, JICA conducted a midterm review (June 2012) and a review at the moment of project completion (March 2014).

excludes purchasing of spare parts) to MEM but it has not yet been a formalized cooperation system, due to difficulties in MEM's internal coordination. In addition, not all municipal authorities were aware of the existence of the Project. There was a comment from one municipal authority that the municipality does not engage in electricity business thus it could not provide technical assistance and that financial assistance would also be difficult due to the limited municipal budget.[39]

In short, the involvement in operation and maintenance of MEM and municipal authorities has been very limited. Therefore, this ex-post evaluation focused on the institutional, technical and financial aspects of the Electricity Administration Unit of each Development Association which is actually responsible for the power plant operation and maintenance, in order to evaluate the operation and maintenance of the Project.



Source: Information provided by Development Associations.

Fig.1 Organizational Chart of the Development Association and Electricity Administration Unit

3.5.1 Institutional Aspects of Operation and Maintenance

A Development Association[40] consisting of local residents as members was established at each site for the purpose of the operation and maintenance of the facilities constructed under the Project, and an Electricity Administration Unit to run the electricity business was created under the General Meeting of Residents and the Board of Directors (Fig. 1). Concrete rules for the electricity business

[39] The midterm review (June 2012) and project completion review (March 2014) of the technical assistance of the Project recommended that municipal assistance should be obtained. However, this recommendation has not been realized, partly because of the frequent change of municipal officials. Although each Development Association compiles a monthly report recording the state of operation, electricity demand, income and expenditure, main repair works carried out, breakdowns and periodic/extraordinary inspections so that MEM and municipalities can conduct monitoring, only the Development Association in Las Conchas submits this report to the municipal authority (municipal authorities have not made it a requirement either). Residents have a strong sense of distrust in municipal authorities, citing the following reasons for the non-submission of the monthly report: "submission of information to the municipal authority does not lead to any actual assistance" and "we do not want to reveal our income and expenditure as we do not trust the municipal authority". Unless this fundamental sense of distrust is solved, municipal assistance for the Project cannot be expected. The Chahal municipal authority of which the jurisdiction covers Las Conchas mentioned that "although financial assistance by this municipal authority is impossible, it is possible to provide assistance such as bring in an engineer if necessary."

[40] The members of the Development Association consist of male household heads and their female spouses and each member has a voting right. The directors are selected through voting at a General Meeting of Residents.

(selection method of directors, operational rules of the electricity business, electricity tariff, obligation of residents to pay the electricity bill and other relevant matters) were created through the technical assistance of the Project.

Operation and maintenance systems for each of the power plants and chain of command are in place at each site. Although the number of persons assigned to monitor the distribution network is less than originally planned (four persons), no problems have been reported as the residents take turns to act as monitors as well. At Las Conchas and Seasir sites, the operation and maintenance system at the time of ex-post evaluation is judged to be mostly adequate and stable. In addition, residents conduct the cleaning of the distribution line, and water intake in turns, helping to ensure a stable electricity supply. At Jolom Ijix, all members of the Board of Directors had been replaced just before this ex-post evaluation. There were no changes in the staff of the Electricity Administration Unit, but one operator was being trained to fill the gap created by the departure of one operator[41], and thus operation and maintenance is conducted with the minimum manpower.

Table 4 Number of personnel at each Development Association's Electricity Administration Units

(unit: persons)

Site Name Name of Development Associations*	Coordinator (Management)	Book-keeper	Meter Reader	Distribution line Inspector	Plant Operator	Total
Las Conchas ASOCALCO	1**	1	1	1	3 (3 shifts)	6
Seasir ADECORK	1	1	1 (Also works as a distribution line inspector)		2 (2 shifts)	5
Jolom Ijix ADESMI	1	1	1	2 (2 shifts)		5
Assumed Appropriate Manpower Strength at Time of Planning	1	2		4	2 to 3	9 to 10

Source: Information provided by Development Associations as of May, 2016.
* ASOCALCO: Asociación para el Desarrollo Las Conchas; ADECORK: Asociación para el Desarrollo Comunitario Rax K'liche; ADESMI: Asociación para el Desarrollo Sierra de las Minas.
**Also works as a plant operator.

From the above, the institutional aspect of operation and maintenance is mostly fine at Las Conchas and Seasir but there are concerns at Jolom Ijix.

[41] In regard to personnel turnover at the Electricity Administration Units, at Las Conchas and Seasir, two operators and one book-keeper were either dismissed or left their posts in 2014, two years after commencement of operation, due to inappropriate work performance, change of job, or family reasons. However, no one has left since then. It is worth mentioning that there is a rule that any vacant posts created by the departure of an employee must be filled by a person trained in the Project and all personnel matters are approved after examination by the Board of Directors.

3.5.2 Technical Aspects of Operation and Maintenance

Routine inspection (Jolom Ijix)

At the moment of the ex-post evaluation, all personnel in charge of operation and maintenance in each Electricity Administration Unit had received technical guidance under the Project. To be more precise, five persons were selected as plant operators and distribution line inspectors from each site and underwent through a training organized by the INTECAP, followed by OJT and other trainings, organized as part of the technical assistance under the Project to learn the basic skills for the routine inspection of the civil engineering facilities as well as power generation and distribution facilities (see Table 2 for more details of the technical assistance). However, no continuous training or training to foster new technical personnel has taken place after this initial training.

Operation and maintenance manuals for the civil engineering facilities and power generation and distribution facilities, as well as forms for daily operation records and routine inspection records were prepared under the technical assistance.[42] These documents are properly used and stored at the Electricity Administration Unit and power plant at each site. Routine maintenance conducted in accordance with the manuals at the time of ex-post evaluation includes the application of grease, cleaning of ventilation filter for the control panel, cleaning of the air inlet and outlet of the generator and cleaning as well as grease application of the intake. In addition, the removal of deposits at the weir and pruning of tree branches along the distribution lines are conducted with the help of residents. In addition, the manuals list the contact information of engineers, suppliers, etc. When a repair or replacement of electrical equipment is required, it is necessary to contact the manufacturer, possibly leading to the import of parts[43] which can become a financial burden. Repair of the distribution facilities is to be conducted by a local company.[44]

From the above, it can be seen that the technical capacity to conduct the minimum routine inspection and maintenance is secured to a certain extent at the time of ex-post evaluation, but concern remains regarding the training of new personnel from the viewpoint of preserving the project effects in a sustained manner from here on.

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[42] As some people working at the Electricity Administration Unit had completed only up to primary education, these manuals and forms were prepared with due consideration of the educational background of the persons involved.

[43] In regard to the procurement of parts to deal with equipment breakdowns, at the time of the ex-post evaluation all the Electricity Administration Units had the understanding that the only available option was to import these parts from the Germany of Austrian manufacturer. According to the local consultant (AIMSA) who worked in the Project, it is possible to import these parts or to call an engineer from a neighbouring country, such as Mexico or Costa Rica.

[44] Based on materials provided by JICA, findings of the questionnaire survey to the Electricity Administration Units, as well as interview surveys conducted during the field work.

3.5.3 Financial Aspects of Operation and Maintenance

The routine maintenance cost of the facilities and equipment installed under the Project is covered by electricity fee collected by each Electricity Administration Unit and it is assumed that MEM is responsible for the provision of financial assistance in the case of operational failure due to an unexpected accident. However, in order for MEM to secure the necessary budget for this purpose, there is a precondition that the ownership of the land where the facilities and equipment installed by the Project must be transferred to MEM, so that these can be registered as state assets. At the time of ex-post evaluation, they were still not registered as state assets and MEM is not in a position to secure any budget[45] (see "3.4.2 Other Impacts: Resettlement and Land Acquisition" for more details of land acquisition at the time of planning). Consequently, each Electricity Administration Unit must finance all project-related operation and maintenance costs, including the repair cost necessary in case of a breakdown, from the collected electricity charges. It is, therefore, essential to lower the delinquency rate as much as possible and, if necessary, revise the tariff in order to build up the reserve to meet the cost of such consumables as grease and the cost of parts scheduled for replacement in due course.

Under the technical assistance of the Project, all Development Associations were advised to save 2,000 quetzal (about 32,000 yen) a month as the minimum amount.[46] If done accordingly, 72,000 quetzal (about 1.16 million yen) should have already been set aside by December 2015. However, only the Development Association in Las Conchas has built up this reserve (Table 5). The financial situation in each site is as follows.

- Las Conchas: Apart from contracts with residents, there is a contract with a large user, which is a mobile phone service provider. Through strict enforcement of the "culture of proper payment", the delinquency rate is low at 18%, making the electricity supply business very healthy with an annual surplus.
- Seasir: The annual balance is in the black, partly due to income from such large users as the health clinic and vocational training school. However, the delinquency rate is very high at 63%, and the reserve as of May 2016 is slightly lower than the required level. It is necessary to improve these aspects.
- Jolom Ijix: Unlike the other two sites, there is no large user and the delinquency ratio is extremely high at 72%. A "culture of proper payment" has not been established, partly because

[45] The project completion review report (March 2014) for the technical assistance states that "in this Project, the latest technologies have been introduced which can operate for at least 20 years without a major maintenance work as long as the minimum routine operation and maintenance work is conducted by the personnel from the Electricity Administration Units that received training through the technical assistance. Regardless of such advantages, it has been pointed out from the time of project planning that these are sensitive equipment, and that it was necessary to make clear and to agree upon a support system, involving MEM, INDE and municipal authorities regarding concrete counter-measures (in terms of system, budget, securing components and spare parts etc.), including the precondition of the registry of the facilities as national assets, to guarantee ways to secure personnel that can conduct the repairs, as well as measures to be taken should a large-scale breakdown occur.

