Ex-Post Project Evaluation 2021

Package II- 1 (Bhutan, Laos)

Evaluation Reports

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Bhutan

FY 2021 Ex-Post Evaluation Report of

Japanese Grant Aid Project

"The Project for Reconstruction of Bridges on Primary National Highway No. 1"

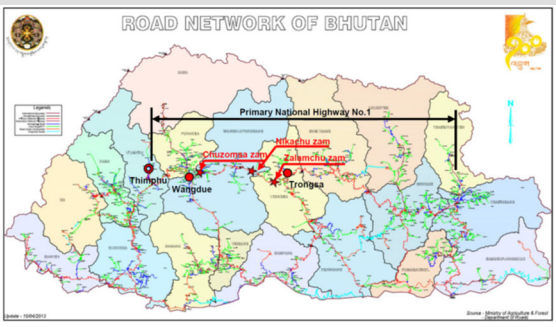
External Evaluator: Keiko Watanabe, Mitsubishi UFJ Research and Consulting Co., Ltd.

0. Summary

This project aimed to ensure smooth traffic and transportation access by constructing three bridges on Primary National Highway No.1 (hereinafter referred to as "PNH-1") and improving bridge performance, thereby contributing to the promotion of local economic revitalization. In Bhutan, road traffic is the most important means of transportation and PNH-1 is the most important trunk road. This objective, therefore, is consistent with the policies and needs of the country both at the time of planning and ex-post evaluation. The project plan and approach considering people who are vulnerable to traffic accidents are appropriate. The project was also consistent with the ODA policy of Japan and collaborated with other projects within JICA and with organizations outside JICA. Concrete results of collaboration have also been confirmed. Therefore, relevance and coherence are high. Outputs were delivered mostly as planned. The project period exceeded the plan but the project cost was within the plan. Therefore, the efficiency is high. All quantitative effect indicators set at the time of planning achieved their goals. It was confirmed through the interviews with the executing agency and bridge users, along with specific grounds, that the project ensured the safety of the bridge, promoted the distribution of goods through smooth traffic flow, and contributed to the development of local economy. In addition, the interview with bridge users revealed that the project contributed to improving of subjective well-being, such as satisfaction with quality of life and satisfaction with life in general. Thus, effectiveness and impacts are high. Sustainability of operation and maintenance of this project is very high, as no major issues have been observed in terms of policy/system, institutional/organizational, technical and financial aspects, or current maintenance status.

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

1. Project Description



Project Location

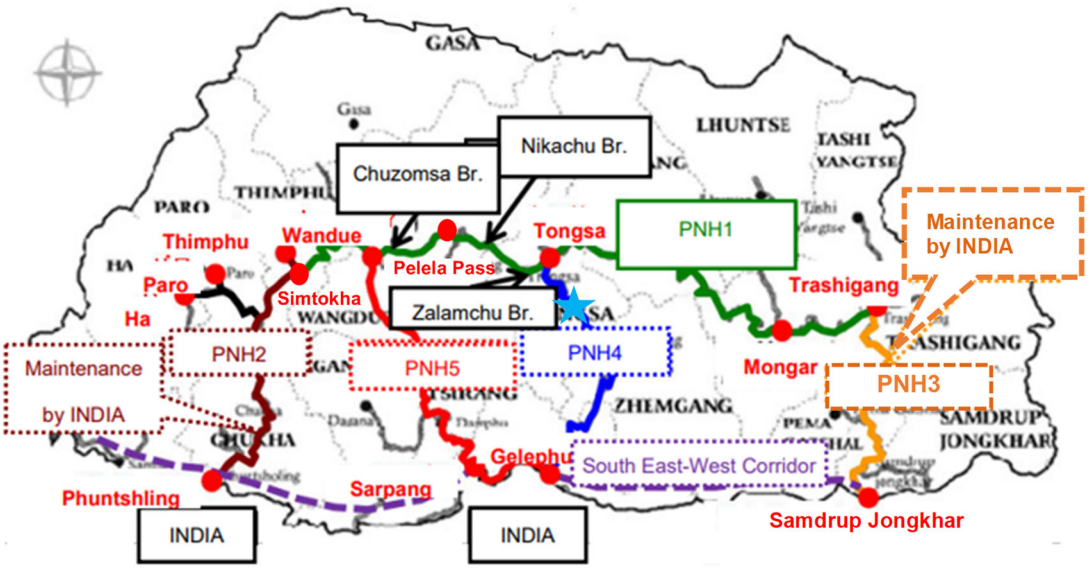
Nikachu Bridge

Source: Information provided by JICA

1.1 Background

In Bhutan, the majority of the national land is mountainous, and bridges play an important role in the road network, which is the most important means of transportation. The total road length was expanding from about 4,000 km in 2003 to about 10,600 km in 2013. However, due to topographical restrictions such as steep mountainous areas, there were a few trunk roads as well as detour and alternative routes. Besides, the roads were not always constructed to adequate specification (width, alignment, pavement, slope protection, etc.).

As shown in Figure 1, major road network in Bhutan has only PNH-1, which runs from east to west across the country and four national highways (PNH-2 to PNH-5) that run south to the borders with India. In particular, PNH-1 is the only trunk road connecting east and west in Bhutan, and is extremely important as transportation network. Although the Government of Bhutan is planning to develop a new Southern East-West corridor, about half of the sections are yet to be implemented. Nonetheless, PNH-1 will continue to play a major role in ensuring east-west connectivity as a trunk road starting from the capital, Thimphu, even after the Southern East-West corridor is completed. Although the section between Thimphu and Trongsa is particularly important connecting PNH-2, PNH-4 and PNH-5 going south, some of bridges in this section have deteriorated, posing a challenge in ensuring the east-west connectivity.



Source: Mangdechhu hydroelectric project site added on National Highway No.4 (light blue ★) in the information provided by JICA. Red circles are major towns.

Figure 1: Major Trunk Roads and Target Bridges

1.2 Project Outline

The objective of this project is to ensure efficient and stable transportation and traffic by reconstructing three bridges (Chuzomsa Bridge, Nikachu Bridge and Zalamchu Bridge) and improving

the performance of these bridges, thereby contributing to promoting the revitalization of local economy and poverty reduction.

Grant Limit / Actual Grant Amount	1,956 million yen / 1,956 million yen
Exchange of Notes Date / Grant Agreement Date	March 2015 / March 2015
Executing Agency(ies)	Department of Roads, Ministry of Works and Human Settlement (DoR/MoWHS)
Project Completion	May 2018
Target Area	Wandue Phodrang District, Trongsa District
Main Contractor(s)	Dai Nippon Construction
Main Consultant(s)	Oriental Consultants Global Co., Ltd./ INGEROSEC Corporation (JV)
Preparatory Survey	July 2014 - January 2015
Related Projects	<Technical Cooperation Project> · Human Resource Development in Bridge Planning, Designing, Construction and Maintenance (August 2006 - August 2007) · Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges (CAMBRIDGE) (September 2016 - April 2022) <Grant Aid> · The Project for Reconstruction of Bridges (2001) · The Project for Reconstruction of Bridges, Phase 2 (2005) · The Project for Reconstruction of Bridges, Phase 3 (2009) · The Project for Reconstruction of Bridges on Primary National Highway No. 4 (2016) <The Government of India> · Widening work of Primary National Highway No. 1

2. Outline of the Evaluation Study

2.1 External Evaluator

Keiko Watanabe, Mitsubishi UFJ Research and Consulting Co., Ltd.

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: October 2021 – February 2023

Duration of the Field Study: April 25 - May 17, 2022, September 30 - October 18, 2022 (by local consultant)

2.3 Constraints during the Evaluation Study

Due to the new corona virus (COVID-19) pandemic, the external evaluator did not travel to Bhutan, and conducted online interviews with the executing agency, Department of Roads, Ministry of Works and Human Settlement (hereinafter referred to as "DoR"). Field surveys of the bridges reconstructed by this project and interviews with bridge users, including local residents, were conducted by a local consultant under the supervision of the external evaluator.

3. Results of the Evaluation (Overall Rating: A[1])

3.1 Relevance/Coherence (Rating: ③[2])

3.1.1 Relevance (Rating: ③)

3.1.1.1 Consistency with the Development Plan of Bhutan

Road traffic is the most important means of transportation both at the time of planning and ex-post evaluation. Improvement and strengthening of roads including bridges were priority issues. At the time of planning, the 11th Five Year Plan (2014-2018) prioritizes the improvement of PNH-1 and the improvement of access to construction sites for large-scale national projects such as a hydroelectric plant in the road and bridge sector. The Road Master Plan (2007-2027), which is effective at the time of ex-post evaluation, stipulates the implementation of road widening and maintenance/repair and reconstruction of bridges over the next 20 years until 2027.

The 12th Five Year Plan (2018-2023) at the time of ex-post evaluation positions the roads and bridges as priority issues, "Improvement of Infrastructure, Communication and Public services" and prioritizes improvement and strengthening of road networks nationwide.

Therefore, the project is in line with the Bhutan's development policies at the time of planning and ex-post evaluation.

3.1.1.2 Consistency with the Development Needs of Bhutan

At the time of planning, although the PNH-1 is the only trunk road connecting east and west of Bhutan, many bridges on the route were dilapidated and did not meet the current

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

[2] ④: Very High、③: High, ②: Moderately Low, ①: Low

specification of design in terms of width and load capacity. There were 10 such aging bridges in the western part of PNH-1 to Trongsa. Among them, three bridges were technically difficult to reinforce or reconstruct due to bridge length, girder height, proximity to residents and so on. Therefore, technical assistance from abroad was required to reconstruct them. Furthermore, road widening work was on going on PNH-1 with the financial assistance from the Government of India and it was an urgent issue to bring the aging bridges to the current design standards along with these widening works in order to stabilize and smoothen the flow of traffic on the country's roads.

At the time of ex-post evaluation, the necessity to improve road network is stipulated in the 12th Five Year Plan (2018-2023). In particular, DoR, the executing agency is tasked with achieving development indicators of the road sector, which are "climate proof road accessible throughout the year in all types of weather," "reduction in travel time," and "quality infrastructure constructed and maintained." In order to achieve these indicators, there was a high need for improvement and strengthening of PNH-1 including bridges. Therefore, the project has continued to meet the country's development needs.

3.1.1.3 Appropriateness of the Project Plan and Approach

Chuzomsa Bridge and Nikachu Bridge where residents live nearby, were designed with consideration given to the safety of pedestrians who are vulnerable to traffic accidents, such as children, people with disabilities and the elderly, by installing sidewalks based on the request from the executing agency. In addition, if the project bridges are installed at right angles to the river, accidents such as vehicles hitting the railings are likely to occur, so the project adopted the curved bridges for the first time in Bhutan with the emphasis on safety. The project plan, which emphasized the safety of pedestrians and drivers, was appropriate. (Details are in "5.2 Additionality")

3.1.2 Coherence (Rating: ③)

3.1.2.1 Consistency with Japan's ODA Policy

At the time of planning, improvement of roads and bridges was positioned as a priority issue in the "development of economic infrastructure," one of priority areas of Japanese aid to Bhutan. The rolling plan for Bhutan states that assistance is provided for the development of road networks and bridges in order to secure efficient and stable transportation and to promote regional economic revitalization. Therefore, it can be said that this project was consistent with Japan's development cooperation policy at the time of planning.

3.1.2.2 Internal Coherence

The internal coherence with “Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges” (September 2016 - April 2022) (hereinafter referred to as “CAMBRIDGE”) was confirmed. DoR officers who are responsible for the maintenance of this project received training in CAMBRIDGE and upgraded their capacity. In addition, the inspection manual and Bridge Management System (BMS), which were the outputs from CAMBRIDGE, were utilized in the operation and management of this project. (See “3.4 Sustainability” for the specific collaboration effects)

3.1.2.3 External Coherence

The road widening work on PNH-1 was being carried out with financial cooperation from the Government of India. The JICA Bhutan office and the Government of India had regular discussions on transportation infrastructure. Regarding this project, the timing of the construction work was coordinated with the widening work by sharing information such as the content and schedule. The project and the widening of PNH-1 have confirmed specific synergetic effects in terms of stabilizing and smoothing traffic, and the external coherence was recognized. (See “3.3.2 Impact” for specific synergetic effects)

The implementation of this project is consistent with Bhutan’s development policy and development needs, and the project plan and approach were appropriate. It is also consistent with Japan’s development cooperation policy, confirming internal and external coherence. Therefore, its relevance and coherence are high.

3.2 Efficiency (Rating: ③)

3.2.1 Project Outputs

The project is to reconstruct three bridges, Chuzomsa Bridge, Nikachu Bridge and Zalamchu Bridge; to construct approach roads; and construct revetments and install sidewalks for Chuzomsa Bridge and Nikachu Bridge. Table 1 and 2 show the actual results of major outputs. Although there were minor design changes of about 1 m each in the overall width of the bridge and the length of the revetment, according to the executing agency and the implementing consultant, the alignment was changed in order to smoothly connect with the existing road adjacent to the approach road. It was found that the change was made appropriately. Therefore, there were no major changes in the outputs and the project was almost as planned.

The timely removal of the existing bridges, which was listed as a responsibility of the Bhutanese side, had not been carried out at the time of ex-post evaluation. Although the old Zalamchu Bridge was completely closed to traffic by both vehicles and pedestrians by the

executing agency, the other two bridges were still being used as foot bridges at the time of ex-post evaluation. There was a plan to remove the two bridges in FY 2021, but it was not implemented due to the effect of COVID-19. At the time of ex-post evaluation, the safety as foot bridges was secured, but it is desirable to remove them in the future.