[46] Based on the interview survey conducted to a local consultant (Solar Foundation) who worked in the Project.

of the fact that electricity supply has so far not been suspended for non-payment. Also, residents generally lack awareness that the electricity supply service is reliant on the payment of a fee by the residents and the lack of any awareness campaign has aggravated the situation. Moreover, when two villages were added to the network, the National Rural Electric Cooperation Association (NRECA)[47] which was assisting the electricity supply business in rural areas advanced a loan of 50,000 quetzal (about 810 thousand yen) to the Development Association. This loan has not yet been repaid. Furthermore 10,000 quetzal (about 160 thousand yen) has been invested in the opening of a computer class but the recovery of this investment is nowhere in sight because of management problems, and there are other loans which have not been recovered. The accumulated reserve as of May 2016 is the lowest of the three sites. Routine operation and maintenance costs are being covered barely, but there are no funds to deal with a breakdown that would require amounts that surpass the reserve. Due to these problems, the entire members of the Board of Directors have been replaced, and a new chairman and coordinator of the Electricity Administration Unit are making efforts to improve this situation.[48]

Table 5 Financial Status of each Electricity Administration Unit

(Unit: Quetzal)

Item	Las Conchas			Seasir				Jolom Ijix		
	2013	2014	2015	2012 (Aug-Dec)	2013	2014	2015	2013	2014	2015
Total income (A)	167,221	230,714	288,825	50,202	129,509	169,959	144,131	149,133	149,161	196,204
·Charge collection	103,964	165,277	226,146	38,781	97,695	64,816	72,441	94,538	49,057	45,126
·Collection of delinquent charges	22,448	39,743	45,811	289	26,906	103,369	71,690	54,595	100,104	151,078
·New membership fee and installation charge, etc.	40,809	25,694	16,868	11,132	4,908	1,774	0	NA	NA	NA
Expenditure (B)	128,485	178,369	207,903	42,463	115,456	142,549	132,579	118,160	155,760	136,014
·Personnel cost	96,000	102,600	110,350	32,380	83,633	80,740	79,800	92,400	92,400	92,400
·Office expenses	32,485	54,059	73,038	2,287	11,746	13,195	2,671	25,760	33,360	33,614
·Other (repair, etc.)	0	21,710	24,515	7,796	20,077	48,614	50,108	0	30,000	10,000
(A) - (B)	38,736	52,345	80,922	7,739	14,053	27,410	11,552	30,973	▲ 6,599	60,190
Reserve for facility renewal, etc.	175,928 (As of January 2016)			62,700 (As of December 2015)				12,000 (As of May 2016)		

Source: Documents provided by the Electricity Administration Units of ASOCALCO, ADECORK and ADESMI. Exchange rates as indicated in the footnote.[49]

[47] The NRECA is a national association of electric companies of the United States. In addition to rural electrification in the U.S., its mission includes rural electrification in other countries. It has conducted rural electrification projects in 43 countries since its establishment in 1962.

[48] Specifically, electricity supply to 26 households with the longest delinquency periods has been suspended and they have been given the option of paying the arrears in instalments with the accrued interest being waived. To reduce personnel costs, negotiations were made and an agreement has been reached with the meter-readers, who will be paid based on 10 days' work which is the number of days required for meter-reading, instead of a monthly payment as full-time employees. In the case of Jolom Ijix, the Rafael Landivar University has been providing small-scale technical assistance for operation and maintenance. OJT by a university engineer was scheduled in June 2016 and this university intends to provide assistance to improve the financial situation in the coming years.

[49] 1 quetzal=13.208 yen in December 2013, 1 quetzal= 15.786 yen in December 2014, 1 quetzal=16.110 yen in December 2015 (JICA rates (JICA website).

The electricity tariff is determined in accordance with the rules of each Development Association and can be revised at the General Meeting of Residents. So far, the tariff has been revised twice since the time of starting operation to the time of ex-post evaluation. The basic charge at the time of ex-post evaluation is 17 quetzal (about 274 yen)/month for general users (110 V) plus a metered rate of 2 quetzal (about 32 yen) per kW of consumption. For commercial and industrial users (220 V), the basic charge is 20 quetzal (about 322 yen)/month plus a metered rate of 4 quetzal (about 64 yen) per kW of consumption. An installed transformer cost 20,000 quetzal (about 322 thousand yen).[50] Some Electricity Administration Units say that the tariff is rather low when the financial sustainability of the service is taken into consideration. While the financial situation may improve with further revision of the tariff, it appears difficult to increase the tariff for general users in the immediate future, when taking into consideration Seasir and Jolom Ijix high delinquency rates, as well as poverty and household income levels in these sites. Although the lack of a thorough "culture of proper payment" is a factor for the high delinquency rate, there are many households which fail to pay the electricity charge out of necessity due to insufficient income. In regard to the tariff for industrial and commercial users, it may be feasible to replace the existing uniform metered rate with a variable tariff based on the scale of business and actual power consumption amount in such businesses as game arcade, copying services and general stores as well as restaurants using refrigerators. However, there is no plan for this kind of differentiation of electricity users at the time of the ex-post evaluation.

For all the sites, their current financial situation makes it difficult for them to properly deal with a situation requiring large funding, including a large-scale accident or an unexpected breakdown. As neither MEM nor the municipal authorities can secure the necessary budget, it is important for the Electricity Administration Units to build up a reserve. However, the reality is that only Las Conchas has successfully built up such a reserve. At Seasir and Jolom Ijix, the delinquency rate is high due to the low level of income of the residents and lack of "a culture of proper payment", causing concern regarding the financial health of the electricity supply situation.

3.5.4 Current Status of Operation and Maintenance

At the time of ex-post evaluation, the condition of facilities and equipment is generally good in each site and no damage or failure has occurred with the civil engineering facilities, power plants or distribution facilities. However, some repairs and replenishment of some spare parts are necessary as shown in Table 6. When routine maintenance in accordance with the manuals and equipment maintenance by specialists are conducted, the minimum service life is 20 years. However, generally

[50] At the Las Conchas site, an independent contract has been signed with a private mobile phone service provider and the agreed payment consists of 15,000 quetzal (about 24,000 yen) for connection with a basic charge of 250 quetzal (about 4,000 yen) /month and a metered rate of 5 quetzal (about 81 yen) /kW. Similar independent contracts have been signed at Seasir with a health clinic and a vocational training school run by a NGO.

in Guatemala, a lack of routine maintenance, or a lack of timely repair by a specialist in case of a breakdown can reduce the service life to about 10 years.

Table 6 Pending Issues and Necessary Measures Regarding Operation and Maintenance

(as of May, 2016)

[Las Conchas] • There is a water leakage from the inlet valve of the turbine and an oil leakage from the generator. As the water leakage has been worsening, urgent repair by an electrical engineer is necessary (the Electricity Administration Unit has already contacted the manufacturer). [Seasir] • The progressive erosion of the water intake weir suggests a need for thorough maintenance work. • As the control panel indicates error signals from the sensors for the bus bar (metallic bar conducting electricity to the control panel) and the location of the injector of the waterwheel, the checking of these by an electrical engineer is necessary. • Power plant operation has been halted several times a year due to increasing water levels, deterioration of the water quality and/or rubbish caused by extraordinary rainfall. The strict enforcement of a regime of preventive routine maintenance is necessary to eliminate problems in advance, including more frequent cleaning of the intake during the rainy season. • As there is no stock of spare parts (governor for the control panel, generator bearings, etc.), an urgent replenishment of these spare parts is necessary. [Jolom Ijix] • The prominent rusting of metal components, such as the intake gate, that are in contact with water is observed, indicating a need for thorough maintenance work. • As the water gauge of the head tank is not functioning, no water level data is indicated on the control panel. This situation must be rectified by a specialist. • As there is no stock of spare parts (governor for the control panel and generator bearings, etc.), an urgent replenishment of these spare parts is necessary.

As described above, the operation and maintenance conditions of the facilities and equipment installed with the Project are generally good at the time of the ex-post evaluation. However, some repair and the replenishment of spare parts are necessary at some sites.

The Development Association of Las Conchas which conducts the actual operation and maintenance has no institutional, technical or financial problems. However, the Development Association of Seasir requires significant improvement in terms of its financial status. The Development Association of Jolom Ijix has concerns in all aspects, that is, institutional, technical and financial aspects thus, MEM must assess this situation and should urgently provide the necessary assistance as described in “4.2 Recommendations”.

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

4 Conclusions, Lessons Learned and Recommendations

4.1 Conclusion

The Project for the Promotion of Productive Activities with Use of Clean Energy in the Northern Villages of the Republic of Guatemala was implemented with the aim of improving the access of local residents to electricity by constructing micro hydroelectric power plants and distribution facilities in three sites located in the poorest area of Alta Verapaz Department in Guatemala where electrification by extension of the electricity grid was difficult, as well as by providing technical assistance for the operation and maintenance of these facilities and to promote productive activities using electricity, thereby contributing to the promotion of productive activities and the improvement of livelihood.

The Project has been relevant to Guatemala's development policies of proceeding with electrification by independent systems utilizing renewable energies in areas to which extension of the electricity grid is difficult; to Guatemala's development needs in terms of a strongly required electrification in Alta Verapaz Department because the electrification rate of this department has been the lowest in the country; and to Japan's ODA policy of assisting developing countries to promote reduction of CO_2 emissions and other measures to combat climate change. Therefore, the relevance of the Project is high.

Although the project cost was exactly as planned, the project period exceeded the plan. Therefore, the efficiency of the Project is fair.

Both power generation and power consumption have been steadily increasing. The targets in terms of number of electrified households and electrified persons have been achieved and the target in terms of household electrification rate has largely been achieved. Although the peak load has not reached the target, it is expected to increase in the coming years due to the increasing demand for electricity. The intended impacts have been realized in regard to improvement of the educational and healthcare environments and improvement of living conditions. In addition, the Project has contributed to improve the quality of living through electrification and to the empowerment of women through productive activities using electricity. Therefore, the effectiveness and impact of the Project are high.

The conditions of both the power generation and distribution facilities are generally good although some require repair or the replenishment of spare parts. The Development Associations are in charge of the electric enterprise as well as the operation and maintenance of the facilities in their respective villages. One of them has no problems at all, another one has some problems with the financial aspects and remaining one has some problems with the institutional, technical and financial aspects of operation and maintenance. It is necessary for the Ministry of Energy and Mines which is the implementing agency, to provide active assistance for the Development Associations of these three villages. Therefore, the sustainability of the Project is fair.

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

4.2 Recommendations

4.2.1 Recommendations to the Implementing Agency (MEM)

- Arrangement with INTECAP regarding human resources development for the three Development Associations

  At the time of ex-post evaluation, the number of staff members which had received technical assistance under the Project is five at each site. The development of additional human resources to follow in the steps of these five is necessary in order to ensure the sustainability of the project effects. While it is possible in Seasir to receive training on electrical engineering by a lecturer from INTECAP at the vocational training school established by the American NGO, there is concern for the succession of technical competence in Las Conchas and Jolom Ijix. In regard to this issue, MEM has expressed its view that although they cannot provide financial assistance, they can arrange training and technical assistance through coordination with INTECAP or other human resources development organizations. It is required that MEM identify the capability (not only technical but also business management and book-keeping) to be strengthened at the Electricity Administration Unit of each Development Association and arrange the participation of personnel of these sections in training programs sponsored by INTECAP or another human resources development organization.