Table 1: Outputs (Bridge)

Bridge	Item	Actual	Difference
Chuzomsa Bridge	Bridge Length	47.5 m	As planned
	Bridge Width	7.28 - 9.08 m	Minor Change
	Carriage Way	3.5 x 2 = 7.0 m	As planned
	Sidewalk	1.5 m	As planned
	Bridge Format	PC simply supported box grinder bridge	As planned
	Revetment	A1: 35.7 m	Minor Change
Nikachu Bridge	Bridge Length	45.0 m	As planned
	Bridge Width	13.33 - 18.65 m	Minor Change
	Carriage Way	3.5 x 2 = 7.0 m	As planned
	Sidewalk	1.5 m	As planned
	Bridge Format	PC simply supported box grinder bridge	As planned
	Revetment	A1: 36.87 m, A2: 41.19 m	Minor Change
Zalamchu Bridge	Bridge Length	46.5 m	As planned
	Bridge Width	8.08 - 10.81 m	Minor Change
	Carriage Way	3.5 x 2 = 7.0 m	As planned
	Bridge Format	PC simply supported box grinder bridge	As planned

Source: Information provided by JICA

Table 2: Outputs (Approach Road) (All as planned)

	Chuzomsa Bridge	Nikachu Bridge	Zalamchu Bridge
Planned Length	75.5 + 97.0 m	47.0 + 41.3 m	113.5 + 71.9 m
Total Width	9.5 m (Lane 3.25 x 2 = 6.5 m, Shoulder 1.5 x 2 = 3.0 m)		

Source: Information provided by JICA

Below pictures are three bridges before and after the project.

Chuzomsa Bridge (Before the Project) (After the Project)

Nikachu Bridge (Before the Project)

(After the Project)

Zalamchu Bridge (Before the Project)

(After the Project)

Source: Photos before the project are provided by JICA. Photos after the project are taken by the local consultant at the time of ex-post evaluation field survey.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The actual cost of the Japanese side was 1,956 million yen compared to the planned cost of 1,956 million yen, which was within the plan (100% of the plan). It was not possible to confirm the actual cost of the project on the Bhutan side, as the executing agency did not have information.

3.2.2.2 Project Period

The project period was 39 months compared to the planned period of 29 months, exceeding the plan (134% of the plan). As a result of the bidding to select the contractor, the price offered by the bidder exceeded the planned price, but as result of price negotiations, the construction start date was pushed back and the construction period was extended. However, it can be judged that the extension was appropriate, as the project could be kept within the planned price range by extending the construction period.

Therefore, efficiency of the project is high.

3.3 Effectiveness and Impacts[3] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

At the time of planning, (1) Bridge load-carrying capacity, (2) Average travelling speed, and (3) Annual average daily traffic were set as quantitative effect indicators. Table 3 shows target and actual values of quantitative effects indicators. All indicators have achieved their target values.

Table 3: Quantitative Effect Indicators

		Baseline value	Target value	Actual value			
		2014	2020	2018	2019	2020	2021
			3 Years after Completion	Completion Year	1 Year after Completion	2 Years after Completion	3 Years after Completion
Indicator 1: Bridge load-carrying capacity (t)	Chuzomsa Bridge	55	100	100	100	100	100
	Nikachu Bridge	55	100	100	100	100	100
	Zalamchu Bridge	55	100	100	100	100	100
Indicator 2: Average travelling speed (km/h)	Chuzomsa Bridge	16	30	30	30	30	30
	Nikachu Bridge	16	20	20	20	20	20
	Zalamchu Bridge	13	20	20	20	20	20
Indicator 3: Annual average daily traffic (vehicle/day)	Wandue – Pelela Pass	434	541	–	492	611	646
	Pelela Pass - Trongsa	314	390	348	303	401	563

Source: Information provided by JICA and executing agency

Note: Indicator 2 is calculated based on road alignment. Indicator 3 is the average number of vehicles measured twice a year for about one week each by the two regional offices of DoR that have jurisdiction over the section. There were lockdowns due to the impact of COVID-19 in 2020 and 2021. However, the traffic surveys were implemented when the lockdowns were not in effect. There was a drop in traffic during the lockdown, but the extent to which it was affected is unknown since they have not measured.

By increasing the bridge load-carrying capacity (Indicator 1) from 55 t to 100 t, it became possible to handle the transport of transformers, the heaviest of the dam construction materials and equipment for the Mangdechhu hydroelectric power plant in Trongsa province. According

[3] When providing the sub-rating, Effectiveness and Impacts are to be considered together.

to the Lobeysa regional office which administers Chuzomsa Bridge and Nikachu Bridge, prior to the project, the load-carrying capacity was not sufficient and some of the heavy materials and equipment had to be unloaded in front of the bridges. It took time and effort to go over the bridges back and forth and carry the load separately. Not having to unload the truck has really enhanced the traffic flow. In addition, the load-carrying capacity has been improved, and the width has become compatible with two-lane driving, making it possible to load more.

Average travelling speed (Indicator 2) also reached the target value. The speed limit for all three bridges is 40 km/h.

Regarding the annual average daily traffic between Pelela Pass and Trongsa (Indicator 3), the widening works from 2016 to 2019 were implemented with assistance from India on the Chuserbu-Nangar section (approximately 100 km), resulting in a temporary decrease in traffic volume. However, three years after completion, the actual number was 563 vehicles, exceeding the target value (390 vehicles). In addition to Indicators 1 and 2, the dramatic improvement in convenience is also thought to be a factor behind the increase in traffic volume. For example, before the project, when large vehicles pass through the bridges, such as those used to transport heavy machinery during the construction of the Mangdechhu hydroelectric power plant project, the business operator had to notify the DoR regional office in charge for ensuring safety. DoR officers had to go to the spot every time they passed through and inspect the bridge after passing through. However, after the project, inspections by DoR officers are no longer necessary even when large vehicles carrying heavy machinery are passing through. Therefore, smooth traffic has been ensured.

3.3.1.2 Qualitative Effects (Other Effects)

The qualitative effects of "improving bridge safety / ensuring pedestrian safety[4]" and "revitalization of local economy by promoting and facilitating the distribution of goods" will be realized after the bridges are reconstructed. Therefore, these effects are regarded as impacts and shown in 3.3.2 Impacts.

3.3.2 Impacts

3.3.2.1 Intended Impacts

The project was expected to contribute to (1) "improving bridge safety / ensuring pedestrian safety" and (2) "revitalization of local economy by promoting and facilitating the distribution of goods." These impacts were confirmed from the results of interview with the executing agency and qualitative survey conducted at the time of observation of the project

[4] At the time of planning, "Improvement of bridge safety" and "Ensuring pedestrian safety" were separate effects. Since they have a lot in common, two were combined into one.

sites[5].

(1) Improving bridge safety / Ensuring pedestrian safety

The following responses were received from the executing agency confirming safety improvement. Before the project, width was not enough for face-to-face driving, but after the project, roads width was enough for two-lane traffic, allowing two vehicles to pass each other safely at the same time. The vehicles can travel in both directions even with pedestrians, and heavy vehicles can now pass through without shaking or damaging the bridges.

From the qualitative survey, all the bridge users who were asked the questions (45 people) responded that safety had increased and they were able to cross the bridge with peace of mind. Specifically, "the bridge no longer sways while crossing, so I can cross the bridge without feeling uneasy," "the sidewalks have made it possible to cross with peace of mind[6]," and "even though there is no sidewalk, the bridge has enough width to walk even when the vehicles are passing by (user of Zalamchu Bridge)." In particular, the sidewalks are barrier-free and have no steps, and the width is 1.5 m, which is more than the required 1 m for a wheelchair. As a result, many people (28 out of 45 people) pointed out that children, people with disabilities and the elderly, and other vulnerable road users can now pass safely.

Furthermore, the driver crossing Chuzomsa Bridge answered that "during monsoon season, when the river overflows, I was worried that the bridge might collapse when the water approached, but now it is a solid bridge and I can cross it with peace of mind." In addition, before the project, there were many accidents and road closures due to over speeding during the monsoon season, such as hitting the railings of the bridge and landslides near the approach road. However, it was pointed out that safety had increased and road closures had decreased after the project since mortar was sprayed on the slopes and the landslides had not occurred in the vicinity. In fact, it was confirmed by the executing agency that no accidents occurred near the three bridges after completion.

Thus, it can be said that the project has contributed to the bridge safety and pedestrian safety.

[5] For the qualitative survey, interviews were conducted with 15 residents and users near each bridge, for a total of 45 people. The breakdown is as follows; (gender) 21 men, 24 women; (age) 7 in the 10s, 10 in the 20s, 9 in the 30s, 12 in the 40s, 5 in the 50s and 2 in the 60s and over; (occupation) 14 self-employed (restaurants, grocery stores, hotels, etc.), 6 drivers (public buses, taxis, etc.), 13 farmers, 8 students, 1 hydroelectric power plant contractor, and 3 employees in the clinic. Although there are no residents near Zalamchu Bridge, there is a village about 3 km east of the bridge. The interview was conducted with the villagers since they use the bridge.

[6] Sidewalks were installed on two bridges, Chuzomsa Bridge and Nikachu Bridge where residents live nearby.

Sidewalk of Chuzomsa Bridge

Slope mortar spraying along the access road to Zalamchu Bridge

(2) Revitalization of local economy by promoting and facilitating the distribution of goods

According to the qualitative survey, 35 out of 45 people (78%) answered that local economy revitalized compared to before the project. Specifically, farmers and self-employed such restaurant and hotel owners answered that access to the capital and neighboring large towns has improved after the new bridges were installed since they no longer have to worry about road closures due to accidents or traffic jams; frequency of public buses between Thimphu and Trongsa has increased from once to twice a week; and the business became active due to frequent visits by people involved in hydroelectric power plant construction. In addition, 31 out of 37 people (84%), excluding students, answered that their income had improved. Many farmers raised that access to the market has improved. In particular, products such as milk, raw vegetables, and fruits, for which freshness is important, were able to be transported as planned, eliminating waste due to traffic jams and road closures. Furthermore, as mentioned above, the contractor of hydroelectric power plant answered that they had to coordinate with the DoR regional office in advance when heavy vehicles passed through the bridges, and had to wait until the officer arrived on the day. However, after the project, the smooth passage became possible without coordination with DoR office and materials and equipment could transport efficiently. In this way, it was confirmed by the bridge users that the project contributed to the revitalization of the local economy through improved market access and increased traffic7.

On the other hand, since this project is part of the road network, in order to promote and facilitate the distribution of goods, not only the effects from the project itself but also the status of the widening works that has been carried out on PNH-1, and the maintenance status of other aging bridges between Thimphu and Trongsa on the western part of PNH-1 are also relevant. Therefore, the status of the widening work and the status of the other 7 bridges that were candidates at the time of planning were confirmed by the executing agency.

In the 12th Five Year Plan (2018-2023), the widening works of PNH-1 (385 km from

[7] During the period of lockdown due to the impact of COVID-19, business has been affected such as shrinking.

Simtokha, the starting point of South Thimphu, to Trashigang) divided into five sections, are planned to be completed by 2023 with financial cooperation from the Government of India. It was confirmed with the executing agency that all sections had been completed by 2021. It was also confirmed that the reconstruction of 7 aging bridges had been completed at the time of ex-post evaluation as shown in Table 4 although the implementation was delayed by one to two years due to the impact of COVID-19. PNH-1 is the major trunk road of Bhutan. The completion of the widening works of PNH-1 and the reconstruction of the other aging bridges by the executing agency, which could have become a bottleneck in the road network if not reconstructed on a timely basis, can be expected to lead to further revitalization of local economy, including contribution to the hydroelectric power plant business, together with the effects of this project.

Table 4: Condition of 7 Aging Bridges between Thimphu and Trongsa

	Bridge	Status
1	Banglapokto zam	Completed reconstruction (2021.8)
2	Bong zam	Completed reconstruction (2022.5)
3	Gaytsa zam	
4	Domkhar zam	
5	Rube zam	Completed reconstruction (2022.6)
6	Yamtrak zam	
7	Hurjee zam	

Source: Results from the questionnaire to the executing agency

3.3.2.2 Other Positive and Negative Impacts

1) Impacts on the Natural Environment

The project does not fall under the category of large-scale projects in the bridge sector listed in the JICA Guidelines for the Confirmation of Environmental and Social Consideration (April 2010). It was determined to fall under Category B because the undesirable environmental impact was judged to be insignificant and it does not fall within the sensitive characteristics and sensitive areas listed in the Guidelines. An Initial Environmental Examination (IEE) was required for this project based on Bhutanese domestic law. After the executing agency implemented the IEE, it was confirmed that an environmental permit was obtained from the National Environment Commission in 2015, before the construction work.

According to the executing agency, during the construction, periodical monitoring was conducted and the project implemented countermeasures for air pollution, water pollution, noise/vibration and waste as planned. Based on the results of interviews with the implementing consultant and local residents as well as the results of site surveys at the project sites, it can be thought that there were no problems with the natural environment.

2) Resettlement and Land Acquisition

No resettlement occurred. On the other hand, land acquisition of 243 m^2 occurred for the reconstruction of Chuzomsa Bridge. The impact of the land acquisition was the scale initially assumed, and the crops and trees on the land of one affected household were subject to compensation. According to the executing agency, the compensation was paid according to the compensation process which was agreed at the time of planning. Based on interviews with the executing agency and the implementing consultant, there were no complaints, therefore, it is considered that there was no impact on the project.

3) Gender Equality, Marginalized People

As stated above, the sidewalks were installed at Chuzomsa Bridge and Nikachu Bridge where people are living nearby, which enabled vulnerable people in traffic such as women, children, people with disabilities and the elderly to walk safely.

4) Social Systems and Norms, Human Well-being and Human Rights

As a result of the interview with the 45 bridge users[8], who underwent a qualitative survey, on their subjective well-being before and after the project, it was confirmed that the project contributed to improving their subjective well-being. Positive changes in safety were the biggest contributors to increased subjective well-being. All 45 respondents (100%) said they felt safer crossing the bridges than before. Both pedestrians and drivers rate the safety positively.

Health was the next contributor, with 39 people (87%) positive evaluations. In particular, many people pointed out that access to hospitals, including transportation by ambulance, has improved and that health concerns have decreased. It was thought that before the project, including access to large hospitals, even if an ambulance was called, it took a long time to get to the hospital.

In addition, 33 people (73%) gave a positive evaluation of the contribution to the relationship within the community. This project has made it easier for people to come and go to see relatives and friends, and reduced arguments over who should cross the bridge first when there was an oncoming vehicle. Furthermore, some commented that the beautiful and sturdy bridge became a source of pride for the community. It is considered that the project contributed to the solidarity of the community.