- Arrangement of technical cooperation by the INDE

  Regarding a support system in case of large-scale accidents or breakdowns due to natural disasters, INDE has expressed that it is possible for them to prove technical cooperation and assistance. They have commented that they can dispatch its technical personnel to assess the technical level of the power plants in order to clarify the scope of technical assistance they can provide and then possibly propose a concrete assistance system and an agreement on technical assistance to MEM. MEM should urgently make the necessary arrangements with INDE.

- Registration of facilities and equipment as state assets

  The procedures to register facilities and equipment as state assets which were scheduled to be completed by August 2016 are required to continue. If this registration procedure is found to be time-consuming, discussions should be held involving legal experts, the municipal authorities and Development Associations to facilitate the necessary work.

- Support for the Jolom Ijix Development Association

  Among the three targeted sites of the Project, Jolom Ijix in particular has problems with all aspects of operation and maintenance, that is, institutional, technical and financial aspects. MEM should maintain close communication with the Electricity Administration Unit of the Development Association in Jolom Ijix and conduct regular monitoring to prevent operating

accidents, etc. If necessary, MEM should consider collaborating with INDE and the Rafael Landívar University which has been providing assistance for Jolom Ijix.

4.2.2 Recommendations to JICA

JICA should continue to check the progress of MEM regarding the recommendations made in "4.2.1 Recommendations to the Implementing Agency", and if necessary, encourage MEM in order to urge the implementation of these recommendations.

4.3 Lessons Learned

- Ensuring sustainability through the combination of an infrastructure development project and technical assistance

  In addition to the development of infrastructure, the Project also emphasised the technical assistance which was necessary to ensure the sustainability of the Project by putting in a fair amount of technical assistance compared to other ordinary grant aid projects. This was a special characteristic of the Project and it is what led to the success of the Project. The timing of the commencement of the technical assistance was appropriate, as training started prior to the completion of the power generation facilities. Once the facilities started operating, OJT on the actual operation and maintenance was jointly conducted with the Japanese and local consultants at the same time. This way it became possible to foster personnel capable of properly conducting basic operation and maintenance of the facilities. The introduction of manuals and data recording methods matching the technical level of operators was the key to successfully ensure the technical sustainability up to a certain level. This Project constitutes a very good precedence for similar projects in the future.

- Importance of establishing a relationship of trust with local residents, collaboration and practical use of local NGOs

  The Alta Verapaz Department where the three sites of the Project are located had been receiving assistance related to rural electrification using renewable energy from other donors through the Solar Foundation, a local NGO, since 2004 (see footnote 2 for details). As such, at the time of the planning of the Project, there was already a relationship of strong trust between this NGO and the local residents. Through the activities of this NGO, the necessity for the empowerment of women was already well understood by male residents. In Guatemala, when any project is implemented in a rural non-Spanish speaking area with difficult access and with a high poverty rate, building a relationship of trust between the donor and the beneficiaries is extremely important for the success of the project. In this Project, employing a trusted local NGO as a local consultant to conduct technical assistance enabled the good use of the above mentioned relationship of trust.

- Registration of infrastructure development projects as state assets in Guatemala

  Land ownership in Guatemala is a very complicated issue due to the country's historical background. Many small-scale projects have been implemented based on an officially registered document approving land use rights between a land owner and user in accordance with customary law. However, if the assets of a project are not registered as state assets, the budget required to deal with a large-scale accident or breakdown may not be secured as has been the case of this Project. For similar infrastructure projects in the future, careful consideration should be given in the stage of project formulation and planning, in order to secure both the transfer of land ownership and registration as state assets.

Republic of Nicaragua

FY 2015 Ex-Post Evaluation of Technical Cooperation Project
"Project on Diffusion of the Sustainable Agricultural Technology for Small Farmers"

External Evaluator: Hajime Sonoda, Global Group 21 Japan, Inc.

0. Summary

The "Project on Diffusion of the Sustainable Agricultural Technology for Small Farmers" (hereinafter referred to as "the Project") was implemented to strengthen the diffusion system on sustainable agriculture of the Nicaraguan Institute of Agriculture and Livestock Technology (*Instituto Nicaragüense de Tecnología Agropecuaria*, hereinafter referred to as "INTA") and initiate the application of learned techniques by small-scale farmers in the Central North, Pacific South and Managua zones of Nicaragua[1], with the overall goal of diffusing sustainable agriculture among small-scale farmers in these areas. At the time of both planning and project completion, the introduction of techniques for sustainable agriculture was found to be highly consistent with the Government of Nicaragua's development policies and of high necessity. Moreover, since it was consistent with Japan's aid policies, the Project is highly relevant. The project purpose was largely achieved, and it is surmised that the overall goal was also attained. Furthermore, following completion of the Project, INTA had started widely promoting the techniques for sustainable agriculture and there has been an extensive impact; therefore, the effectiveness and impact of the Project are high. The Project period was within schedule; the activities on the whole proceeded smoothly; and the technical transfer by the Japanese experts was conducted effectively. However, because the project cost exceeded the planned amount, efficiency of the Project is fair. Sustainability of the Project in terms of policy, organization and technology is high. In financial terms, INTA has a high degree of dependence on donors. However, it is expected that activities in the demonstration farms that utilize the results of the Project will be continued even when the donor assistance comes to an end. Accordingly, sustainability of the Project is high.

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

[1] Target area of this project is the Central North Zone (those provinces of Matagalpa and Jinotega), the Pacific South Zone (those provinces of Masaya, Granada, Caraso, Rivas) and Managua Zone (Managua province).

1. Project Description

Project Location

Nursery tunnel for vegetable (pest management)

1.1 Background

The Republic of Nicaragua (hereinafter referred to as "Nicaragua") has a population of 5,670,000 people (2008), and it is one of the lowest income countries in Latin America due to the economic damage caused by the civil war that lasted for more than 10 years from 1979. The poverty reduction strategy that was compiled in 2005 intended to reduce the ratio of the population living in extreme poverty (annual income no higher than USD 200) from 15.1% to 11.5% by 2010. However, in order to achieve this goal, it was essential to address poverty via the vitalization of agricultural sector, which employs some 30% of the working population (as of 2008).

Almost all agricultural producers in Nicaragua are small and medium-scale farmers[2]. Problems facing the agricultural production were low productivity and profitability due to lack of technology including measures for soil fertilization management and pest control, lack of information on markets, lack of producers' organization for purchasing materials and selling products and so on. Furthermore, use of inappropriate pesticides had led to health problems and environmental contamination; while the growth of large plantations that conduct excessive pasturing and use large quantities of chemical fertilizers had caused the deterioration of soil fertility.

In response to such conditions, the Government of Nicaragua, while making efforts to increase agriculture products, through proposing "National Strategy for Promotion of Organic Farming in Nicaragua" in 2005 and other means, tried to promote "sustainable agriculture" as low-cost and competitive alternative agricultural technology that is suitable to the local situations[3]. Sustainable

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[2] Nicaragua has approximately 2.6 million farmers (producers), of which 94% are small and medium-scale farmers. Definitions of the scale of farmers differ between areas based on the type of crops and area of farmland.

[3] In Nicaragua, from the 1980s, international NGOs promoting fair trade started disseminating organic cultivation of coffee and cacao while private sector organizations introduced a certification system for organic farming. In addition, due to the influence of European and American NGOs and donors, groups such as National Union for Agriculture and Livestock started to disseminate sustainable agriculture from the 1990s. Entering the 2000s, against a backdrop of growing interest in and demand for organic farming and sustainable agriculture, the government compiled "National Strategy for Promotion of Organic Farming in Nicaragua" upon widely gathering information and exchanging opinions with farm producers, consumers, certification agencies, and groups promoting organic farming and sustainable agriculture all over the country.

agriculture is defined as “a farming system that restricts use of chemical fertilizers, agricultural chemicals, etc., and thereby contributes to the realization of safer food production and conservation of natural resources and environment, while aiming for higher productivity and incomes.” In order to resolve the problems facing small-scale farmers while observing this strategy, it is necessary to offer concrete options of techniques for sustainable agriculture to farmers. In Nicaragua, INTA used to be in charge of developing and diffusing agricultural techniques among small- and medium-scale farmers, however, it lacked experience in sustainable agriculture. It was against such a background that the Government of Nicaragua requested JICA to provide assistance for development and diffusion of techniques for sustainable agriculture to small-scale farmers, and the technical cooperation project for this was implemented from March, 2008[4].

1.2 Project Outline

The Project was implemented to strengthen the diffusion system on sustainable agriculture of INTA and initiate the application of learned techniques by small-scale farmers in the target areas, with the overall goal of diffusing sustainable agriculture among small-scale farmers in the Central North, Pacific South and Managua zones of Nicaragua.

Overall Goal		Techniques for sustainable agriculture are diffused among small-scale farmers in the target areas.
Project Purpose		The diffusion system of sustainable agriculture of INTA is strengthened, and small-scale farmers in the target area initiate using the learned techniques.
Outputs	Output 1	Techniques on sustainable agriculture are developed.
	Output 2	Methodology for technical certification for diffusion of techniques on sustainable agriculture is established.
	Output 3	Farmers in the target areas learn the techniques of sustainable agriculture.
Total Cost (Japanese Side)		382 million yen
Period of Cooperation		March, 2008 - March, 2013
Implementing agency		Nicaraguan Institute of Agriculture and Livestock Technology (INTA)
Other Relevant Agencies / Organizations		None
Supporting Agency / Organization in Japan		None
Related projects		“Project for Improvement of Living Standard through Promotion of the Farming Production in the Indigenous / Ethnic-Communities of Puerto Cabezas” (February, 2008-February, 2013), “Project on Community Level

[4] The Project targets being small farmers, however, because INTA makes no distinction between small-scale farmers and medium-scale farmers in its activities, the Project also included both small and medium-scale farmers among its targets. For simplicity, all target farmers are referred to as small-scale farmers in this report.