There were also 31 positive evaluations (69%) on the economic side. There was an opinion that the increase in the number of people coming and going led to the opening of new restaurant and cafe businesses, and sales of agricultural products increased due to improvement of access to the markets.

[8] See footnote 5 for breakdown.

5) Unintended Positive/Negative Impacts

<Continuous Capacity Building of Bhutanese Construction Workers>

The contractor of this project also implemented past grant aid projects related to bridge reconstruction. Many Bhutanese construction workers were employed in these projects. Some of them became local employees of the contractor. It was confirmed that this project contributed not only to the capacity building of executing agency but also to the skills development of Bhutanese construction workers. According to the implementing consultant, at the completion ceremony of this project, the Minister of MoWHS expressed his appreciation for the continuous human resource development of Bhutanese workers.

In light of the above, this project has achieved its objectives. Therefore, effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ④)

3.4.1 Policy and System

At the time of ex-post evaluation, the 12th National Five-Year Plan (2018-2023) continues to position PNH-1 as the most important route. There is no change in the policy and system regarding the positioning of this project and maintenance. In addition, anticipating monsoon damage, a system is in place to allocate emergency response costs and repair costs according to damage to regional offices every year. In light of the above, the policy and institutional sustainability of this project have been ensured.

3.4.2 Institutional/Organizational Aspect

There is no change in the roles of maintenance from the time of planning. Basically, the regional office in the district where the bridge is located conducts routine inspections (cleaning, removal of sediment, etc.) and periodic inspections. The head office monitors the regional offices. The Maintenance Department of the head office inspects the condition of roads and bridges after monsoons and makes judgments on the necessity of repairs. Lobeysa Regional Office is in charge of Chuzomsa Bridge and Nikachu Bridge, and Trongsa Regional Office is in charge of Zalamchu Bridge[9]. A certain number of civil engineers are stationed at the head office and each regional office, and the system is in place to handle emergency repairs. The cleaning of roads, including bridges, is carried out by Bhutanese workers (National Work Force (NWF)) registered with the executing agency. NWF is cleaning the roads in its assigned section, including bridges. The amount of work

[9] There are sub-branch offices in Trongsa regional office. Routine inspection of Zalamchu Bridge is carried out by the officer of sub-branch office nearby the bridge.

per NWF person is 1.5 km for national roads.

From the above, it can be judged that there are no particular problems with the institutional/organizational aspects.

3.4.3 Technical Aspect

At the time of ex-post evaluation, more than 20 engineers were stationed at each of the regional offices in charge, and they have the ability to perform maintenance of minor damage and emergency response. If there are technical problems, they can get advice from the engineers at the head office. According to the executing agency, technical training is basically focused on OJT, but the officers in charge of bridges at the executing agency have improved their technical capabilities through Japan's bridge reconstruction projects and technical cooperation assistance such as CAMBRIDGE. The BMS developed by CAMBRIDGE has enabled the executing agency to carry out planned maintenance and management, such as making evidence-based budgets. In addition, maintenance management guidelines and manuals for bridges have been prepared by CAMBRIDGE, and maintenance is being performed using those.

Based on the above, there were no particular problems with technical sustainability.

3.4.4 Financial Aspect

According to the executing agency, the budget for maintenance has been shrinking overall for the past two years due to the impact of COVID-19, but the budget for routine maintenance and maintenance for minor damage has been secured. The maintenance budget for regional offices is distributed according to the distance of roads under their jurisdiction and the number of bridges. Within the limited budget, each office is devising measures such as prioritizing bridges in need of repair according to the BMS.

In addition to the basic maintenance budget, 3 million Nu (approximately 5.4 million yen[10]) is allocated to each regional office at the beginning of each year as a monsoon emergency response, and additional repair costs are added as necessary after inspections after the monsoon[11].

The bridges that were reconstructed in this project are still new, therefore, no major maintenance costs will be required for the time being unless major damage occurs.

In light of the above, there were no particular problems with the financial sustainability of the maintenance of this project.

[10] 1Nu=1.79 yen (November 2022)

[11] Since the limited budget is distributed nationwide, an additional 20 million to 25 million Nu (approximately 36 million to 45 million yen) is allocated to each office every year. In 2021, repair costs distributed to Lobeysa office was 25 million Nu and Trongsa office was 20 million Nu.

3.4.5 Environmental and Social Aspect

As a result of confirming with the executing agency, there were no unforeseen aspects related to environmental and social consideration.

3.4.6 Preventative Measures to Risks

Due to the impact of COVID-19, the maintenance budget has been reduced overall. Preventive measures are taking such as prioritizing maintenance and management according to the necessity.

3.4.7 Status of Operation and Maintenance

It was confirmed by inspection that there were no major damages on any of the three bridges, and the drainage outlets on the bridges surface, which are important for maintenance, had been thoroughly cleaned. Interviews with local residents also confirmed that the bridges and the roads leading to the bridges are being cleaned regularly (almost every week). According to the regional offices in charge, routine inspections are carried out at least once a week, and periodic inspections are carried out at least once a year. In addition, there was an answer that inspections were always carried out after the monsoon. Therefore, the maintenance status is considered to be good.

Drainage Outlet of Chuzomsa Bridge

Well-cleaned Zalamchu Bridge

No issues have been observed in the policy/system, institutional/organizational, technical, financial, and environmental and social aspects, including the current status of operation and maintenance. Risks have been well mitigated. Therefore, sustainability of the project effects is very high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project aimed to ensure smooth traffic and transportation access by constructing three bridges on PNH-1 and improving bridge performance, thereby contributing to the promotion of local economic revitalization. In Bhutan, road traffic is the most important means of transportation and

PNH-1 is the most important trunk road. This objective, therefore, is consistent with the policies and needs of the country both at the time of planning and ex-post evaluation. The project plan and approach considering people who are vulnerable to traffic accidents are appropriate. The project was also consistent with the ODA policy of Japan and collaborated with other projects within JICA and with organizations outside JICA. Concrete results of collaboration have also been confirmed. Therefore, relevance and coherence are high. Outputs were delivered mostly as planned. The project period exceeded the plan but the project cost was within the plan. Therefore, the efficiency is high. All quantitative effect indicators set at the time of planning achieved their goals. It was confirmed through the interviews with the executing agency and bridge users, along with specific grounds, that the project ensured the safety of the bridge, promoted the distribution of goods through smooth traffic flow, and contributed to the development of local economy. In addition, the interview with bridge users revealed that the project contributed to improving of subjective well-being, such as satisfaction with quality of life and satisfaction with life in general. Thus, effectiveness and impacts are high. Sustainability of operation and maintenance of this project is very high, as no major issues have been observed in terms of policy/system, institutional/organizational, technical and financial aspects, or current maintenance status.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

The old bridges before the project had not been removed at the time of ex-post evaluation due to the impact of COVID-19. However, in consideration of safety, it is desirable to remove all three bridges in the future including those used for foot bridge.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

Implementation of technical cooperation projects for the executing agency contributes not only to this project but also to ensuring the sustainability of similar projects in the past

The maintenance of this project was carried out appropriately by utilizing the BMS and maintenance manuals which were the outputs of CAMBRIDGE. In previous ex-post evaluations of similar projects in Bhutan, it was pointed out that maintenance systems such as periodic inspections and maintenance guidelines prepared with grant aid were not being utilized. Given this situation, it is commendable that the executing agency is implementing a maintenance plan in order of priority with the limited budget allocated for maintenance. In Bhutan, grant aid projects for reconstruction of

bridges have been implemented since the 2000s, and the implementation of such technical cooperation projects has contributed not only to this project but also to ensuring the sustainability of bridges reconstructed in the past. If multiple similar grant aid projects are being implemented, it would be better to comprehensively address them through a technical cooperation project, instead of formulating maintenance manuals and guidelines for each grant aid project, in order to ensure the sustainability of all similar projects.

5. Non-Score Criteria

5.1 Performance

5.1.1 Objective Perspective

None.

5.2 Additionality

As additionality of the project, two points are raised, installation of sidewalks on bridges on national highways and enhancement of value through installation of curved bridges. Both points were the first adoptions in Bhutan.

As for Chuzomsa Bridge and Nikachu Bridge, sidewalks were installed because there were settlements and frequent pedestrian traffic around the bridges. This was at the request of the executing agency, but this project provided the first bridges with sidewalks on the national highway in Bhutan. Even the bridges that were reconstructed with grant aid in the past did not have sidewalks. It has been confirmed that the presence of sidewalks increases the sense of safety and security for both pedestrians and drivers. In particular, the fact that children, people with disabilities, and the elderly, who are vulnerable to traffic accidents, can cross the bridge with peace of mind is an added value that enhances the effects of this project. In this respect, it was shown that this project can be a good example of future bridge construction in Bhutan.

In addition, this project adopted a curved bridge design for the first time in Bhutan. Including past grant aid projects, Bhutan usually uses the design of straight bridges that span rivers at right angles, which sometimes causes vehicles to collide with railings on both sides of the bridges, and there were many bridges which do not have railings to avoid accidents. In this project, there was a risk that a straight bridge would cause such danger due to its location, so it was decided to design the front and rear of the bridge in a curved line rather than at right angles (straight lines) to the river

Curving Zalamchu Bridge

so that drivers can drive safely and smoothly. This proposal was made possible thanks to the knowledge and experience of the implementing consultant who was responsible for the implementation of past grant aid projects and is familiar with the bridge situation in Bhutan, as well as the lessons learned from the past years of JICA's continued support for bridges. In addition, due to the expansion of the width of the curved bridges, both sides of the bridges have a wider planar shape than straight bridges. As a result, the road safety has been further improved, and the design has become beautiful. Such added value creates even higher value, such as the bridge becoming a symbol of the local community.

END

Kingdom of Bhutan

FY2021 Ex-Post Evaluation Report of Japanese Grant Aid Project

"The Project for the Rehabilitation of Taklai Irrigation System in Sarpang District"

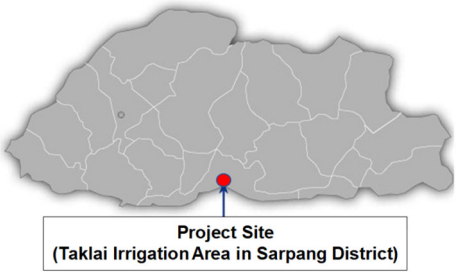
External Evaluator: Masumi Shimamura, Mitsubishi UFJ Research and Consulting Co., Ltd.

0. Summary

This project improved headwork (fixed weir, bed protection) and canals, etc. to ensure stable supply of irrigation water in Taklai Irrigation System located in Sershong Geog and Chuzagang Geog in Sarpang District, Bhutan. The project, which aims to increase rice production by strengthening irrigation systems, is consistent with Bhutan's development policies and development needs, and project plan and approach were appropriate. The project is also consistent with Japan's development cooperation policy and concrete results can be confirmed through collaboration with other JICA projects as well as with organizations outside JICA. Therefore, relevance and coherence of the project are high. In terms of project implementation, both project cost and project period were within the plan and thus efficiency of the project is very high. Regarding project effects, of the indicators of quantitative effects set at the time of planning, the actual value of "paddy area in dry season" have not achieved the target. Regarding impacts, the results of interviews with the executing agency and farmers in the project area indicate that irrigation water supply have improved in both rainy and dry seasons, irrigation area has increased, and farmers are making better use of agricultural machinery. Farmers are using irrigation water to grow vegetables and cash crops during dry season, and they also make effective use of irrigation water for raising livestock. For this reason, farmers feel that irrigation water has improved during dry season, which together with increase in rice production due to improved irrigation water during rainy season, has generated concrete effects. However, the key indicator for judging the effectiveness of the project, "expansion of double cropping of rice due to stable irrigation water during dry season," has not been achieved. Thus, while other indicators gave mostly achieved the target as planned, effectiveness and impacts cannot be considered as high. Therefore, effectiveness and impacts of the project are moderately low. No negative impacts on natural environment have been reported. Land acquisition and resettlement did not take place. Regarding operation and maintenance, slight issues have been observed in the financial and the current status, however, there are good prospects for improvement/resolution. Therefore, sustainability of the project effects is high.

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

1. Project Description



Project Location
(Source: Processed the map posted on the JICA website)

Water Intake

1.1 Background

Bhutan's Sarpang District is blessed with an exceptionally warm climate and vast, flat farmland, and has high potential for agricultural production, but has been left out of development. Development of irrigation facilities in the district has played an important role in increasing rice production in the country. In particular, Taklai Irrigation Scheme in the District is the largest irrigation system in the country and was developed in the 1980s with the support of the United Nations Development Programme (UNDP) and other organizations. It supplied irrigation water to approximately 1,300 ha (planned value) of land and 535 farm households. However, the facilities were damaged by repeated flooding, and the Bhutanese government has repeatedly carried out temporary repair work every time floods occur during rainy season. In particular, the flood in 2010 severely eroded the right bank of Taklai River, washing away more than 500m of the main canal as well as the headwork. Although emergency reconstruction work was carried out, the need for more durable facilities became an urgent issue to ensure a long-term and stable water supply. In addition, due to repeated damage to facilities caused by flooding, the irrigated area was only about 70% of the originally planned area (880 ha), and the facilities were not fully functioning at their capacity.

1.2 Project Outline

The objective of this project is to provide stable supply of irrigation water to the target areas by improving the headwork and the canal of Taklai irrigation system, thereby contributing to the increase of rice production in the area.

Grant Limit / Actual Grant Amount	1,097 million yen (detailed design: 46 million yen, main work: 1,051 million yen) / 1,094 million yen (detailed design: 44 million yen, main work: 1,050 million yen)
Exchange of Notes Date /Grant Agreement Date	February 2013 (detailed design), June 2013 (main work) / February 2013 (detailed design), June 2013 (main work), January 2016 (amended Grant Agreement for main work)
Executing Agency	Department of Agriculture, Ministry of Agriculture and Forests
Project Completion	April 2016
Target Area	Sershong Geog and Chuzagang Geog in Sarpang District
Main Contractor	Dai Nippon Construction
Main Consultant	Sanyu Consultants Inc.
Preparatory Survey	December 2011–November 2012
Related Projects	[Technical Cooperation] ・ The Strengthening Farm Mechanization Project (2008–2011) ・ The Strengthening Farm Mechanization Project Phase 2 (2014–2018) [Grant Aid] ・ Improvement of Farm Machinery for Hiring Services of Tillage (2016–2019) [EU] ・ Construction of rice mill and provision of post-harvest processing equipment in Sarpang District (2009)

2. Outline of the Evaluation Study

2.1 External Evaluator

Masumi Shimamura, Mitsubishi UFJ Research and Consulting Co., Ltd.