	Alliance for Strategical Implementation of Rural Development" (March, 2009-March, 2013), "Vocational Training Improvement Project in Agricultural and Livestock Sector" (September, 2013-September, 2018)

1.3 Outline of the Terminal Evaluation

1.3.1 Achievement Status of the Project Purpose at the Time of the Terminal Evaluation

Through the training and extension activities at the Demonstration and Training Plot (*Parcela Demostrativa y de Capacitación*; hereinafter referred to as "PDC"), the capacity building of INTA technicians (extension officers) has been realized[5]; it appears that the system for certification of technicians will be proposed, and the situation regarding application of techniques by the farmers targeted for diffusion of techniques for sustainable agriculture is good. Accordingly, it is judged that the degree of achievement of the Project purpose has been high.

1.3.2 Achievement Status of Overall Goal at the Time of the Terminal Evaluation (including other impacts)

Since it is scheduled for activities to be continued in the target areas following completion of the Project, it is judged that there is a good possibility that the indicator stating that "more than 840 small-scale farmers (40% of small-scale farmers) in the target areas practice the techniques for sustainable agriculture by 2016" will be achieved.

1.3.3 Recommendations at the Time of the Terminal Evaluation

Short-term recommendations targeting the end of the Project are as follows:

- Filing of activity reports on field tests and conversion of electronic data to CDs
- Preparation of a proposal concerning revision of the system for technical certification of technicians and utilization of the system
- Completion of the technical certification of technicians in the target areas
- Completion of technical pamphlets and manuals for technicians and farmers
- Improvement of the contents of the draft training curriculum for technicians and consolidation of training materials
- Preparation of the final version of the guidebook on PDC activities for pilot farmers
- Implementation of a project completion seminar

Long-term recommendations targeting after the completion of the Project are as follows:

- Continued implementation of validation tests in Technical Development Centers and PDCs
- Continuous improvement of the diffusion techniques and diffusion system

[5] INTA had "extension officers" up to the end of the Project. However, as a result of organizational reform, the description of these officers was changed to "technical innovation and transfer technicians" (*Técnico de Inovación y Transferencia Tecnológica*). (Refer section 3.2.2.2. (1) for details) In this report, the term "technicians" that is currently in common use is used.

- Preparation of additional pamphlets on techniques for sustainable agriculture
- Continuous revision of the training curriculum and training materials for technicians with the addition of technical improvements
- Formulate a strategy concerning adaptation and diffusion of techniques for sustainable agriculture as a package, and technical training for technicians outside of the Project target areas and extension officers of other organizations

2. Outline of the Evaluation Study

2.1 External Evaluator

Hajime Sonoda, Global Group 21 Japan, Inc.

2.2 Duration of Evaluation Study

The ex-post evaluation study for the Project was conducted over the following period.

Duration of the Study: October 2015 – Februrary 2017

Duration of the Field Survey: 26 February – 18 March, 2016

28 May – 2 June, 2016

2.3 Constraints during Evaluation Study

Concerning the composition and trends of budget, etc. in the implementing agency, it was not possible to acquire adequate information due to confidentiality. As a result, it was difficult to conduct the financial analysis in detail. Accordingly, sustainability was analyzed upon considering the contents and scale of the necessary costs and the types of INTA funding and so on for securing sustainability.

Moreover, because the field survey and beneficiary survey were conducted during the agricultural off-season, it was not possible to confirm the application of techniques on the land, making it difficult to acquire sufficiently accurate information concerning the application of techniques. Therefore, in cases where it was not possible to confirm the application of techniques in the field through the beneficiary survey, farmers were requested to explain the contents and applied conditions of techniques, and it was deemed that the techniques had been applied only in cases where specific and detailed explanations could be given.

3. Results of the Evaluation (Overall Rating: A[6])

3.1 Relevance (Rating: ③[7])

3.1.1 Relevance to the Development Plan of Nicaragua

As was described in section 1.1 Background, at the time of the ex-ante evaluation (2008), the Government of Nicaragua had proposed the National Strategy for Promotion of Organic Farming in Nicaragua (2005) and was promoting sustainable agriculture. Moreover, under the Ortega administration that commenced in 2007, as the national development plan of the highest level, the National Human Development Plan (2008-2012) made the promotion of agriculture sector, which provides employment for many impoverished people, one of the pillars of poverty reduction policy. The government displayed its intention to take various measures for enhancing food security on the domestic front, while supporting food self-sufficiency, making small-scale loans, diffusing improved seeds and so on with a view to promoting agricultural exports on the external front, as well as taking steps to establish a sustainable production setup in rural areas.

In 2009, the Ortega administration compiled the Program for Comprehensive and Sustainable Productivity and Rural Development (2010-2014) with the stated purpose of "contributing to fair human development while utilizing Nicaragua's natural resources on a sustainable basis." It then enacted the Law for Promotion of Agro-Ecological and Organic Production in 2011, proposing the framework of an official certification system geared to establishment of an organic agricultural market inside and outside of the country. Furthermore, in the new National Human Development Plan (2012-2016) that was announced in 2012, the policy of giving consideration to the conservation of natural resources was further clarified from the viewpoint of securing the sustainability of agriculture within initiatives aimed at expanding, diversifying and adding value to agricultural production[8]. As a result of such policies and initiatives, in 2014 INTA turned the focus of agricultural technologies for development and diffusion from agriculture that relies on large quantities of chemical fertilizers, pesticides and herbicides to sustainable agriculture. Moreover, the above plans also include responses to food security and climate change, and such themes are viewed with importance in the agricultural sector too.

As such, the Project is highly relevant to the development plans of Nicaragua at the time of planning and also at the time of its completion in 2013.

3.1.2 Relevance to the Development Needs of Nicaragua

As already mentioned in 1.1 Background, at the time of planning, agricultural producers in Nicaragua were faced with problems such as lack of techniques, market information and

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6 A: Highly satisfactory; B: Satisfactory; C: Partially satisfactory; D: Unsatisfactory

7 ③: High; ②: Fair; ①: Low

8 In this plan, "conservation of Mother Earth" is identified as an important policy issue and the following measures are emphasized: improvement of productivity, strengthening of responses to climate change and natural disasters, diversification of farm crops, utilization of local varieties, conservation of soil and water and so on.

organization. Also it was pointed out that use of improper agricultural chemicals is causing damage to human health and environment as well as depleting the fertility of farmland.

According to INTA, low productivity, soil degradation, lack of access to high-quality seeds and so on are still the problems that faced small-scale farmers at the time of ex-post evaluation, and INTA is tackling these issues mainly via techniques for sustainable agriculture. Additionally, there is a growing awareness that steps need to be taken to address issues of climate change such as the decline in rainfall brought about by the El Niño phenomenon, and INTA is responding to this through utilizing and furthering techniques for sustainable agriculture.

Based on the above, it is clear that the necessity for the Project is strong at the time of both the planning and Project completion.

3.1.3 Relevance to Japan's ODA Policy

Japan's Country Assistance Program for Nicaragua (2002) identified agriculture and rural development as one of the priority fields. JICA Country Program for Nicaragua (2007) also identified agriculture and rural development as one of the fields where technical transfer can be expected to have an impact. This Project was included in the program of assistance for sustainable productive technology in the agriculture and rural development field under the said program, and was regarded as making a contribution towards the issue of enhancing agricultural and livestock productivity. As such, the Project is consistent with Japan's ODA policies.

Based on the above, the Project is highly relevant to Nicaragua's development plans and development needs, as well as Japan's ODA policies. Therefore, its relevance is high.

3.2 Effectiveness and Impact[9] (Rating: ③)

3.2.1 Effectiveness

3.2.1.1 Revision of the Project Design Matrix

In the Project, the Project Design Matrix was revised at the time of the intermediate review survey (October, 2010). The target crops at the beginning of the Project were fruits and vegetables, however, in line with the Government of Nicaragua's decision to adopt a policy of placing emphasis on food security, staple crops such as rice, sweet corn, beans and so on were added to the targets while fruits were removed. Although this change was made in reflection of a policy shift and was an appropriate decision at the time, the switching of target crops midway through the Project impacted the efficiency of the activities. Furthermore, since many of the techniques for sustainable agriculture that were developed and diffused in the Project were applicable to crops that are labor intensive and were not entirely applicable to staple crops that entail large cultivated areas, they ended up being primarily applied to vegetables.

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

Output 2 was originally defined as “training system for diffusion of the developed techniques for sustainable agriculture is established,” however, “training system” was amended to “methodology for certification of technicians.” It was originally intended to embody contents for establishing a training system, however, technical certification was entirely the duty of the National Technological Institute and thus was not included in the work scope of INTA. Accordingly, the established technical certification methodology was only used for evaluating the capacity of INTA technicians during the Project, and it was not used any more following completion of the Project. As a result, it cannot be said that this modification was made based on sufficient examinations.

Apart from the above revisions, modifications were also made to clarify and enhance each indicator, which were largely appropriate.

3.2.1.2 Project Outputs and Process

（1） Development of techniques for sustainable agriculture (Output 1)

Following investigation of the farming conditions of small-scale farmers in the target areas and pre-existing techniques for sustainable agriculture, various tests were conducted with a view to developing techniques at three Centers of Technological Development in the target areas. INTA has approximately 90 researchers (as of 2009) engaged in the development of techniques around the country. Concerning the procedure for developing techniques, effectiveness is ascertained first through technical evaluation tests, and then the techniques are adapted via technical validation tests. The techniques that are certified to be practically applicable through both tests are listed in the Technology Catalog and are targeted for diffusion.

In the Project, 29 technical evaluation tests and eight technical validation tests were implemented on fruits, vegetables and staple crops. As a result, as techniques for improving soil fertility, “liquid fertilizer with fortified micronutrients” and “seedling raising soil utilizing crop residues” were newly added to the Techniques Catalog, while as techniques for controlling pests, “appropriate height of ridges in vegetable cultivation” and “utilization of sulfur and lime mixed material in bean cultivation” were added. Moreover, concerning more than 20 existing techniques that were already listed in the catalog, improvements were made via the Project, for example, locally available materials were used as alternative materials and so forth. In light of these facts, the Project output of developing techniques for sustainable agriculture was achieved[10].

[10] According to the indicators defined in the Project Design Matrix, the goal was to develop two techniques for improving soil fertility and two techniques for controlling pests, and both these goals were attained.

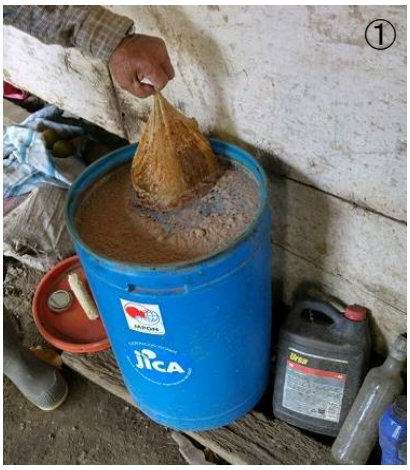
Box: Techniques (examples) for sustainable agriculture introduced in the Project

Technique for improving soil fertility; fertilizer

① Liquid fertilizer: Molasses, dead leaves with indigenous bacteria, cereal flour such as rice bran, grain flour, etc. are fermented. Sometimes, minute quantities of mineral components and bacteria are also added.

② *Bokashi*: This is made by piling and fermenting withered leaves, leaf charcoal (carbonized chaff), cow dung, grain flour, soil, molasses, etc.

③ Worm manure



Techniques for controlling pests

④ Sulfur and lime mixed material: Diluted and sprayed to prevent pests.

⑤ Insect trap: Insects are gathered and captured by luring with colors and odors.

⑥ Hedge fence: Infiltration by pests is prevented by means of a hedgerow.

Source: Compiled by the evaluator based on materials provided by JICA and INTA

（２） Capacity strengthening of technicians (extension officers) (Output 2)

INTA had approximately 200 technicians all over the country (as of 2009), and they were diffusing techniques mainly through making door-to-door visits to small-scale farmers. Also, they conducted field demonstrations in demonstration farms that were established in cooperating farmers. However, before the Project, because INTA was mainly concerned with diffusion of techniques for agriculture that utilized chemical fertilizers and agricultural chemicals, its technicians possessed hardly any knowledge on techniques for sustainable agriculture and even did not understand its necessity.

In the Project, Japanese experts conducted comprehensive training on techniques for sustainable agriculture for the INTA technicians and researchers. Over five years, a total of 1,345 persons received training that was conducted a combined 33 times over 53 days. Moreover, in third country training lasting approximately one week that was conducted four times in Costa Rica and the Republic of Dominica, a total of 60 trainees learned about the techniques being practiced in these two countries. In addition, 12 trainees were invited to Japan to take part in training on extension and organic farming techniques, vegetable cultivation and so on. In the final year of the Project, the foregoing activities were consolidated into training curriculums entitled “integrated pest control” and “management, conservation, fertility of soil” and these were proposed together with the “technical certification methodology” described hereafter.

In the latter part of the Project, the “technical certification methodology” concerning techniques for sustainable agriculture was proposed. Through written and field examinations, this aimed to evaluate the knowledge, skills and practical capacity for diffusion activities of technicians regarding techniques for sustainable agriculture, and certify technicians according to the three levels of beginner, intermediate and advanced. It was added to the activities of the Project at the time of the intermediate review as a concrete means of strengthening the training system for technicians. In accordance with the proposed methodology, 49 technicians out of 52 technicians in the target areas sat beginner level examinations in the two fields of “integrated pest control” and “management, conservation, fertility of soil and agroforestry,” and 47 of these received certification in both fields before the end of the Project.

In the interviews that were conducted in the ex-post evaluation, many counterpart persons said that the training inside and outside of Nicaragua had been effective, and that the field guidance by Japanese experts entailing analyzing and presenting solutions to problems on the spot had been very effective. According to the questionnaire with the technicians[11], more than 90% of the counterpart technicians rated the usefulness of the knowledge gained in the Project as “very high” or “high”. Moreover, approximately 80% responded that the training inside and outside of Nicaragua and the

[11] Questionnaires were sent to all of the 50 technicians of the INTA who were the counterparts in the target areas as well as 20 technicians selected randomly based on its list of members outside of the target areas, and responses were obtained from 28 and 19 technicians respectively (47 in total).

field guidance by Japanese experts had been “very useful,” while 20% rated it as “fairly useful” or “useful”.

Among the comments made by the technicians, they said the following: “Until the Project started, I thought that chemical fertilizers and agricultural chemicals were everything, and I did not trust organic agriculture at all. Now I know otherwise. The JICA Project has been like a school for us.” On accompanying the technicians on visits to farms, it could be seen that they have acquired ample capability to utilize techniques for sustainable agriculture in resolving the issues faced by farmers. At the time of the ex-post evaluation, many of the technicians who received certification in the Project were serving as instructors in training targeting farmers and extension officers in other government agencies.

In view of the above, it is deemed that the capacity of technicians in the target areas was improved greatly through the Project.

（３） Diffusion of techniques for sustainable agriculture (Output 3)

Diffusion activities by INTA were centered around making visits to individual farmers. However, activities in the demonstration farms, which have been conducted separately, were left to each technician in charge and not operated in an organized or efficient manner. In the Project, diffusion of techniques for sustainable agriculture to farmers in the target areas was conducted upon constructing an organized and efficient diffusion setup utilizing the PDCs that were developed from the conventional demonstration farms.

During the Project, a total of 227 PDCs were established in the target areas. The PDCs were established with the cooperation of farmers, and the technicians in charge conducted diffusion activities through distributing farm tools and materials, and conducting training and technical assistance for cooperating farmers, Practical Demonstrations and Field Day for local farmers, and Technical Exchange Trips between farmers based on a one-year plan of activities[12]. Following completion of the first year of activities, follow-up and evaluation of results were conducted for one or two more years. Since 10 or more local farmers on average participated in the activities in each PDC, it is estimated that more than 2,000 farmers have received diffusion of techniques[13]. Moreover, as teaching materials concerning the techniques for sustainable agriculture, 11 pamphlets, 17 posters, six manuals, etc. have been prepared and distributed to farmers. In the fourth year of the Project, a monitoring survey of the extension activities at PDCs was conducted, and the results were used in

[12] In the Practical Demonstrations, cooperating farmers and nearby farmers practiced and learned specific sustainable farming techniques under the guidance of the INTA technicians. In the Field Day, nearby farmers were invited to witness the results of the sustainable farming techniques and receive lessons with a view to promoting dissemination. At the Technical Exchange Trips between farmers, farmers were invited from nearby villages in order to exchange information and opinions on the practice of sustainable farming techniques, again with the aim of promoting diffusion.

[13] During the Project period, Practical Demonstrations were held a total of 476 times for 6,382 participants, while Field Days were staged 79 times for 2,228 participants, and Technical Exchange Trips were held nine times and gathered 265 participants.

reviewing the diffusion techniques. In the fifth year of the Project, the above activities were compiled into a PDC operating manual.

Since the goals of the diffusion activities have been achieved and conditions regarding the learning and application of techniques for sustainable agriculture among targeted farmers have been good, it is thought that adequate progress has been made concerning the acquisition of techniques for sustainable agriculture among small-scale farmers in the target areas[14].

3.2.1.3 Achievement of Project Purpose

Table 1 Degree of Achievement of the Project Purpose

Project Purpose	The diffusion system of sustainable agriculture of INTA is strengthened, and small-scale farmers in the target area initiate using the learned techniques. <Generally achieved>
Indicator	Results
① At least 50% of technicians receive technical certification in two or more techniques	By the end of the Project, 47 out of 52 technicians (90%) in the target areas received beginner level technical certification in two or more techniques. <Achieved>
② At least 70% of PDC farmers apply techniques for sustainable agriculture introduced by the Project	By the end of the Project, techniques for sustainable agriculture were being practiced at least by 151 out of 227 PDC farmers (67%, including 29 farmers practicing in their own fields after receiving training in the PDCs). <Generally achieved>

The project purpose was: "The diffusion system of sustainable agriculture of INTA is strengthened, and small-scale farmers in the target area initiate using the learned techniques." It was anticipated that the project purpose would be achieved through the preparation of techniques to diffuse for sustainable agriculture based on development and improvement of techniques (Output 1), the capacity strengthening of technicians (Output 2), and efficient diffusion activities centered on PDCs (Output 3).

As is indicated in Table 1, the degree of achievement was high regarding the two indicators set for the project purpose. According to the findings of the beneficiary survey[15], concerning the application of techniques (Indicator ②), since 93% of PDC farmers (farmers who own PDC and cooperated with the Project) are practicing the techniques for sustainable agriculture that were introduced in the Project at the time of the ex-post evaluation, it is highly possible that the degree of

[14] It was intended to establish 210 or more model fields with 2,100 or more participants. Concerning the application of techniques, see section 3.2.1.3 Achievement of the Project Purpose.

[15] In the ex-post evaluation, a questionnaire survey targeting farmers in the target areas was implemented as the survey of beneficiaries. The survey targeted 44 PDC farmers (randomly selected by allocating quotas to each municipality according to the INTA register) and 76 other farmers (37 farmers introduced by PDC farmers, and 39 farmers considered to be representative in the communities of PDC farmers), and comparative analysis was conducted between the benefiting farmers (97 farming households that received training in the Project or from INTA) and non-benefiting farmers (23 farm households that received no such training).

achievement at the completion of the Project was in excess of 70%[16]. Furthermore, although not included in the indicators, it can be said that strengthening of the sustainable agriculture diffusion system, which was part of the project purpose, was aided by two factors, namely 1) numerous diffusion materials giving an easy commentary on techniques for sustainable agriculture to farmers were prepared, and 2) a more organized and efficient diffusion system was established through utilizing the PDCs.

In view of the above, the Project largely achieved its purpose.

3.2.2 Impact

3.2.2.1 Achievement of Overall Goal

The overall goal of the Project was: "Techniques for sustainable agriculture is diffused among small-scale farmers in the target areas." In specific terms, it was anticipated that 40% of the small-scale farmers that received technical transfer in the PDCs would be practicing techniques for sustainable agriculture by 2016 through continuous extension activities modeled in the Project in the target areas.

According to the findings of the beneficiary survey, 61% of indirect benefiting farmers (farmers who have received training or technical transfer from INTA but are not the PDC farmers) in the target areas utilize techniques for sustainable agriculture in some form or other. Moreover, according to a questionnaire survey with technicians (counterparts), they estimate that approximately 50% of PDC farmers and approximately 40% of nearby farmers (indirect benefiting farmers and non-benefiting farmers) are using techniques for sustainable agriculture in some form or other (these figures express the average values in the responses given by the technicians). Summing up, it is inferred that target level of the indicator (40% of the indirectly benefiting farmers are using some techniques for sustainable agriculture introduced by the Project) was achieved, therefore, the overall goal has been achieved.