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: October 2021–February 2023

Duration of the Field Study: April 25–May 12, 2022, September 19–23, 2022

3. Results of the Evaluation (Overall Rating: B[1])

3.1 Relevance/Coherence (Rating: ③[2])

3.1.1 Relevance (Rating: ③)

3.1.1.1 Consistency with the Development Plan of Bhutan

At the time of planning, Bhutanese government's *Tenth Five Year Plan (2008–2013)* set out the improvement of agricultural productivity as a priority goal. This project was regarded as the major project of the "Irrigation and Water Management Program," (the objective of which was to expand irrigated paddy area in dry season from 40% to 70%) implemented by the Ministry of Agriculture and Forests to achieve the goal.

At the time of the ex-post evaluation, Bhutanese government's *Twelfth Five Year Plan (2018–2023)* identified "food security" and "improved nutrition and livelihoods" as key objectives. In order to improve food self-sufficiency rate, it is essential to secure arable and highly productive land and government has specified "expansion and strengthening of irrigation system" as one of the strategies to achieve this goal. This project is also consistent with *Economic Contingency Plan (2020)*, which Bhutanese government has prepared and is implementing to address the effects of the spread of COVID-19, and *Comprehensive Development Plan for Bhutan 2030*, which was formulated in 2019 in collaboration with JICA. Agriculture is one of the key sectors in Bhutan's regional economic development and national food security, and irrigation projects are regarded as important driver for improving agricultural production and local livelihoods. Thus, the implementation of the project is also consistent with the development policy of Bhutan at the time of the ex-post evaluation.

3.1.1.2 Consistency with the Development Needs of Bhutan

At the time of planning, Taklai Irrigation System was the largest facility in Bhutan and played an important role in increasing rice production. However, every year the headwork was washed away by floods during rainy season, and Bhutanese government repeatedly carried out temporary restoration work each time. In particular, the flood in 2010 severely eroded the right bank of Taklai River, washing away not only the headwork but also more than 500 m of the main canal. For a long-term and stable water supply, development of more durable facilities was an urgent issue.

At the time of the ex-post evaluation, flooding occurred every year due to overflow of Taklai River, and stable supply of irrigation water was necessary for double cropping of rice remains a challenge. After completion of construction of the project, sediment flowed into the culvert (head race) and water flow stopped. At the time of the ex-post evaluation, the follow-up

[1] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[2] ④: Very High, ③: High, ②: Moderately Low, ①: Low

cooperation has been conducted additionally for emergency measures in order to solve the culvert blockage problem. Thus, developing durable irrigation facilities continues to be a pressing issue. (Refer to "3.1.1.3 Appropriateness of the Project Plan and Approach") Therefore, the project continues to meet the country's development needs at the time of the ex-post evaluation.

3.1.1.3 Appropriateness of the Project Plan and Approach

The project has not realized "paddy area in dry season" and "expansion of double cropping of rice in dry season" that were expected at the time of planning. According to the obtained documents and interviews with the consultant in charge of construction supervision of the project, the following four points can be cited as the main reasons.

- Farmers less willing to carry out double cropping of rice: Farm Machinery Corporation Limited (hereinafter referred to as "FMCL") conducted dry-season crop demonstrations in 2017 and 2018 after the project. It is reported that although farmers were initially motivated to carry out double cropping, but after they found that animal damage by wild elephants was significant and rice yields were low, they became less enthusiastic.
- Problems with dry-season rice varieties: Dry-season crop varieties developed by Agriculture Research and Development Centre (hereinafter referred to as "ARDC") have a harvest time that coincides with rainy season, causing concerns about rain damage, and there is no non-crop period between dry-season and rainy-season crops to allow injection of fertilizer.
- Problem of guaranteed purchase: Food Corporation Bhutan purchases surplus crops that farmers cannot sell to the market based on its own standards, but it did not have standards for dry-season crops and was not likely to be able to guarantee the purchase of surplus rice.
- Problem of rice distribution: Chuzagang Agriculture Farmers Cooperative encountered management problems, which limited the distribution of Taklai brand rice.

According to interviews with the consultant in charge of construction supervision of the project, the most significant factor among the above four factors is considered to be the decline in farmers' motivation to double crop. But all of these factors were due to significant changes in the environment surrounding local farm management since the planning stage, and it would have been difficult to foresee these changes at the time of planning.

In addition, based on lessons learned from past similar projects, this project adopted high-strength concrete containing rail method (hereinafter referred to as "rail method"), which has been adopted in Japanese rivers, especially for the headwork section, which is vulnerable to damage from sediment contained in floodwaters. However, after construction was completed,

the high-strength concrete was worn away by the annual floods and rolling stones that flowed down with the floods, and some of the rails were washed away. When interviewed the executing agency of this case at the time of the ex-post evaluation, they explained that hydrological and flood records/data had not been adequately maintained at the time of planning. In addition, according to the construction supervision consultant, risk factors and their countermeasures were taken into account in the project design at the time of planning, but risks beyond expectations surfaced. Considering the situation at that time, the rail method was adopted under the situation where quantitative flow data was not prepared, but an unexpected sediment flowed down during the flood season, resulting in this incident. It would have been difficult to anticipate these situations and their impacts on the project at the time of planning. (Refer to "4.3 Lessons Learned") The chronological history of this case is as follows.

<Chronology of incidents related to sedimentation and blockage in culverts and suspension of water flow>

- April 2015: Completion of construction (initial)
- June 2015: Blockage due to sediment accumulation in culvert, and water flow stopped
- January–April 2016: Implemented countermeasure work (detailed design and construction) using the remaining funds from the project, and completed construction
- June 2016: Recurrence of culvert clogging and stoppage of water supply
- July 2017: JICA established a Technical Review Committee consisting of an external expert and senior advisors
- March 2018: Technical Review Committee members submit position paper to JICA
- August 2018: JICA formulated a response policy based on the views of the Technical Review Committee, etc.
- The Follow-up cooperation is underway at the time of the post-evaluation (scheduled for completion in September 2024)

From the standpoint of equity, consideration have been given in the formulation and implementation of the project so that irrigation water would be distributed fairly and appropriately to the farmers in the target area. For example, the soft component (capacity building program) of the project includes discussions with Water Users Associations (hereinafter referred to as "WUA") to which farmers in the project target area belong, in order to ensure fair water distribution between high and low level areas, such as guidance on how to operate the gates and rules for necessary items are provided in the WUA's articles in order to distribute water appropriately. In addition, according to the executing agency, most of the farmers own the same area of farmland, and there are no vulnerable groups that require special consideration in the allocating irrigation water. Furthermore, it was pointed out that Water User

Committee (hereinafter referred to as “WUC”), which is the upper body of WUA selects members based on an equal rotation system, regardless of gender or social status and thus there is no particular problem from fairness and impartiality.

3.1.2 Coherence(Rating: ③)

3.1.2.1 Consistency with Japan’s ODA Policy

At the time of the plan, Japanese government placed agriculture as the most important area of cooperation with Bhutan and gave special priority to this area. This project aims to provide stable supply of irrigation water to the project areas through rehabilitation of irrigation system, and contributes to increasing rice production by increasing irrigated areas and expanding double cropping of rice through stable supply of irrigation water in dry season. Therefore, it can be said that the project purpose was consistent with Japan’s development cooperation policy at the time of planning.

3.1.2.2 Internal Coherence

Collaboration with technical cooperation projects “The Strengthening Farm Mechanization Project” (2008–2011) and “The Strengthening Farm Mechanization Project Phase 2” (2014–2018) took place for this project. In both projects, as in this project, Department of Agriculture, Ministry of Agriculture and Forests was the counterpart agency, and agricultural machinery rental service model has been established and undertaken by FMCL to farmers in the target areas of this project. In addition, agricultural machinery is maintained under Grant Aid “Improvement of Farm Machinery for Hiring Services of Tillage.” Internal consistency has been secured since concrete effects of collaboration, such as increased production of rice in rainy season. (Refer to Impacts for specific synergistic effects.)

3.1.2.3 External Coherence

Collaboration with EU assistance implemented by EU in 2009 (with this assistance, rice mill was constructed and post-harvest processing equipment was provided in Sarpang District) took place for this project. Concrete synergistic effects have been generated such as increase in rice for sale, as rice produced by farmers is milled at the rice mills constructed by EU support. On the other hand, at the time of planning, this project was expected to secure irrigation water in dry season, expand double cropping, and increase rice production in cooperation with canal rehabilitation project implemented by the Bhutanese side. However, the expected double crop of rice has not been realized, and project effects from collaboration have not realized. (Refer to Impacts for specific synergistic effects.)

In terms of consistency with international frameworks, interviews with the executing agency

confirmed that the project contributes to SDG targets 1, 2, 6, and 13.[3]

The project is consistent with Bhutan's development policy and development needs, and the project plan and approach were appropriate. The project is also consistent with Japan's development cooperation policy, and collaboration with other projects within JICA is taking place. Regarding collaborations with organizations outside of JICA and with international frameworks, coordination and collaboration that was initially expected has achieved, and concrete results can be confirmed. Therefore, its relevance and coherence are high.

3.2 Efficiency (Rating: ④)

3.2.1 Project Outputs

This project aims to secure stable irrigation water supply by improving the headwork and the canal of Taklai irrigation system in Sershong Geog and Chuzagang Geog in Sarpang District. Major outputs are shown in Table 1. According to the executing agency, all items were implemented almost as planned.

Table 1: Major Outputs of the Project

Item	Description
Integrated Headwork	・ Fixed weir: Length 38.9 m x 1.0 m ・ Bed protection: Length 30.0 m
Head Race and Sedimentation Basin	・ Box culvert: Length 358.9 m ・ Open canal: Length 631.2 m ・ Sedimentation basin: Length 37.5 m ・ Retaining wall: Height 3.9 m x Length 410 m
Link Canal	・ Rise up wall: Length 654.6 m ・ Improvement: Length 109.6 m
Confluence between Link Canal and Low Level Intake	・ L type retaining wall: Height 2 m x Length 4.65 m ・ Newly constructing gate: One gate
High and Low Level Canal	・ Restoration of wet masonry: Length 123.7 m ・ Rise up wall: Length 165 m ・ Covered by concrete: Length 205.8 m ・ Rehabilitation of leakage at 2nd siphon outlet: Covered by concrete

[3] Goal 1: No poverty, Goal 2: Zero hunger, Goal 6: Clean water and sanitation, Goal 13: Climate action.

	・ Rehabilitation of leakage at aqueduct: Length 50 m ・ Safe fence around siphon: Six places ・ Improvement of siphon: Covered by reinforce concrete ・ Waterway crossing bridge: Concrete bridge (width, bridge length 4 m) x 2 bridges
Exposed Siphon Pipe on High Level Canal	・ Protection of exposed siphon pipe at 3rd siphon: Length 45 m
Gate on High and Low Level Canal	・ Check and distribution gate: 10 gates ・ Check gate: two gates
Water Gauge at Integrated Headwork	・ Water gauge: Sound wave type one set
Protection Dike at Downstream of Taklai River	・ Dike: Width 4.0 m x Height 3.0 m x Length 340 m ・ Retaining wall: Height 3.9 m x Length 340 m
Soft Component (Capacity Building Program)	・ Instruction and assistance for operation of facility, water management, and maintenance

Source: Preparatory Survey, results from questionnaire survey of the executing agency

Regarding construction of facilities, there were some changes from the original plan, such as changes in some structures, changes in the number of new gates on the main canal, and changes in the canal slope and canal elevation for headwork. All of these changes were made based on an accurate grasp of the situation through field surveys and measurement results during detailed design stage and were appropriate changes. In addition, as mentioned earlier in "3.1.1.3 Appropriateness of the Project Plan and Approach," culvert was blocked by sediment after construction was completed and water flow was stopped, and thus countermeasure work was carried out using the remaining funds from this project.

Regarding obligation of Bhutanese government, results of questionnaire survey and interviews with the executing agencies confirmed that all items were carried out in a timely manner without any problems.

Gate on Canal

High Level Canal

Head Race

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total project cost was initially planned to be 1,106 million yen (1,097 million yen on the Japanese side, 9 million yen on the Bhutanese side). In actuality, the total project cost was 1,103 million yen (1,094 million yen on the Japanese side, 9 million yen on the Bhutanese side), which is within the plan (100% of the planned amount).

3.2.2.2 Project Period

The overall project period was planned as 33 months as opposed to 31 months in actuality, which is within the plan (94% of the planned period). Since sediment accumulation in the culvert, blockage and water supply stoppage could not have been foreseen at the time of

planning, the time required for the countermeasure work (4 months), which was carried out using the remaining funds, was added to the originally planned period (29 months), resulting in a period of 33 months at the time of planning. In addition, the actual period was set to 31 months, including the actual period for countermeasure work to the actual period for original plan (27 months). Table 2 summarizes the project period, including the period required for countermeasures. (Refer to "3.1.1.3 Appropriateness of the Project Plan and Approach" for background on the incident of culvert blockage and water stoppage)

Table 2: Comparison of Planned and Actual Project Period

Planned Period	Actual Period	Comparison
33 months (29 months + 4 months)	31 months (27 months + 4 months)	94% of the planned period
Originally Planned Period	Actual Period for Original Plan	Actual Period for Countermeasure Work Using the Remaining Funds
February 2013–June 2015 (29 months)	February 2013–April 2015 (27 months)	January 2016–April 2016 (4 months)

Source: Information provided by JICA and results from questionnaire survey of the executing agency

Note 1: The starting point of the project period is the conclusion of Grant Agreement. The starting point for the countermeasure work is the conclusion of amended Grant Agreement.

Note 2: The definition of project completion at the time of original planning was upon completion of construction.

Note 3: At the time of the ex-post evaluation, it was agreed with the executing agency that the final completion of this project would be when countermeasures for the blocked culverts were completed.