[16] According to the Project completion report (March 2013), there were 122 farmers who were still continuing activities in the PDCs when the Project was finished. Furthermore, it was confirmed that 29 farmers who had received training in PDC were implementing sustainable agriculture autonomously. It is assumed that these 151 farmers were practicing sustainable farming techniques at the time of Project completion. In addition, out of 104 farmers who had completed PDC activities by the time the Project was completed, it is thought that some were still practicing sustainable farming techniques at the time of Project completion. According to a survey implemented during the Project (2012), approximately 90% of the farmers who had practiced sustainable farming techniques in the past were continuing to practice them. In view of these findings, it was concluded that "the ratio of continuing use of the techniques is high and the situation regarding application of techniques is good" in the terminal evaluation. Following Project completion, INTA support for PDC farmers was gradually finished. However, according to the beneficiary survey at the time of the ex-post evaluation, the techniques application rate was more than 90%, indicating the possibility that it was higher than the ratio of 70% at the time of Project completion.

Table 2 Degree of Achievement of the Overall Goal

Overall Goal	Techniques for sustainable agriculture are diffused among small-scale farmers in the target areas. <Presumed to have been achieved>
Indicator	Results
More than 840 small-scale farmers (40% of small-scale farmers) in the target areas practice techniques for sustainable agriculture by 2016.	61% of indirect benefiting farmers (farmers who have received training or technical transfer from INTA but are not PDC farmers) in the target areas utilize techniques for sustainable agriculture in some form or other. (According to the beneficiary survey)

Note: The small-scale farmers targeted by the above indicator are farmers who have received training on techniques for sustainable agriculture in PDCs. It was assumed that 10 farmers would receive training at each of the 210 PDCs, and that 840 farmers (40% of the total number) would practice the techniques.

According to the interviews in the field survey, almost all of the PDC farmers have retained and are utilizing the knowledge they have learned about techniques for sustainable agriculture over the extent that is necessary or possible for them. There have been striking success stories of farmers who have purchased additional land for vegetable cultivation, farmers who are retailing organic fertilizers and so on. The techniques are mostly utilized for cultivating vegetables. But, they are also utilized in cultivation of cereals, fruits, coffee and so on. However, in the south of the country, many farmers find it difficult to cultivate vegetables at all due to drought.

According to the results of the interviews with technicians and benefiting farmers and the beneficiary survey, the techniques for sustainable agriculture impart the following kinds of merits and their diffusion is being promoted by them. Among these, reduction of production costs is the most practical merit for accelerating the diffusion of techniques.

- Through utilizing materials such as remains of crops and old leaves etc. that can be acquired locally at the farm at no cost, use of chemical fertilizers and pesticides can be reduced. As a result;
  - Production costs can be reduced (cited by almost all the benefiting farmers).
  - Farmers who were previously unable to purchase chemical fertilizers and pesticides have been able to increase production and cultivate new crops (cited by 80% of benefiting farmers).
- Organically cultivated crops are recognized to be good for health and are popular in markets (cited by 70% of benefiting farmers).
- Due to reduction in use of pesticides, health damage has declined among producers (cited by almost all the benefiting farmers).

On the other hand, the following constraints on diffusion of techniques for sustainable agriculture can be seen.

- Availability of some of the materials that need to be purchased is limited; nursery tunnel materials, mineral for making liquid fertilizer (boron, molybdenum, etc. in order to supply as micronutrients), etc.
- Small-scale farmers lack the economic means to purchase the necessary materials.
- Since it takes time and effort to prepare organic fertilizer, it is hard to apply it to large-area crops (It is suitable for vegetables and fruits but not for cereals).
- Drought has continued for three years, making it difficult to cultivate vegetables in coastal areas and so on.


Vegetable fields of a benefiting farmer


(Left) Production and sale of worm fertilizer by a benefiting farmer

(Right) Preparation of organic fertilizer from coffee husks

3.2.2.2 Continuation of Activities following Completion of the Project

（１） Changes in the Organizational Structure of INTA

In 2012, the Government of Nicaragua established the Ministry of Family, Communal, Cooperative and Associative Economy and conducted organizational revamping placing all rural development infrastructure projects and extension activities including agricultural sector under the jurisdiction of this ministry. In line with this, the role of INTA was restricted to research and development and technical transfer (training) for producers, educational institutes and other governmental organizations responsible for extension activities, and it no longer conducted technical assistance through door-to-door visits to farmers. At the same time, a new term – an agricultural technique innovation and transfer technician – came to be used instead of an extension technician.

Technical transfer activities were previously managed by the research department. However, in order to strengthen the management of activities related to technical transfer, INTA established a new Technical Transfer Department.

（２） Development of techniques for sustainable agriculture (Output 1)

Concerning the development of techniques, following completion of the Project, techniques have been continuously developed and improved via field test of various kinds. Some achievements include; application of techniques originally developed for vegetables to staple crops, coffee, etc.; continuation of the tests started for fruits; practical application of the improved rice varieties that were introduced on a trial basis in the Project, etc.[17] Moreover, there are plans to improve some of the techniques via assistance from other donors.

（３） Capacity strengthening of technicians (extension officers) (Output 2)

Concerning the training of INTA technicians, the INTA regional offices compile the training needs and prepare annual training programs based on them. With respect to technicians in areas other than those targeted in the Project, similarly, training programs are implemented according to each area's annual training needs. INTA employees serve as the instructors, but training is sometimes consigned to universities. Concerning newly recruited technicians, in addition to the abovementioned training, on-the-job training is conducted by veteran technicians. There are no training programs for the small numbers of new recruits only[18].

According to INTA, it is not possible to use the training curriculum proposed in the Project as it

[17] In the Project, a sucker variety of paddy rice, which enables the environmental damage caused by slash and burn farming to be reduced, was introduced from the Republic of Dominica (sucker refers to a young shoot that grows from a tree stump or root). Following completion of the Project, validation tests for this was completed, and it is scheduled to be distributed during 2016 as an official improved variety.

[18] There is not a lot of turnover among the INTA researchers and technicians. However, following completion of the Project, some new technicians have been employed in the target areas. According to INTA, because universities have recently started teaching techniques for sustainable agriculture, even new recruits possess basic knowledge and are able to serve as training instructors after gaining two or three years of practical work experience.

is, while they are used as reference material for planning training programs, because the training needs are always changing according to time and place. Following completion of the Project, certification examinations for technicians have not been implemented and the technical certification methodology has not been used. According to the explanation given by INTA, its mandate does not include "certification of technical capacity"[19].

（4） Diffusion of techniques for sustainable agriculture (Output 3)

In the Project target areas, approximately 90% of the Project counterparts were continuously employed by INTA and were playing a major role in researching and transferring techniques for sustainable agriculture at the time of the ex-post evaluation. Furthermore, from 2014, the agricultural techniques handled by INTA were entirely changed to techniques for sustainable agriculture, and the development and transfer of such techniques came to be implemented over not just the Project target areas but the entire country[20]. Concerning the transfer and diffusion of techniques for sustainable agriculture, following completion of the Project, INTA has mainly been conducting activities by the following methods.

Demonstration Farms

Technical transfer to farmers' groups has been conducted based on the Demonstration Farms (officially called Technical Investigation and Innovation Farms), which were newly established from 2014. The contents and mechanism for operating the Demonstration Farms were established through developing the mechanism of PDCs that was established in the Project, although some Demonstration Farms are different in that they also include livestock, cover a larger area of farmland and entail five years of activities as standard (activities for the PDCs under the Project were for 2 – 3 years). Furthermore, because the Demonstration Farms can be used to conduct validation tests, which represents the final stage of technical development, they are the hubs for developing and diffusing techniques for sustainable agriculture. By 2015, approximately 600 Demonstration Farms had been established all over Nicaragua and INTA plans to further increase these from now on. In the Project target areas, some of the PDCs that were established in the Project are being utilized as Demonstration Farms. Activities at the Demonstration Farms include the demonstration and display of techniques for sustainable agriculture, practical demonstration and on-site trainings targeting nearby farmers, and so on. According to the interviews with technicians, although the manual for PDCs that was created in the Project has not been adopted as it is because the PDCs have been

[19] The National Technological Institute is the agency with official responsibility for certification. When the introduction of technical certification methodology was included in the plan at the time of mid-term review (October 2010), this point was not clearly recognized. After that it became obvious while examining such methodology in detail. The experts anticipated that by utilizing this in the evaluation of capacity of technicians, it could be used to help strengthen the training system.

[20] For this reason, the quantities of chemical fertilizers and agricultural chemicals purchased by INTA for research and diffusion purposes in 2015 were roughly one twentieth of the quantities in 2007.

changed to the Demonstration Farms, around 80% of the contents are being utilized on the demonstration farms.

Technical transfer to other agencies

Having inherited agricultural techniques extension activities from INTA, the Ministry of Family, Communal, Cooperative and Associative Economy has newly recruited extension officers and conducts extension activities for farmers and farmers' groups. The INTA researchers and technicians conduct training (indoor and practical training) for the Ministry's extension officers at its Technical Development Center, etc.

The Government of Nicaragua has been implementing the "Rural Technical School" program described on the following pages since 2014, and the researchers and technicians of INTA serve as lecturers in the training for extension officers and technicians that take part in the program from relevant agencies (National Technological Institute, Institute of Agricultural Protection and Safety [*Instituto de Protección y Sanidad Agropecuaria*], Ministry of Family, Communal, Cooperative and Associative Economy, Ministry of the Environment and Natural Resources [*Ministerio del Ambiente y de los Recursos Naturales*], Ministry of Agriculture and Live Stock [*Ministerio Agropecuario*], etc.).

The vocational schools run by the National Technological Institute conventionally had been teaching mainly agricultural technologies centered on chemical fertilizers and agricultural chemicals, but from 2013 onwards they also came to teach techniques for sustainable agriculture. Accordingly, lecturers in charge of agriculture at the National Technological Institute received training from INTA, and under guidance from INTA, established demonstration plot on the campus ground to teach techniques for sustainable agriculture.

Rural Technical School

The Office of the President started the program of Rural Technical School in 2014 and deploys technical training in rural communities all over the country. The National Technological Institute plays the central role in implementing the program. Technicians of the National Technological Institute and relevant agencies are developed as facilitators (instructors) and once a week for periods ranging from seven to nine months, conduct technical training for small-scale farmers and agricultural laborers based on classroom learning and practical training concerning topics such as introduction on natural resources, water and soil conservation and improvement, pest management, farm management and so on. In two years between 2014 – 2015, approximately 31,000 farmers, equivalent to 12% of all farmers in Nicaragua, received training of this kind.

The Rural Technical Schools exclusively deal with techniques for sustainable agriculture, and their teaching materials are prepared in cooperation with the National Technological Institute, INTA, other relevant agencies and universities. Each regional department has its own training team to

prepare facilitators. INTA researchers and technicians also join the training teams, while the INTA technicians also act as facilitators in some technical training.

3.2.2.3 Other Impacts

(1) Impacts among benefiting farmers in target areas

As was described in section 3.2.2.1 Achievement of the Overall Goal, many of the benefiting farmers who utilize the techniques for sustainable agriculture in the Project have reported merits such as reduction of production costs, increased production, cultivation of new crops (vegetables, etc.) and so on. Concerning the reduction of production costs, INTA has reported the cases where costs have actually been cut by between 20 – 40% and that this is the most practical merit supporting the introduction of techniques for sustainable agriculture.

In the field visit, it was found that yields of tomatoes, green peppers and other vegetables have increased because farmers are able to deal with pests without using pesticides, while some farmers who had previously abandoned the idea of vegetable cultivation have started growing vegetables. As striking examples, some farmers have learned vegetable cultivation for the first time in the Project and have used its profits to buy additional farmland, while other farmers have started producing worm fertilizer and liquid fertilizer in large quantities and selling it to nearby farmers. Thus, the Project has had an impact on such farmers in terms of improving income and quality of life. Additionally, there have been cases where vegetable farming that had been previously limited had displayed geographical expansion (Pacific South Zone), cases of large-scale farmers introducing vegetable nursery tunnels inspired by the introduction of the same by small-scale farmers (Central North Zone), cases where farmers who received training in PDCs formed groups to jointly purchase materials and start producing fertilizers, pest control materials and seedlings (Managua Zone) and so forth.

Moreover, in the beneficiary survey, almost all farmers said that limiting use of pesticides would contribute to improving the health of producers and consumers. The Government of Nicaragua established the Institute of Agricultural Protection and Safety in 2014 and has been conducting food safety initiatives for farm products including a mass media campaign aimed at raising awareness, and a similar heightening in awareness can be seen among farmers. However, apart from one instance in which a farmer no longer suffered from a skin rash caused by pesticides, no concrete examples have been confirmed.

Moreover, according to the interviews in the field surveys, crops (especially vegetables) that have been produced without using chemical fertilizers and pesticides are popular in markets and quickly sell out. However, because there is no certification system for organic products, the farmers are unable to differentiate prices[21]. As the market for organic crops becomes more established from

[21] In Nicaragua, organic certification is conducted by the private sector mainly with a view to exporting coffee, cacao and honey. However, there are no certification systems concerning other crops or domestic markets. The

now on, it is thought that the merits of techniques for sustainable agriculture will become even more widespread.

(2) Impact in areas other than the target areas

As was described in section 3.2.2.2 Continuation of Activities following Completion of the Project, INTA now only deals with techniques for sustainable agriculture on the national scale. Diffusion of sustainable agriculture is being practiced in 600 Demonstration Farms established throughout the country.

Additionally, in the vocational schools of the National Technological Institute and the National Program of Rural Technical School being implemented by the Office of the President, techniques for sustainable agriculture are handled in cooperation with INTA, thereby helping to diffuse them all over the country. In particular, in the latter of these programs, approximately 12% of all small-scale farmers in the country have received training about techniques for sustainable agriculture in three years, demonstrating the speed of diffusion taking place.

In this way, the Project has contributed to the nationwide diffusion of techniques for sustainable agriculture through enhancing INTA's capacity in that field.

(3) Linkage with other JICA technical cooperation projects

In Nicaragua, there are three technical cooperation projects in the agricultural sector linked to the Project, imparting the following kind of linkage and synergistic effects. In the "Project for Improvement of Living Standard through Promotion of the Farming Production in the Indigenous / Ethnic-Communities of Puerto Cabezas" (February, 2008 – February, 2013) and the "Project on Community Level Alliance for Strategical Implementation of Rural Development" (March, 2009 – March, 2013), the Project's contribution has only been partial and limited. However, in the "Vocational Training Improvement Project in Agricultural and Livestock Sector" (September, 2013 – September, 2018, under implementation), the Project counterparts have made an important contribution.

<u>Project for Improvement of Living Standard through Promotion of the Farming Production in the Indigenous / Ethnic-Communities of Puerto Cabezas</u>

In the city of Puerto Cabezas, which is located in the indigenous autonomous region on the Atlantic side of Nicaragua, the municipal government, university and NGOs have established a rural development committee to work on developing promoters, disseminating agricultural techniques to farmers' groups and improving livelihoods. While there is no INTA office in this area, the experts

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Agricultural Ecological and Organic Production Promotion Law that was enacted in 2011 is a legal framework for an official organic farming market. However, according to INTA, no new certification agencies have been established based on this law, and the operating criteria are too stringent for many farmers. As a result, development of such a market has not yet been realized.

from both projects conducted regular exchange and promoted transfer of techniques for sustainable agriculture through conducting training for the local counterparts and promotors. As a result, some farmers were able to start cultivation of vegetables through the activities of this project. However, due to differences in soil and weather conditions, there were some situations where not all the techniques used in the Project could be applied as they are.

Project on Community Level Alliance for Strategical Implementation of Rural Development

Through forming and implementing model activities responding to the needs of target communities via a participation process based on linkage among local administrative agencies, agricultural cooperative associations, communities, etc. in the target areas (within the scope of target areas of the Project), this project aimed to build a system to facilitate collaboration between parties engaged in rural development. INTA technicians (the Project counterparts) conducted evaluation of farming potential, provided techniques for sustainable agriculture, supplied seeds and so on in the rural development model activities. It has been confirmed that the techniques for sustainable agriculture (organic fertilizer, mulch, etc.) introduced in this project continue to be utilized by the beneficiaries of these model activities.

Vocational Training Improvement Project in Agricultural and Livestock Sector

This project has been implemented with the objective of creating the education curriculums[22] and teaching materials for the agricultural sector at vocational schools run by the National Technological Institute and enabling the teachers of these schools to adequately conduct guidance on agricultural and livestock techniques at the schools. Some counterparts (INTA researchers and technicians) have participated in the technical committees charged with creating teaching materials and curriculums in each field, and they have made a technical contribution based on the knowledge and experience acquired in the Project. Moreover, the various materials (pamphlets, training resources) that were created in the Project concerning techniques for sustainable agriculture are being referred to.

(4) Social and environmental impacts

The techniques for sustainable agriculture are environmentally friendly agricultural techniques, and the Project has imparted favorable impacts on the natural environment through their diffusion. No negative impacts have been confirmed in terms of environment and society (resettlement of residents) and so on.

[22] There are 15 vocational schools in the agriculture field throughout the country.

Summarizing the evaluation on effectiveness and impacts of the Project, with the implementation of the Project, the project purpose "the diffusion system of sustainable agriculture of INTA is strengthened, and small-scale farmers in the target area initiate using the learned techniques" has been generally achieved. In terms of the overall goal as well, effects have been realized as planned and the impact has been far reaching. Therefore, the effectiveness and impact of the Project are high.

3.3 Efficiency (Rating: ②)

3.3.1 Inputs

The planned and actual inputs by the Japanese and Nicaraguan sides to the Project are outlined in the following table.

Table 3 Comparison of Planned and Actual Inputs in the Project

Inputs	**Plan**	**Actual** (at the time of project completion)
Japanese Side		
(1) Dispatch of experts	3 long-term experts (180 person-months), some short-term experts	6 long-term experts (145 person-months), 4 short-term experts (35 person-months) (general management, cultivation techniques, organic fertilizer, diffusion, training, work coordination)
(2) Trainees received	A few trainees each year	Training in Japan: 12 trainees Third country training: 60 trainees
(3) Provision of equipment	Vehicles, training equipment and materials, construction of facilities, etc.	Vehicles, motor cycles, ploughing machines, PC, printer, copier, projector, etc.
(4) Operational expenses	Training, creation of reference and teaching materials, survey, preparation of PDCs, etc. (scheduled cost unknown)	Training, creation of reference and teaching materials, survey, preparation of PDCs, etc. (624,000USD)
Japanese side Total Project Cost	Total approximately 310 million yen	Total 382 million yen
Nicaragua side		
(1) Assignment of counterparts	30 persons	70 persons
(2) Others	Experts' offices, furniture, stationery, other work expenses	Provision of Project offices, storage, meeting rooms, etc.
(3) Project overheads	Fuel cost, office expenses, diffusion expenses, business travel expenses, etc.	Fuel cost, office expenses, diffusion expenses, business travel expenses, etc.: 14,000USD (estimate as of September 2012)

Source: Created based on materials provided by JICA

3.3.1.1 Elements of Inputs

While the long-term experts were replaced midway through the Project, the Japanese experts were dispatched more or less as planned. INTA generally assessed the experts to have high capacity. The number of assigned counterparts was 70, far more than planned, and 60 of these took part in third country training that was not specified in the plan. The basic capacity of INTA researchers and technicians was high, and the large increase in the dispatched number of counterparts targeted for capacity building helped enhance the efficiency of the Project. Equipment supply on the Japanese side went almost exactly as planned and was appropriate.

According to the Terminal Evaluation report and interviews with the experts and counterparts, it is deemed that efficiency of implementation of the Project was affected by the following conditions.

- In the second year of implementation, there was a change of target crops from fruits to staple crops. Accordingly, the outputs from the earlier fruit initiatives were not realized, while the time spent on initiatives for staple crops was shorter than the full five years of the Project, meaning that efficiency was somewhat diminished as a result.

- At the beginning of the Project (1st and 2nd year), communications between the Japanese experts and some counterparts on the central office level were inadequate, and there was a period when organized activities could not be realized as a result. Moreover, the joint coordinating committee was staged for the first time towards the end of the second year of the Project. In the Terminal Evaluation, it was pointed out as the background of the above that the experts had failed to make a sufficient effort to build common understanding among the stakeholders concerning the activities implemented according to the Project's planning framework.