Therefore, efficiency of the project is very high.

3.3 Effectiveness and Impacts[4] (Rating: ②)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

At the time of planning, "irrigation water supply in dry season," "irrigation area," "paddy area in dry season," and "annual maintenance cost" were set as quantitative effects of the project. Table 3 summarizes baseline, target and actual values between 2018 and 2021 for each indicator. As the project completion is April 2016, the target year to be compared is 2019, three years after completion.

[4] When providing the sub-rating, Effectiveness and Impacts are to be considered together.

Table 3: Quantitative Effects of the Project

Indicators	Baseline Value 2012	Target value 2018 3 Years After Completion	Remarks	Actual Value			
				2018	2019	2020	2021
Irrigation water supply in dry season (m^3/s)	0	Max. 2.24 (Note 1)	Enable to supply irrigation water by construction of head works	Max. 1.8 (80% of target value)	Max. 1.8 (80% of target value)	Max. 1.8 (80% of target value)	Max. 1.8 (80% of target value)
Irrigation area (ha)	883	Max. 1,120 (Note 2)	Enable to supply irrigation water by rehabilitation of damaged siphon	Max. 1,120	Max. 1,120	Max. 1,120	Max. 1,120
Paddy area in dry season (ha)	10	560	Expand the double crop area by supplied stable water in dry season. As the condition of assumptions, the cropping pattern of irrigation area is divided to vegetable and rice by a half respectively.	N.A. (Note 3)	0	0	0
Annual maintenance cost (Nu)	Average 3,500,000	1,750,000	Reduce cost of rehabilitation works for the head race and protection wall by gabions.	183,400 (Note 4)	186,400 (Note 4)	194,200 (Note 4)	177,700 (Note 4)

Source: Ex-ante evaluation report, Preparatory Survey and results from questionnaire survey of the executing agency and WUC

Note 1: Considering the probability of drought year, it is possible that drought discharge of Taklai river (minimum discharge in the dry season) will fall below the planned maximum water intake of $2.24m^3/s$.

Note 2: Based on rainy season. Actual registered households and beneficiaries in Taklai irrigation area are approximately 530 and 4,300 respectively at the time of planning. Those were expected to receive the benefit directly. Actual registered households in Taklai irrigation area are 442 (Chuzagang Geog: 396 households, Sershong Geog: 46 households) at the time of the ex-post evaluation.

Note 3: FMCL conducted demonstration in dry season, but the planted area is unknown. ("Very limited" according to FMCL)

Note 4: Total cost of fuel for excavator procured through the follow-up cooperation for excavating temporary head race and water usage fees collected by the WUA from the members.

The actual values for “irrigation area” and “annual maintenance cost” met their targets, and “irrigation water supply in dry season” was generally achieved as planned (80% achievement rate). However, the actual value for “paddy area in dry season” is zero and the target has not been met. This is because double cropping of rice has not been realized, and the reasons for this are explained earlier in “3.1.1.3 Appropriateness of the Project Plan and Approach.”

3.3.1.2 Qualitative Effects (Other Effects)

Qualitative effects were classified as impacts.

3.3.2 Impacts

3.3.2.1 Intended Impacts

As impacts of this project, state of generation of “increase in paddy area in dry season and expansion of double cropping of rice,” “improved utilization of agricultural machinery during fallow periods,” “improved operation and maintenance capacity through implementation of soft component,” “prevention of damage (erosion and loss) to farmland and irrigation facilities during floods by construction of river embankments,” “increase of rice production” and “increase in rice for sale” were evaluated.

1) Increase in paddy area in dry season and expansion of double cropping of rice

As mentioned earlier, rice planting in dry season and double cropping of rice have not been realized. As a result of interviews with 32 farmers[5] in the project area, two farmers tried rice cultivation in dry season, but the yield was so low that they gave up on double cropping. However, all 32 farmers responded that irrigation water supply has improved significantly in both dry and rainy seasons compared to before the project, and that they were using irrigation water in dry season to grow vegetables and cash crops such as areca nuts, and also effectively using irrigation water for raising livestock.

2) Improved utilization of agricultural machinery during fallow periods

According to FMCL, which provides agricultural machinery rental services to farmers in the project area, agricultural machinery rental hours has increased over the years. In addition, as a result of interviews with farmers, 29 out of 32 (90%) responded that they have rented tractors from FMCL or individual (private sector) owners. Of the remaining three, two said they own agricultural machinery and one said they did not use it.

[5] The 32 farmers consisted of 12 in Sershong High (seven men and five women), 12 Chuzagang High (seven men and five women), and eight in Chuzagang Low (five men and three women).
Breakdown by gender and age is 19 men (one in 20s, five in 30s, five in 40s, one in 50s, and seven in 60s or older) and 13 women (three in 30s, four in 40s, one in 50s, and five in 60s or older).
Interviewees include one WUA Chairman (one man in 40s) and five Gatekeepers (two men in 30s, one man in 50s, and two men in 60s).

3) Improved operation and maintenance capacity through implementation of soft component (capacity development program)

According to the executing agency, through soft component (capacity building program) of the project, WUC has improved the skills and techniques needed to maintain the facility, and is now able to collect data to properly share information within WUC, between WUC and WUA, and with other stakeholders. The results of interviews with farmers confirmed that Gatekeepers[6] belonging to WUAs properly keep maintenance records in accordance with WUA regulations, and that Gatekeepers belonging to WUAs operate gates and control water flow, etc. based on manuals prepared in the soft component. Regarding the functions of facilities, measures such as preventing sediment inflow and ensuring water intake methods during rainy season have been taken in the on-going follow-up cooperation.

4) Prevention of damage (erosion and loss) to farmland and irrigation facilities during floods by construction of river embankments

According to the executing agency, the river embankment constructed by the project has prevented erosion of farmland along Taklai River. Interviews with farmers showed that, with the exception of one farmer who lost his farmland to flooding caused by severe rainfall, 31 farmers responded that they had no problems with erosion or loss of farmland or irrigation facilities.

5) Increase of rice production

Results of interviews with farmers showed that 30 of 32 farmers (97%) responded that production of rainy-season rice increased after the project. Two of them said that they started rice production after the project. However, it should be noted that production volume depends on rice varieties and cultivation efforts by farmers in addition to the project effects. The remaining two farmers were, one farmer who decided to focus on areca nuts cultivation because of reduced rice yield due to damage from animals, and another farmer whose land was eroded by floods caused by severe rainfall. As mentioned above, farmers commented that the irrigation water provided by the project has been very useful not only for rice, but also for growing cash crops such as vegetables and areca nuts, and for raising livestock.

Trends in rice production in the project area are shown in Table 4. In terms of total volume, it increased from 1,818.30 tons in 2015 to 2,181.79 tons in 2021, an increase of about 363 tons. It declined in 2019 but recovered the following year, and in 2021 it was at about the same level as the previous year.

[6] In this report, those who manage the main canals and those who manage small canals (Water Guards) who deliver water to each farmer's fields are collectively referred to as Gatekeepers.

Table 4: Trends in Rice Production in the Project Area

(Unit: ton)

	2015	2016	2017	2018	2019	2020	2021
Sershong Geog	863	842	876	844	891.41	982.25	984.77
Chuzagang Geog	955.30	1,098.83	1,268.34	1,236.03	1,010.26	1,209.65	1,197.02
Total	1,818.30	1,940.83	2,144.34	2,080.03	1,901.67	2,191.90	2,181.79

Source: Data provided by Sershong Geog and Chuzagang Geog

6) Increase in rice for sale

Farmers sometimes sell rice in the informal market, and there are no data available to grasp the overall picture of rice sales volume. Results of interviews with farmers showed that 14 of the 32 farmers (44%) earned income from selling rice after the project.

3.3.2.2 Other Positive and Negative Impacts

1) Impacts on the Natural Environment

The project was classified as Category B based on the *JICA Guidelines for Confirmation of Environmental and Social Considerations* (April 2010) since it does not fall under any sensitive sectors/characteristics or sensitive areas, and its undesirable effects on the environment were considered to be not significant. According to the executing agency, Environmental Impact Assessment (EIA) was not required to be prepared under Bhutanese domestic law.

According to the executing agency, measures were taken during construction to meet Bhutanese standards for air quality, noise and vibration, and waste, and there were no major problems, such as exceeding standards. In addition, environmental mitigation measures were taken, such as watering during construction (countermeasures against dust), disposal of waste in designated places, and prevention of oil and garbage spills into river, and facility was constructed with consideration for the environment. As a result of environmental monitoring, no negative impacts on the natural environment have been reported, and no complaints have been received from local residents. Based on interviews with farmers and the results of the project site inspection, it can be considered that there were no major problems with the natural environment.

According to the consultant in charge of construction supervision, environmental monitoring is not being carried out because the follow-up cooperation underway is to restore the existing facilities, which would have minimal or no undesirable impacts on the environment and society.

2) Resettlement and Land Acquisition

Resettlement and land acquisition did not take place for this project.

3) Gender Equality

According to the interviews with the executing agency and farmers, development of irrigation facilities by the project will not increase workload of farm work and operation and maintenance only for women.

4) Marginalized People

According to the executing agencies and interviews with farmers, there are no vulnerable groups that require special consideration in the allocation of irrigation water. (Refer to "3.1.1.3 Appropriateness of the Project Plan and Approach")

5) Social Systems and Norms, Human Well-being and Human Rights

Interviews with 32 farmers confirmed that the project contributed to the improvement of farmers' subjective life satisfaction. Positive changes in livelihoods were the most significant factor. Specifically, when asked about changes in "income and living conditions" before and after the project, all 32 farmers (100%) responded in favor of positive changes, saying "increased rice production increased income and improved living conditions."

In addition, when asked about changes in their "confidence in irrigated agriculture" before and after the project, 31 farmers (97%) self-evaluated that "they were able to increase their confidence in irrigated agriculture" after the project. One respondent who stated that there was no change before and after the project gave the reason of "getting older and having no successor in the family." In addition, 28 farmers (88%) answered that there were positive change in the "awareness of cooperation among farmers" before and after the project, while four answered that there had been no change. Reasons for positive changes include "WUA has been able to resolve conflicts among farmers amicably" and "better organizational formulation has been realized through WUAs," indicating that WUAs play an important role in conflict resolution, cooperation, and coordination among farmers. Regarding changes in "willingness to increase production" before and after the project, 17 farmers (53%) responded that there were positive changes. On the other hand, 14 farmers (44%) responded that there was no change, and one farmer answered that there was a negative change. The most common responses for no change were "no more farmland available for cultivation" and "no one else in the family can do the farm work," both of which were due to external factors external of the project. The one farmer who gave a negative response said "I am older

and can no longer work as much as I used to" as the reason, which is also due to external factor.

6) Unintended Positive/Negative Impacts

This project is considered as a "climate change adaptation project" by JICA. In southern Bhutan, where Taklai Irrigation System is located, meteorological and hydrological data for the last 10 years at the time of planning showed an increasing trend in short-term rainfall, and the flood of 2010 caused abnormal runoff. According to the executing agency, if the project were not implemented and the past trend continued, farmlands along the Taklai River would be eroded by annual floods and the supply of irrigation water would become unstable, discouraging farmers from cultivating their land. In addition, it was explained that the government had to construct temporary head race as a measure against flooding every year during rainy season, which would have further increased government's maintenance costs.

<Synergies with other projects in JICA>

Through questionnaire survey and interviews with the executing agency, it was confirmed that agricultural mechanization of farmers in the project target area has been promoted through collaboration between this project and "The Strengthening Farm Mechanization Project Phase 1, 2." In these technical cooperation projects, agricultural machinery rental service model has been established, and FMCL has been providing agricultural machinery rental services to farmers in the project area. In addition, agricultural machinery is maintained under Grant Aid "Improvement of Farm Machinery for Hiring Services of Tillage." From the results of the interviews with the farmers, it was also confirmed that they are cultivating rice by renting tractors and rice harvesters from FMCL, leading to increased production of rice during rainy season. (Refer to "3.3.2.1 Intended Impacts")

<Synergies with organizations outside of JICA>

Through questionnaire survey and interviews with the executing agency, it was confirmed that rice produced by the farmers in the project target area has been milled and commercialized at the rice mill through collaboration between this project and the EU support (construction of rice mill and provision of post-harvest processing equipment in Sarpang District).

This project was expected to secure irrigation water during dry season, expand double cropping, and increase rice production in collaboration with the canal improvement project to be implemented by the Bhutanese side. However, the expected double cropping of rice has not been realized, and the project effects of collaboration have not been realized as expected.

In light of the above, the key indicator for judging the effectiveness of the project, "expansion of double cropping of rice due to stable irrigation water during dry season," has not been achieved, and although other indicators have mostly achieved the targets as planned, effectiveness and impacts cannot be considered as high. This project has achieved its objectives only to a certain extent. Therefore, effectiveness and impacts of the project are moderately low.

3.4 Sustainability (Rating: ③)

3.4.1 Policy and System

According to the executing agency, there are no policy or system changes with respect to Taklai Irrigation System and farming conditions. Albeit the spread of COVID-19, crop selection is left to the discretion of farmers and there is no government policy intervention. Even after project completion, farmers are encouraged to expand rice production for self-sufficiency. In addition, vegetable production in winter is recommended in order to make effective use of irrigation facilities developed by the project.

From the above, sustainability of policy and system of the project is assured.

3.4.2 Institutional/Organizational Aspect

WUAs are responsible for operation and maintenance of the project after project completion. WUAs conduct operation and maintenance work based on its standard operating procedures, rules, and by-laws, and the division of roles, decision-making process, authority, etc. are also clear. WUAs operate with decisions made without intervention from other agencies. WUAs keep track of irrigation water user fees, remuneration of Gatekeepers, division of labor among members (farmers), etc. Issues that need to be agreed upon at WUAs are discussed at the annual general meetings.

WUC, which is the upper body of WUA, has the necessary personnel for operation and maintenance. Members of WUC are shown in Table 5.

Table 5: Members of WUC

Position	Number of Persons
Chairman	1
Vice Chairman	1
Secretary	1
Accountant	1
Gate Keeper	14
Total	18

Source: From interviews with WUC

Since the temporary head race near the headwork requires dredging, an excavator operator has been dispatched from Central Machinery Unit (hereinafter referred to as "CMU") to excavate the canal. WUA and CMU are in constant communication and have a smooth cooperation system in place.

From the above, no particular problem has been identified regarding the institutional/organizational aspect of operation and maintenance.

3.4.3 Technical Aspect

There are no specific qualifications required for WUC members, but they all have basic reading and writing skills. All WUC members have received training in the soft component (capacity building program) of the project and have acquired knowledge and skills related to basic knowledge of the facility, gate operations and rules, and formulation of annual maintenance activity plans, and are competent enough to carry out daily operation and maintenance tasks. In addition, a manual for maintenance and management of irrigation facilities was prepared under the soft component of the project, which is always available at maintenance sites for reference and use in daily operations. WUC members have not yet been replaced, but there will be a full handover when they are replaced.

From the above, technical staff in charge of operation and maintenance appears to have sufficient technical capacity to conduct usual operation and maintenance tasks, and there are no particular problems.

3.4.4 Financial Aspect

As regards operation and maintenance costs of the project, necessary amounts are estimated by WUC, and budget request will be made to Sershong Geog and Chuzagang Geog. Each Geog government scrutinizes and allocates the amount possible within the budget.

At the time of the ex-post evaluation, main operation and maintenance cost is the fuel cost for excavators, which is borne by CMU, due to incidents that occurred after completion of construction (sediment inflow and clogging of culvert). (Refer to Table 6) The excavator was procured as part of the follow-up cooperation, and excavator operators dispatched by CMU are removing debris near the headwork and excavating temporary head race.

Table 6: Operation and Maintenance Cost for the Project

(Unit: Nu)

2018	2019	2020	2021
183,400	186,400	194,200	177,700

Source: Results from questionnaire survey of the executing agency and WUC
Note: Total cost of fuel for excavator procured through the follow-up cooperation for excavating temporary head race and water usage fees collected by the WUA from the members.

The irrigation water user fees (total amount) collected by WUA from its members (farmers) are shown in Table 7. The fee per member household is 300 Nu.

Table 7: Irrigation Water User Fees Collected by WUA from its Members (Total)

(Unit: Nu)

2018	2019	2020	2021
83,400	86,400	94,200	77,700

Source: Results from questionnaire survey of the executing agency and WUC
Note: According to the executing agency, the 2021 amount was lower than the previous year due to the effects of the spread of COVID-19. Many farmers were unable to pay the fees due to the spread of COVID-19.

Due to the effect of the spread of COVID-19, many farmers are unable to pay their irrigation water user fees, and the collection rate in 2021 is about 60%.[7] As a result, remunerations for WUC members other than Gatekeepers who operate the water gates have not been paid, and the fees will need to be increased in the future. Farmers' incomes are expected to recover once COVID-19 pandemic is over, and an increasing number of farmers are growing vegetables and cash crops after the project. In addition, WUAs are trying to secure budget from Geog governments, and there is a move to assign one official each from Sershong Geog and Chuzagang Geog as co-chairmen of WUC, and concrete discussions are underway. They are also considering raising the irrigation water user fees in the future. Therefore, prospects for improvement in the financial situation are considered to be high.

From the above, there are some minor problems with financial aspect of operation and maintenance, but various measures have been taken and the prospects for improvement are high.

3.4.5 Environmental and Social Aspect

As a result of confirming with the executing agency, there were no unexpected environmental and social considerations.

[7] As the number of registered households (WUA members) in the Taklai irrigation area is 442, irrigation water user fee collection rate in 2021 is 58.9%.

3.4.6 Preventative Measures to Risks

The follow-up cooperation is conducted at the time of the ex-post evaluation. As mentioned earlier in "3.1.1.3 Appropriateness of the Project Plan and Approach," a Technical Review Committee was established to investigate the cause and study countermeasures in light of the case in which a culvert was blocked by sediment after construction was completed and water flow was stopped. Based on the position paper submitted by the Committee, JICA has formulated a response policy, and in the follow-up cooperation, based on the policy, measures are taken such as changing the bar screens of water intake facility to mesh and installing a temporary head race.

3.4.7 Status of Operation and Maintenance

According to the results from questionnaire survey of the executing agency and interviews with farmers, facilities and equipment developed by the project are effectively utilized by farmers and CMU, and they continue to make efforts for maintenance in the field. Temporary head race is washed away every time floods occur during rainy season, requiring frequent excavation, and there are times when supply of irrigation water is not stable. In the follow-up cooperation, prevention of sediment inflow, ensuring of water intake methods during rainy season, and monitoring during rainy season, etc. are carried out. The mesh screens covering manholes are frequently clogged, and Gatekeepers are dealing with this problem in their daily maintenance work.

As a result of interviews with farmers, they answered that they could not predict the period required for maintenance work before the project, but that the predictability has increased after the project. They also said that the time required to clean water intake and maintain irrigation canals was reduced. Most of the work at the intake after floods has been undertaken by excavator, with operators dispatched from CMU quickly removing debris.

Spare parts are stored at the CMU Bhur Office, and there are no particular problems with procurement of spare parts.

From the above, there are some problems in the operation and maintenance status at the time of the ex-post evaluation, but as a whole, there is no problem because facilities are properly operated and maintained.

Slight issues have been observed in the financial and the current status of operation and maintenance, however, there are good prospects for improvement/resolution. Therefore, sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project improved headwork (fixed weir, bed protection) and canals, etc. to ensure stable supply of irrigation water in Taklai Irrigation System located in Sershong Geog and Chuzagang Geog in Sarpang District, Bhutan. The project, which aims to increase rice production by strengthening irrigation systems, is consistent with Bhutan's development policies and development needs, and project plan and approach were appropriate. The project is also consistent with Japan's development cooperation policy and concrete results can be confirmed through collaboration with other JICA projects as well as with organizations outside JICA. Therefore, relevance and coherence of the project are high. In terms of project implementation, both project cost and project period were within the plan and thus efficiency of the project is very high. Regarding project effects, of the indicators of quantitative effects set at the time of planning, the actual value of "paddy area in dry season" have not achieved the target. Regarding impacts, the results of interviews with the executing agency and farmers in the project area indicate that irrigation water supply have improved in both rainy and dry seasons, irrigation area has increased, and farmers are making better use of agricultural machinery. Farmers are using irrigation water to grow vegetables and cash crops during dry season, and they also make effective use of irrigation water for raising livestock. For this reason, farmers feel that irrigation water has improved during dry season, which together with increase in rice production due to improved irrigation water during rainy season, has generated concrete effects. However, the key indicator for judging the effectiveness of the project, "expansion of double cropping of rice due to stable irrigation water during dry season," has not been achieved. Thus, while other indicators gave mostly achieved the target as planned, effectiveness and impacts cannot be considered as high. Therefore, effectiveness and impacts of the project are moderately low. No negative impacts on natural environment have been reported. Land acquisition and resettlement did not take place. Regarding operation and maintenance, slight issues have been observed in the financial and the current status, however, there are good prospects for improvement/resolution. Therefore, sustainability of the project effects is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

Due to the effects of the spread of COVID-19, many farmers have not been able to pay water user fees, and remunerations to WUC members except Gatekeepers have not been paid. It has been suggested that there is a need to raise the user fees, but since this is an important matter

that needs to be agreed at the WUAs, WUAs are required to hold discussions at the annual general meeting in accordance with the WUA regulations, while taking into consideration the local COVID-19 situation and the farmers' economic situation, etc. Since this issue is an exclusive matter of WUAs, the executing agency is not in a position to give instructions to them, however, it is desirable that the executing agency follows up on the situation as appropriate.

The Excavator procured through the follow-up cooperation plays an extremely important role in maintenance work at the field. In the future, when it reaches the end of service life and is no longer operational, it will have a significant impact on daily maintenance. Therefore, it is important for Sershong Geog and Chuzagang Geog to work with WUAs to systematically record the excavator cost as depreciation expenses every year and procure new excavator in a timely manner at the end of its service life so that maintenance activities are not affected.

4.2.2 Recommendations to JICA

It was expected that the project would stabilize water intake during dry season and expand double cropping of rice. Expansion of double cropping of rice will lead to increased rice production, which will contribute to improving self-sufficiency rate of rice and higher income of farmers. However, there is a possibility that farmers will not carry out double cropping of rice even if the facilities are rehabilitated through the follow-up cooperation. Therefore, it is important for JICA to sort out the issues related to double cropping after the facilities are rehabilitated by the follow-up cooperation, and to discuss with the Bhutanese side whether to expand double cropping in the future. Irrigation water supplied by this project is useful not only for rice, but also for cultivation of vegetables and cash crops, as well as for raising livestock. Thus it is also desirable that JICA holds discussions with the Bhutanese side regarding realistic farm management such as growing two crops that combine other crops in dry season and livestock production, etc. Survey by farm management experts may be considered as an option when sorting out issues and discussing countermeasures.

4.3 Lessons Learned

<u>Importance to strengthen risk mitigation measures through soft component activities with further emphasis on maintenance after project completion</u>

In this project, the rail method used for rivers in Japan was adopted for the development of apron downstream of headwork. At the time of planning, this method was recognized as an appropriate construction method, but after construction was completed, it was found that the high-strength concrete was worn away by the annual floods and rolling stones that flowed down with the floods,

and some of the rails were washed away. According to the executing agency, it was pointed out that flood records, and rainfall and river water volume data were not sufficiently developed in Bhutan at the time of planning. On the other hand, according to the construction supervision consultants, even at the time of the ex-post evaluation, it would be technically difficult to predict damage caused by floods, including gravel and boulders, even if sufficient data were available at the time of planning and careful analysis was conducted. In addition, although more robust methods exist than the rail method, they are expensive protection construction methods and require larger project cost. As in this project, when similar projects are implemented in the future under both technical and budget constraints, in addition to adopting as robust a construction method as possible as in this project, it is conceivable to conduct soft component activities that emphasize post-completion maintenance (especially repairs in the event of damage). For example, risk assessment content could be added to the soft component activities to strengthen risk mitigation measures after project completion by adding new tasks such as (i) possible risks (e.g., damage), (ii) scenarios of events that could occur if risks are left as is, and (iii) specific construction methods that can take place by the recipient country side while risks (damage) are still small (what specific repairs should be conducted if any damage occurs) to avoid the situation described in (ii).

Importance of considering various support approaches to increase the feasibility of double cropping of rice (dry season crop)

In this project, double cropping of rice has not been realized as planned. This is due to changes in the local farming environment. Following issues were identified regarding the varieties developed by ARDC: 1. harvesting period coincides with rainy season, which raises concerns about rain damage; 2. there is no non-crop period between dry-season and rainy-season cropping, which makes it impossible to secure a period for fertilizer application. However, these issues were revealed in the dry-season crop demonstrations conducted by FMCL using irrigation water from the project after the project completion, and it was not realistic to address the issues during the project. The ARDC research team continues to develop new varieties, but it will take many years to develop and improve varieties by the Bhutanese themselves. Therefore, it would be important to include approaches that utilize a variety of support schemes in this sector, for example, in addition to development of irrigation facilities (hard support) and providing technical guidance on their maintenance, formulation of annual farming plans and assistance in selecting rice varieties, etc. can be included in a soft component, or separately providing research support for variety improvement, etc. through technical cooperation projects, dispatch of experts, overseas cooperation volunteers, etc. (soft support). In addition, taking into account the possibility that the environment surrounding farming may change from the time of planning, as in this project, it is

desirable take into account to support flexible farming that combines other crops in dry season and raising livestock, etc. rather than developing an irrigation system with only double cropping of rice in mind.

END

Lao People's Democratic Republic

FY2021 Ex-Post Evaluation Report of Japanese ODA Loan

"Southern Region Power System Development Project"

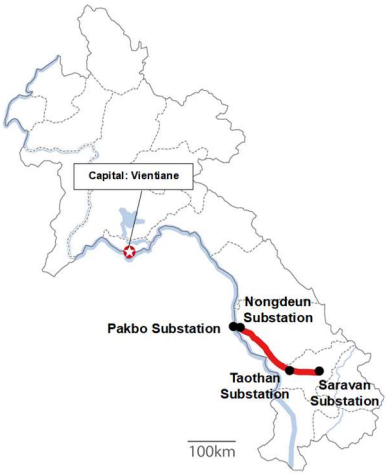
External Evaluator: Masumi Shimamura, Mitsubishi UFJ Research and Consulting Co., Ltd.

0. Summary

This project constructed 115kV power transmission lines and related facilities in the southern region of Laos with the aim of ensuring stable power supply in Savannakhet Province and its surrounding areas. The project, which connects the country's fragmented main power system, is consistent with Laos' development policy and development needs. The project is also consistent with Japan's development cooperation policy, and concrete results can be confirmed through collaboration with organizations outside of JICA. Therefore, relevance and coherence of the project are high. In terms of project implementation, there were some changes from the original plan, such as increase in total length of transmission lines, but all of these changes were based on the site conditions at the time of detailed design, and were appropriate changes. Both project cost and project period were within the plan and thus efficiency of the project is very high. Regarding project effects, of the indicators of quantitative effects set at the time of planning, "annual electric supply" was not achieved as planned but the remaining indicators, "maximum power flow" and "transmission loss" were mostly achieved as planned. Regarding impacts, results of interviews with the executing agency, Electricité du Laos (hereinafter referred to as "EDL") and electricity consumers in the project area, as well as related data and trends of nighttime light intensity indicate that the project is facilitating rural electrification, investment promotion, and industrial revitalization in the southern region. No negative impacts on natural environment have been reported. Land acquisition was carried out without any particular problems, and resettlement did not take place. The project is also contributing to improving access to electricity for the poor through its collaboration with the World Bank's Rural Electrification Project. Therefore, effectiveness and impacts of the project are high. Regarding sustainability, some minor issues have been observed in the related technical and financial aspects, and the current status of operation and maintenance, sustainability of the project effects is moderately low.