- Apart from the period described above, communications between the Japanese experts and counterparts were extremely smooth; the activities proceeded well, and many positive outputs were achieved as mentioned earlier. Factors behind this were as follows: communication skill of the newly appointed experts were high, all the counterparts actively engaged in the Project activities encouraged by government and INTA policies of encouraging sustainable agriculture, and numerous experts who had experience of similar technical cooperation in other Latin American countries participated in the Project. INTA thought that the on-the-job training in field, in which experienced experts visited farmers together with the counterparts, was extremely effective and unique to the Project as opposed to other donor projects.

3.3.1.2 Project Cost

The total Project cost for the Japanese side was originally planned to be approximately 310 million yen. The actual cost of 382 million yen exceeded the planned cost (123% of the planned cost). As there was not a huge cost over-run and the details of the planned cost are unknown, it was impossible to determine the reasons for this cost over-run.

3.3.1.3 Period of Cooperation

The planned project period was 60 months from November, 2007 to November, 2012. The commencement of the Project was delayed by four months; nevertheless, the Project was completed over the originally planned 60 months from March, 2008 to March, 2013.

Summing up, some aspects of the Project activities were inefficient and, although the Project was implemented within the originally planned period, the Project cost exceeded the plan. Therefore, efficiency of the Project is fair.

3.4 Sustainability (Rating: ③)

3.4.1 Related Policy and Institutional Aspects for the Sustainability of Project Effects

As already mentioned in 3.1 Relevance, the promotion of sustainable agriculture was a priority area of policy at the time of the project completion, and is still a priority area of policy at the time of ex-post evaluation. Policies in recent years have placed emphasis on the introduction of techniques for the conservation and sustainable management of natural resources such as land and water and the introduction of environmentally friendly techniques. In response to this, INTA has completely changed the focus of the agricultural technologies it handles, shifting from conventional agriculture that relies on large quantities of chemical fertilizers, pesticides and herbicides to sustainable agriculture, and it is now continuing the development and technical transfer (diffusion) of techniques for sustainable agriculture over the entire country at the time of ex-post evaluation as explained in the section on Impact. Accordingly, the Project is deemed to have high sustainability in policy and institutional aspects.

3.4.2 Organizational Aspects of the Implementing Agency for the Sustainability of Project Effects

With establishment of the Ministry of Family, Communal, Cooperative and Associative Economy in 2013, all extension activities in the various fields in rural areas were placed under the jurisdiction of this ministry, and INTA ceased to conduct technical support through door-to-door visits to farmers. However, diffusion of techniques via the PDCs that were started in the Project is being continued as technical transfer based on Demonstration Farms. Moreover, in order to strengthen technical transfer activities to other organizations, demonstration farms, etc., it has

established Technical Transfer Departments in its headquarters and regional offices and constructed a system in which dedicated employees conduct management of technical transfer activities that was previously conducted concurrently by researchers.

On the other hand, concerning research in the agricultural field, in order to conduct research and diffusion of research outputs more efficiently and effectively through strengthening links between government agencies (including INTA), universities, producers (farmers), production cooperatives and so on, the government has established the “National Agricultural Research System” as an institutional framework.

In this way, concerning the extension activities of INTA, the setup for continuing technical transfer activities based on the Demonstration Farms, and the system for advancing the diffusion of techniques going beyond the organization framework have been strengthened. Accordingly, the Project sustainability in organizational aspects is high.

3.4.3 Technical Aspects of the Implementing Agency for the Sustainability of Project Effects

The retention rate of INTA researchers and technicians is high, with more than 90% of counterparts in the Project target areas continuing to work at INTA at the time of the ex-post evaluation. The INTA researchers and technicians in general have high interest in technology, and more than half of the Project counterparts can perform technical transfer to other agencies. Some of the counterparts are working with university professors, etc. on the technical committee charged with revising the education curriculums and teaching materials of the National Technological Institute. The high level of interest and technical capability of the counterparts were sensed from the responses to the interviews.

INTA implements training for technicians every year. The regional offices judge the necessity of training programs, make applications to headquarters, and implement the training that has been approved. There are few new recruits and no special training is conducted for rookie technicians, but new recruits slowly learn from veterans on-the-job. According to the technicians and so on, even new recruits become able to serve as instructors in rural technical colleges after two or three years’ experiences in field.

According to the questionnaire survey with technicians, the non-counterpart technicians (those in areas not targeted by the Project) are relatively inferior to the counterparts in terms of degree of training and ability concerning techniques for sustainable agriculture (Table 4). Since the non-target areas have no opportunities for overseas training or on-the-job training by experts such as was implemented in the Project, they do not benefit from the training effects.

Table 4 Degree of Training and Knowledge of INTA Technicians concerning Sustainable Agriculture

	Technicians in target areas (counterparts)	Technicians outside of target areas
Have received training in techniques for sustainable agriculture following the Project completion	36%	11%
Possess adequate knowledge on techniques for sustainable agriculture	89%	32%

Source: Questionnaire survey of INTA technicians
(28 technicians in target areas, 19 technicians outside of target areas)

Following completion of the Project, INTA has printed additional copies of the training and diffusion materials that were created in the Project; has distributed them and utilizes them in diffusion activities. According to the questionnaire survey with technicians, 85% of the counterparts still have the manuals that were created in the Project (two manuals: "Preparation of organic fertilizer and liquid fertilizer" and "Diagnosis of the main diseases of vegetables"), and 63% of counterparts still use them. Also, more than 80% of counterparts are able to utilize the training and diffusion materials (11 pamphlets, 17 posters, 6 manuals, etc.) that were created in the Project, and 90% of them rate their usefulness very highly.

Summing up, the counterpart researchers and technicians have displayed sufficiently high technical capability and retention rate; the manuals and teaching materials that were created in the Project are utilized, and the technical development and the abovementioned diffusion activities continue to be implemented (also see section 3.2.2.2 Continuation of Activities following Completion of the Project). Accordingly, technical sustainability of the Project is maintained in the target areas. However, in order for sustainable agriculture to further spread all over the country, ample capacity building will be necessary in areas other than the Project target areas.

3.4.4 Financial Aspects of the Implementing Agency for the Sustainability of Project Effects

INTA covers the general administrative expenses including personnel costs out of its own budget, although it depends on donors and other agencies to finance its activities budget[23].

The Demonstration Farm activities that were started in 2014 (see section 3.2.2.2 Continuation of Activities following Completion of the Project) extend the Project outputs over the entire country in a more developed form, and enough funds to finance activities up to 2017 have been secured through assistance from the Inter-American Development Bank[24]. Even after this assistance is finished, INTA plans to continue developing techniques for sustainable agriculture and to maintain

[23] According to INTA, at the time of the ex-post evaluation, INTA was implementing 25 or more donor projects, and the combined budget of these was equivalent to roughly 80% of the INTA activities budget.
[24] Program for Productivity Promotion of Sustainable Agriculture

activities at the Demonstration Farms as nationwide hubs for conducting development and diffusion activities.

Since the Demonstration Farm activities are the main responsibility of the technicians, so long as technicians are employed by INTA, it is likely that activities at the Demonstration Farms will be continued regardless of whether or not donor funding is available. Considering the fact that the government places high priority on sustainable agriculture and INTA has come to fully be engaged in sustainable agriculture, it is highly likely that a budget for activities will continue to be secured even after the aforementioned assistance by the Inter-American Development Bank comes to an end. Also considering that various activities are being continued and extended following completion of the Project, it is judged that financial sustainability is on the whole high.

Summing up, no major problems have been observed in the policy background and the organizational, technical, financial aspects of the implementing agency. Therefore, sustainability of the project effects is high.

4. Conclusions, Lessons Learned and Recommendations

4.1 Conclusions

The Project was implemented to strengthen the diffusion system on sustainable agriculture of the INTA and initiate the application of learned techniques by small-scale farmers in the Central North, Pacific South and Managua zones of Nicaragua, with the overall goal of diffusing sustainable agriculture among small-scale farmers in these areas. At the time of both planning and project completion, the introduction of techniques for sustainable agriculture was found to be highly consistent with the Government of Nicaragua's development policies and of high necessity. Moreover, since it was consistent with Japan's aid policies, the Project is highly relevant. The project purpose was largely achieved, and it is surmised that the overall goal was also attained. Furthermore, following completion of the Project, INTA had started widely promoting the techniques for sustainable agriculture and there has been an extensive impact; therefore, the effectiveness and impact of the Project are high. The Project period was within schedule; the activities on the whole proceeded smoothly; and the technical transfer by the Japanese experts was conducted effectively. However, because the project cost exceeded the planned amount, efficiency of the Project is fair. Sustainability of the Project in terms of policy, organization and technology is high. In financial terms, INTA has a high degree of dependence on donors. However, it is expected that activities in the demonstration farms that utilize the results of the Project will be continued even when the donor assistance comes to an end. Accordingly, 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 Implementing Agency

Recommendations to INTA

- In order to further strengthen the capacity of technicians regarding sustainable agriculture outside of the Project target areas, INTA will need to strengthen training for them. In addition to fully referring to the curriculums, technical certification methodology, manuals and teaching materials that were created by the Project, it is desirable to provide training that combines classroom training with practical training while seeking cooperation from the counterparts who acquired greater capacity thanks to the guidance of the experts in the Project.
- In light of the fact that channels for acquiring the materials needed to apply techniques for sustainable agriculture are limited, INTA should examine ways of establishing distribution channels for such materials targeting small-scale farmers.

4.2.2 Recommendations to JICA

- To ensure the further diffusion and utilization of the results for sustainable agriculture in the Project, JICA should examine the possibility of conducting technical cooperation with specific targets, for example, production, processing and retailing of vegetables and fruits; development of techniques for responding to climate change (drought); capacity building of INTA technicians and so on.

4.3 Lessons Learned

Technical cooperation that is timely and pertinent to needs has a greater impact

There is a greater possibility that activities will continue following the end of technical cooperation and contribute to a bigger impact if technical cooperation that is timely and fits well with policy and development needs is implemented and the planned effects are realized. The Project was consistent with the policies of the Government of Nicaragua and its implementation coincided with a major shift towards sustainable agriculture by INTA and produced the results that had been anticipated. Moreover, following the completion of the Project, INTA has been entirely devoted to diffusing sustainable agriculture and the Project outputs have been widely utilized. Furthermore, techniques for sustainable agriculture have been newly adopted in the national program on Rural Technical School and the nationwide network of vocational schools that are operated by the National Technological Institute, and INTA has been able to contribute to this while utilizing the capacity acquired through the Project.