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

1. Project Description



Project Locations

Saravan Substation

1.1 Background

In Laos, the country's main power system connecting the north and south was fragmented, with some parts of the country exporting power to neighboring countries while areas with power shortages were importing power. In particular, the area surrounding Savannakhet Province in the southern part of the country, electricity was supplied by interchange from the northern and central parts of the country and imports from Thailand. The province passes through the East-West Economic Corridor linking Vietnam, Laos, and Thailand, and further growth in demand was expected as the Savan-Seno Special Economic Zone (hereinafter referred to as "SEZ") was developed taking advantage of its location. Thus, there was an urgent need to take measures. On the other hand, in the area surrounding Saravan Province in the southern part of the country, power development plan for domestic use was progressing, and it was expected that surplus power would be generated. Therefore, it was necessary to develop Lao National Grid by connecting the areas around Savannakhet Province and Saravan Province with transmission lines and interconnecting fragmented grid to ensure stable power supply in the areas around Savannakhet Province in order to further improve investment environment and realize economic growth in this region.

1.2 Project Outline

The objective of this project is to interconnect the country's fragmented main power system and to realize stable power supply in Savannakhet Province and its surrounding areas by constructing 115kV power transmission lines and related facilities in the southern region of Laos, thereby contributing to the promotion of economic growth of the country.

Loan Approved Amount/ Disbursed Amount	4,173 million yen / 4,164 million yen	
Exchange of Notes Date/ Loan Agreement Signing Date	March 2012 / March 2012	
Terms and Conditions	Interest Rate Repayment Period (Grace Period Conditions for Procurement	0.01% 40 years 10 years) General Untied
Borrower / Executing Agency	Electricité du Laos: EDL	
Project Completion	June 2016	
Target Area	Southern region of Laos	
Main Contractors (Over 1 billion yen)	J-Power Systems Corporation (Japan) / Mitsubishi Corporation (Japan) (JV)	
Main Consultants (Over 100 million yen)	Nippon Koei Co., Ltd. (Japan) / Tokyo Electric Power Services Co., Ltd. (Japan) (JV)	
Related Studies (Feasibility Studies, etc.)	・JICA "The Study on Power Network System Plan in Lao People's Democratic Republic" (technical cooperation for development planning) (2010) ・JICA "Data Collection Survey on Power System Development" (System Analysis Review) (2011)	
Related Projects	[Technical Cooperation] ・Improvement of the Power Sector Management (2010–2013) ・Project on Power System Master Plan (2017–2020) ・Project for Improvement of Power Utility Management of Electricite du Laos (Scheduled for 2021–2024) ・Individual Experts "Electricity Policy Advisor" (2006–Present) [World Bank] ・Rural Electrification Project Phase 2 (2010–2015)	

2. Outline of the Evaluation Study

2.1 External Evaluator

Masumi Shimamura, Mitsubishi UFJ Research and Consulting Co., Ltd.

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: October 2021–February 2023

Duration of the Field Study: July 8–29 2022, October 3–12 2022

2.3 Constraints during the Evaluation Study

In this study, due to the global spread of COVID-19, the external evaluator could not travel to Laos. Instead, local consultant was utilized remotely to conduct the survey. The external evaluator was unable to collect answers to the questionnaires, conduct interviews with stakeholders and beneficiaries, and carry out project site survey, etc. directly in the field, which limited the information and data necessary for the evaluation and analysis. Therefore the external evaluator conducted evaluation analysis and judgment by closely examining the information and data obtained through the remote surveys and desk research.

3. Results of the Evaluation (Overall Rating: B[1])

3.1 Relevance/Coherence (Rating: ③[2])

3.1.1. Relevance (Rating: ③)

3.1.1.1 Consistency with the Development Plan of Laos

At the time of the project appraisal, Lao government has set the expansion of power grid as a goal in its *Seventh Five-year National Socio-Economic Development Plan (2011-2015)* and has placed a high priority on this project. In addition, Lao government has set a goal of raising the national household electrification rate to 90% by 2020, and construction of new Thaothan substation by the project was expected to promote electrification of rural areas surrounding the substation.

At the time of the ex-post evaluation, Lao government has regarded promotion of rural electrification through expansion of power grid as priority issues in its *Ninth Five-year National Socio-Economic Development Plan (2021-2025)*. The government also aims to improve and strengthen interconnections between domestic grids and to neighboring countries, to increase flexibility of power interchange, and to increase power exports. Furthermore, Lao government has set the goals of "promoting international interconnection of power grids in the ASEAN region" and "achieving stable power supply for industrialization and modernization" in its *Vision 2030 (2016-2025)*. The project, which contributes to stable power supply, economic growth, and rural electrification in Laos by developing main power grid, is also consistent with Lao PDR's development policy at the time of the ex-post evaluation.

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

[2] ④: Very High, ③: High, ②: Moderately Low, ①: Low

3.1.1.2 Consistency with the Development Needs of Laos

At the time of the project appraisal, power import from neighboring countries was increasing in Laos due to increasing domestic power demand and underdeveloped power transmission and distribution network, which resulted in chronic shortage of power in Savannakhet Province, where Savan-Seno SEZ was under construction. On the other hand, many power development projects were planned in the vicinity of Saravan Province, which was expected to expand power generation capacity, and generation of surplus power was anticipated. Therefore, there were urgent needs to secure stable power supply in the area surrounding Savannakhet Province (hereinafter referred to as "S1 area"[3]) by connecting the area with the area surrounding Saravan Province (hereinafter referred to as "S2 area"[4]) with transmission lines and interconnecting the fragmented grid through this project.

At the time of the ex-post evaluation, with the progress of economic and social development and rural electrification in Laos, domestic power demand and consumption have been steadily increasing, and stable power supply to S1 area continues to be necessary. The necessity of promoting rural electrification in S1 and S2 areas is also pointed out. Table 1 summarizes the trend of maximum power demand and power consumption in S1 and S2 areas.

Maximum power demand in S1 area in 2020 is about 1.6 times higher than in 2015, and power consumption in 2020 is 10% higher than in 2015. Similarly, maximum power demand in S2 area in 2020 is about 1.3 times higher than in 2015, and power consumption in 2020 is 39% higher than in 2015.[5] Decrease in power consumption in S1 area in 2021 compared to the previous year can be attributed to the effects of spread of COVID-19, especially among large power consumers. According to EDL and tenant companies in the Savan-Seno SEZ, S1 area has many large power consumers, including the SEZ, and they were affected by temporary suspension of factory operations, etc. On the other hand, in S2 area, there are many family-owned micro-enterprises,[6] and from the perspective of power consumption, it is thought that they were not affected as much as the large power consumers.

[3] S1 area includes two provinces, Savannakhet and Khammouan.
[4] S2 area includes four provinces, Saravan, Xekong, Champasak and Attapeu.
[5] While Table 1 includes data through 2021, comparison of data is made from 2020 and 2015 here because 2021 was the year affected by the spread of COVID-19 (comparisons with 2021 data was avoided since they may have been affected by external factors).
[6] According to EDL, about 80% of power consumed in Saravan Province is for residential use (including family-owned microenterprises).

Table 1: Trend of Maximum Power Demand and Power Consumption in S1 and S2 Areas

	2015	2016	2017	2018	2019	2020	2021
S1 Area (Savannakhet and Khammouan Provinces)							
Maximum Power Demand (MW)	116.68	131.62	152.02	141.33	173.62	183.89	188.05
Power Consumption (GWh)	505	519	506	503	527	551	501
S2 Area (Saravan, Xekong, Champasak and Attapeu Provinces)							
Maximum Power Demand (MW)	107.59	117.05	115.87	114.91	120.52	136.11	130.10
Power Consumption (GWh)	472	487	505	535	610	656	671

Source: Results from questionnaire survey of EDL

Note: In 2021, Power supply and demand were considered to have been affected by the spread of COVID-19 pandemic.

The main power source in Laos is hydropower, and if power output in dry season is secured to meet the demand, surplus power will be generated in rainy season when the amount of power generated is high. Surplus power is exported to neighboring countries, but the majority of exports are made by private independent power producers (hereinafter referred to as "IPPs"). The problem is that power cannot be flexibly and optimally transferred between the country and neighboring countries. For this reason, Lao government is aiming to develop and establish a wide-area interconnection system that connects domestic grid with neighboring countries' power grids.

3.1.1.3 Appropriateness of the Project Plan and Approach

As mentioned later in "3.3.1.1 Quantitative Effects (Operation and Effect Indicators)," among the operation and effect indicators set at the time of the appraisal, "annual electric supply" has not achieved its target as planned. Regarding the reason for this, EDL stated, "It is considered that the power demand forecast referenced to at the time of the appraisal was excessive." Since data to back up the statement was not available from the EDL, analysis was also conducted by referring to the documents at the time of the appraisal and the analysis of the technical cooperation project "Project on Power System Master Plan" (2017-2020) Final Report. (See "3.3.1.1 Quantitative Effects (Operation and Effect Indicators)" for details.) The power demand forecast referenced at the time of the appraisal was based on Lao government's Power Development Plan (2010-2020) at the time, and it would have been difficult to foresee at the time of the appraisal that the actual results would deviate significantly from the future forecast. Therefore, project plan and approach are considered to be appropriate.

In terms of equity, the project is designed to ensure that the poor have access to power

through collaboration with the World Bank's Rural Electrification Project[7] (2010-2015). (See "3.1.2.3 External Coherence" for details)

3.1.2 Coherence (Rating: ③)

3.1.2.1 Consistency with Japan's ODA Policy

At the time of the appraisal, Japan's *Country Assistance Program for Lao PDR* (September 2006) placed development of socioeconomic infrastructure and effective utilization of existing infrastructure as one of the priority areas. In addition, Japanese government placed electric power sector as part of its "Electricity Development Program," with a policy of cooperating in the development of government-owned power generation facilities and main power grids, as well as development of facilities for rural electrification, in order to expand safe and stable power supply. This project contributes to promote economic growth and rural electrification by providing stable power supply to Laos, and the project objectives are consistent with Japan's development cooperation policy at the time of the appraisal.

3.1.2.2 Internal Coherence

According to the documents at the time of the appraisal, this project was expected to have synergistic effects with the technical cooperation project "Improvement of the Power Sector Management"[8] (2010–2013) and the individual experts "Electricity Policy Advisor."[9] However, it was not possible to confirm direct collaboration with this project from the responses to the questionnaires and interviews with EDL, the consultants in charge of construction supervision of the project, and the electricity policy advisor at the time. According to the consultant in charge of construction supervision, project progress reports were made to the Electricity Policy Advisor as appropriate, but there was no direct effect on this project. The Electricity Policy Advisor[10] interviewed visited the project site after the facilities developed by the project started operation, but he was not particularly aware of any collaboration during project implementation, and there was no specific collaboration for the procurement of spare parts after project completion. (See "3.2.2.2 Project Period" for procurement of spare parts)

3.1.2.3 External Coherence

At the time of the appraisal, it was expected that this project would collaborate with the

[7] Rural Electrification Project Phase 2

[8] Human resource development, including capacity building for examination and inspection work at the Department of Electricity of the Ministry of Energy and Mines, was conducted to strengthen regulatory functions in the Laotian power sector.

[9] Capacity building support was provided to EDL staff for power development planning, and operation and maintenance of existing facilities.

[10] The local assignment period was from August 2016 to August 2019.

World Bank's Rural Electrification Project (2010–2015), and collaboration has taken place and synergistic effects have been generated. The World Bank's project promoted rural electrification in seven provinces, including Savannakhet and Saravan, which are the target areas of the project. At the time of the appraisal, it was expected that the substations developed by the project would be connected to the power distribution network developed by the World Bank's project to promote rural electrification and to increase access to power for the poor, and these substations have actually been connected. According to EDL, during project implementation process, information and data on power supply and demand and power consumption in the project area were shared with the World Bank project stakeholders, and the results of specific collaboration were also confirmed. (See 6) in "3.3.2.2 Other Positive and Negative Impacts" for details)

In terms of consistency with international frameworks, interview with EDL confirmed that the project contributes to SDG Goal 7 (Affordable and clean energy) and Goal 13 (Climate action).

The project is consistent with Lao PDR's development policy and development needs, and the project plan and approach were appropriate. The project is also consistent with Japan's development cooperation policy, and concrete results can be confirmed through collaboration with organizations outside of JICA and coordination with international frameworks. In light of the above, relevance and coherence of the project are high.

3.2 Efficiency (Rating: ④)

3.2.1 Project Outputs

This project connected the country's fragmented main power system in order to realize stable power supply in S1 area. Table 2 compares the planned and actual major outputs.

Table 2: Comparison of Planned and Actual Major Outputs

Plan	Actual	Comparison (Major Difference)
Civil Works, Procurement of Equipment etc.		
・Construction of Transmission Lines (115kV, Two lines) (Total length about 200km)	・Construction of Transmission Lines (115kV, Two lines) (Total length about 226.74km)	・Increase in total length of transmission lines
・Development of Nongdeun Substation Facilities (Installation of four 115 kV transmission line bays (Note) for Pakbo and Thaothan Substations)	・Development of Nongdeun Substation Facilities (Installation of three 115 kV transmission line bays for Pakbo and Thaothan Substations)	・Development of Nongdeun Substation Facilities (Reduction of a 115 kV transmission line bay for Pakbo and Thaothan Substations)
・Development of Pakbo Substation Facilities (Installation of two 115 kV transmission line bays for Nongdeun Substations)	・Development of Pakbo Substation Facilities (Dismantling of one existing 115 kV line and installation of one 115 kV transmission line bay for Nongdeun Substation)	・Development of Pakbo Substation Facilities (Dismantling of one existing 115 kV line and reduction of one 115 kV transmission line bay for Nongdeun Substation)
・Development of Saravan Substation Facilities	・Development of Saravan Substation Facilities	・As planned
・Construction of new Thaothan Substation	・Construction of new Thaothan Substation	・As planned
Consulting Services		
Plan		Actual
・Detailed Design, Preparation of Bid Documents		・As planned
・Tendering Assistance		・As planned
・Construction Supervision		・As planned
・Environmental Measures (assistance with environmental monitoring during construction and advice on countermeasures in the event of problems, etc.)		・As planned
・Completion and Defect Inspections		・As planned

Source: Results from questionnaire survey of EDL

Note: A bay is an electrical wire used to electrically connect power lines and transformers to busbars in a substation.

Regarding civil works, there were some changes from the original plan, including increase in total length of transmission lines, reduction of a 115 kV transmission line bay, and dismantle of one existing 115 kV line.

Total length of transmission line increased by about 27 km because EDL changed the location of towers and rerouted transmission lines to reduce impacts on social environment at the request of the landowners. Regarding dismantling of one existing 115kV line, at the time of project planning, one transmission line was connected between Pakbo substation and the Kengkok substation, which is located about 50km southeast of Pakbo substation, and was not connected to Nongdeun substation. However, at the start of the project, it was found that one line was connected from Pakbo substation to Kengkok substation via Nongdeun substation, and the original one line from Pakbo substation to Kengkok substation was disconnected. Under such situation, if two lines were installed between Pakbo and Nongdeun substations as planned, total number of transmission lines would be three, and there was a risk that the existing one would become overloaded, so the existing one was dismantled and two lines were installed as planned (See Figure 1). Reduction of 115 kV transmission line bay is due to the dismantling of one existing 115 kV line. All of these changes were according to the actual conditions at the site at the time of detailed design and were appropriate changes.

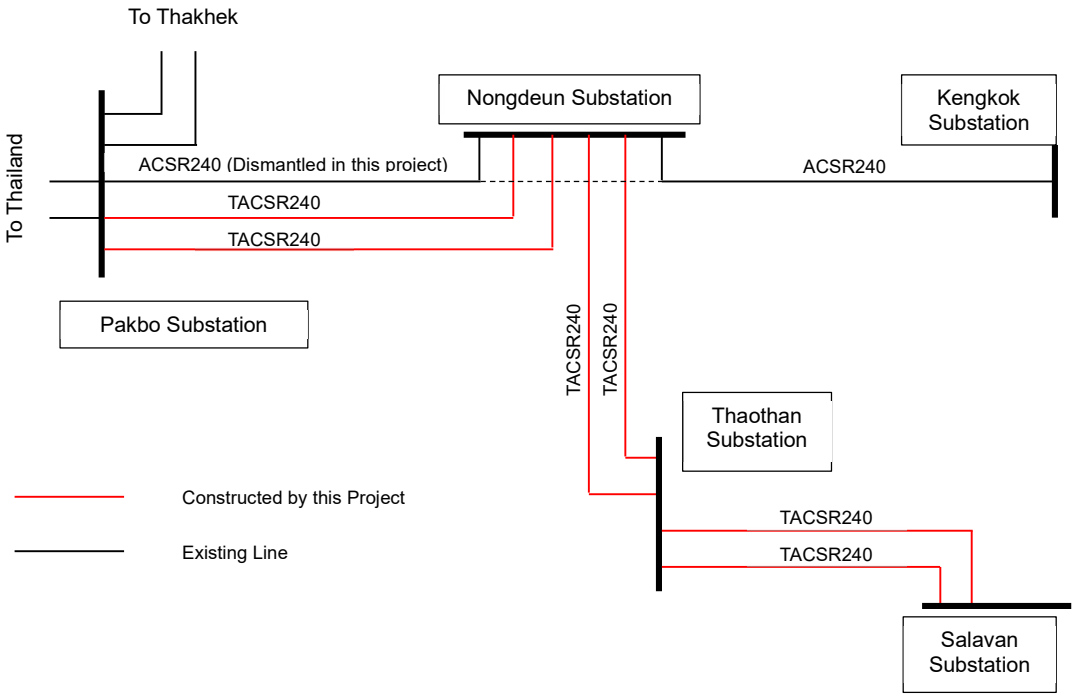


Figure 1: Design of this Project

Source: Prepared based on information provided by JICA

Control Room at Savaran Substation

Thaothan Substation

Nongdeun Substation

Pakbo Substation
(Entrance to Substation Site)

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total project cost was initially planned to be 4,660 million yen (out of which 4,173 million yen was to be covered by Japanese ODA loan). In actuality, the total project cost was 4,639 million yen[11] (out of which 4,164 million yen was covered by Japanese ODA loan), which is within the plan (100% of the planned amount).

3.2.2.2 Project Period

The project period was planned as 54 months, from March 2012 (signing of Loan Agreement) to August 2016 (when the facilities started operation) as opposed to 52 months in actuality, from March 2012 (signing of Loan Agreement) to June 2016 (when the facilities started operation), which is within the plan (96% of the planned period).

[11] The exchange rate was calculated at 1 LAK=0.01274 yen. (From IMF International Financial Statistics (2012–2016 average rate))

Table 3 summarizes the comparison of planned and actual project period.

Table 3: Comparison of Planned and Actual Project Period

Item	Plan	Actual
Signing of Loan Agreement	Mar. 2012	Mar. 2012
Selection of Consultants	Mar. 2012–Feb. 2013 (12 months)	May 2012–Dec. 2012 (8 months)
Consulting Services	Mar. 2013–Aug. 2017 (54 months)	Dec. 2012–Dec. 2017 (61 months)
Selection of Contractors	Jun. 2013–Aug. 2014 (15 months)	Mar. 2013–Mar. 2014 (13 months)
Construction Works	Sept. 2014–Aug. 2016 (24 months)	Mar. 2014–Jun. 2016 (28 months)
Start of Facility Operation	Aug. 2016	Jun. 2016

Source: Information provided by JICA and results from questionnaire survey of EDC

Note: Definition of project completion is at the start of facility operations.

The consultant and contractor selection periods were four and two months shorter than planned, respectively, so the four-month construction delay did not affect the project, and the entire project was completed two months earlier than planned. The four-month delay in construction was due to thorough investigation and disposal of unexploded ordnance at the project site.

While the project period was within the plan, the loan period was extended from July 2018 to July 2019. This was due to procurement of additional spare parts utilizing the unused balance of ODA yen loan. EDL submitted the relevant application to JICA in 2018, and JICA made concurrence in December of the same year. Procurement of additional spare parts was completed in July 2019. The reason for this response was that procurement of spare parts that had been initially planned was canceled due to a possibility of cost-overrun because of large fluctuation in the exchange rate (depreciation of yen) during the construction period after the loan agreement was signed and EDL was to make adjustments to cover the cost. However, depreciation of yen did not progress as expected during the construction period, resulting in an unused balance. In response to this, EDL expressed its desire to use the remaining balance to procure spare parts that were originally planned to be procured, in order to make more sustainable use of the facilities developed by the project. Although the loan period was extended, procurement of additional spare parts was not included in the project period, since the definition of project completion was at the start of facility operations, and thus project period was within the plan.

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

Economic internal rate of return (EIRR) calculated by EDL at the time of the appraisal was

13.0%. Since information/data was not provided by EDL and alternative approaches were attempted, but no information/data were available. Thus, EIRR recalculation at the time of the ex-post evaluation was not possible.

Therefore, both the project cost and the project period were within the plan and efficiency of the project is very high.

3.3 Effectiveness and Impacts[12] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

At the time of the appraisal, "maximum power flow," "annual electric supply" and "transmission loss" were set as quantitative effects of the project. Table 4 summarizes target values and actual values between 2018 and 2021 for each indicator. As the project completion is June 2016, the target year to be compared is 2018, two years after completion. The target achievement rates are shown in parentheses in the table.

Table 4: Operation and Effect Indicators

Indicators	Baseline value 2010 Actual value	Target value 2018 2 Years After Completion	Actual value			
			2018	2019	2020	2021
Maximum Power Flow (MW)	－	100	36.46 (36%)	132.7	181.51	107.16
Annual Electric Supply (GWh)	－	613.2	223.67 (36%)	313.72 (51%)	414.23 (68%)	341.53 (56%)
Transmission Loss (%)	－	7.0	0.87	1.22	1.67	1.5

Source: Ex-ante evaluation report and PCR

Note 1: Coverage is the sections of the 115kV transmission line (Pakbo Substation to Saravan Substation) developed by the project.

Note 2: Achievement rates in the lower rows of Maximum Power Flow and Annual Electric Supply.

Note 3: According to EDL, both the target value and actual value of Transmission Loss are "values calculated by dividing the difference between the amount of power at the sending end and the amount of power delivered to the customer by the amount of power at the sending end."

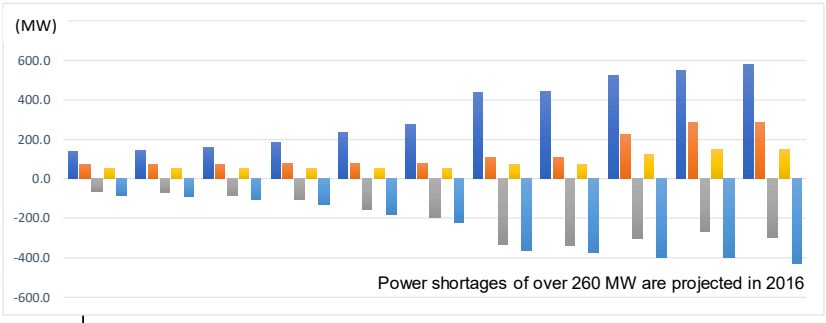
[12] When providing the sub-rating, Effectiveness and Impacts are to be considered together.

For “maximum power flow,” the actual value in 2018 was significantly below the target value, but has exceeded the target values since 2019. According to EDL, power demand in the southern region did not increase as much as expected in 2018, and it is considered that power supply was possible within the region. Although back up data to support this statement could not be obtained from EDL, EDL’s explanation is consistent with the fact that maximum power demand in S1 and S2 areas in 2018, summarized in Table 1, was lower than the figures for the previous year and the following year.

“Annual electric supply” has fallen well below the target value not only in 2018 but also for each subsequent year. According to EDL, it is considered that power demand forecast that was referenced at the time of the appraisal was excessive. Since data to back up the statement was not available from the EDL, analysis was conducted by referring to the documents at the time of the appraisal and the analysis results of the final report of the technical cooperation project “Project on Power System Master Plan” (2017–2020). Table 5 shows power supply-demand balance forecast for S1 area at the time of the appraisal. According to this, the projected maximum power in S1area for 2018 is 523.8 MW. On the other hand, the actual maximum power demand in S1 area in Table 1 for 2018 is only 141.33 MW. In addition, when comparing the actual values for other years, all are lower than those projected at the time of the appraisal.

Table 5: Power Supply-Demand Balance Forecast for S1 Area at the Time of the Appraisal (peak hour)

(Unit: MW)



Calendar Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Maximum Power	136.8	143.6	159.9	186.0	233.0	273.7	438.6	445.2	523.8	547.7	578.9
Capacity (rainy season)	75.0	75.0	75.0	78.2	78.2	78.2	108.2	108.2	221.2	281.2	281.2
Insufficient power capacity (rainy season)	-61.8	-68.6	-84.9	-107.8	-154.8	-195.5	-330.4	-337.0	-302.6	-266.5	-297.7
Capacity (dry season)	52.5	52.5	52.5	53.8	53.8	53.8	74.8	74.8	122.1	152.1	152.1
Insufficient power capacity (dry season)	-84.3	-91.1	-107.4	-132.2	-179.2	-219.9	-363.8	-370.4	-401.7	-395.6	-426.8

Source: Prepared based on information provided by JICA (Original data are from the Lao government’s Power Development Plan 2010-2020)

Furthermore, in “Chapter 5: Review of Domestic Demand Forecast” of the final report (February 2020) of the “Project on Power System Master Plan,” it is pointed out that there is a

discrepancy (overestimation) between Laos' power demand forecast and the actual results for 2016–2030 regarding domestic demand forecast. The reason cited for this is that the Large Industry's[13] power consumption estimates are excessive. In fact, looking at Table 6, among Large Industry projects in Savannakhet Province, the actual maximum power consumption projects in 2016 was 18 MW lower than expected in total.

Table 6: Large Industry Assumptions and Actual Values in 2016

	Province	Industry	Forecast	Actual	Difference
			Maximum Power (MW)	Maximum Power (MW)	Maximum Power (MW)
Central 2	Borikhamxai	Mine	13	45	+32
		Factory	10	0	-10
	Khammouan	Factory	17	17	0
		Mine	7	7	0
		Mine	10	0	-10
		Mine	5	0	-5
		Factory	5	0	-5
		SEZ	5	0	-5
	Savannakhet	Mine	45	35	-10
		SEZ	2	0	-2
		SEZ	3	0	-3
		SEZ	3	0	-3

Source: Prepared in part from Table 5.1-1 on p.5-4 from "The Study on Power Network System Master Plan in Lao People's Democratic Republic" Final Report 2020

The results of the above analysis are consistent with EDL's explanation.

"Transmission loss" has achieved its target.

3.3.1.2 Qualitative Effects (Other Effects)

In light of the project objectives, "stabilization of power supply in Savannakhet and surrounding areas"[14] was analyzed as qualitative effect. "Reduction of transmission loss" was also analyzed as qualitative effect.

As for "stabilization of power supply in the surrounding areas of Savannakhet Province," Table 7 summarizes the maximum power demand and power consumption in Savannakhet Province. The Province's maximum power demand is on the rise, and power is supplied in response to this.

[13] In EDL, demand forecasts are made by classifying power users receiving power at 115 kV as Large Industry and those power users less than 115 kV as General Sector.

[14] The beneficiary areas of the project are Savannakhet Province in S1 area and Saravan Province in S2 area. Project effects are different in each province, and the effectiveness (qualitative effects) was analyzed on "stabilization of power supply" for Savannakhet Province and impacts were analyzed on "promotion of rural electrification" in Saravan and Savannakhet Provinces.

Table 7: Maximum Power Demand and Power Consumption in Savannakhet Province

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Maximum Power Demand (MW)	42.83	50.56	65.42	66.17	64.89	76.72	96.94	87.4	114.89	119.03	116.61
Actual Power Consumption (GWh)	205	237	218	198	215	235	200	172	195	223	167

Source: Results from questionnaire survey of EDC

According to EDL's offices in Savannakhet and Saravan, power demand has increased year after year and power supply has improved after project completion. Furthermore, frequency of voltage fluctuations and power outages has also decreased significantly compared to before the project.

Interview surveys were conducted with 20 power consumers in Savannakhet and Saravan Provinces. All 20 consumers[15] (nine in Savannakhet and 11 in Saravan) responded that voltage fluctuations and frequency of power outages has improved significantly after the project. Specifically, their responses are as follows.

- Three out of five power users in the power supply area of Nongdeun substation (Savannakhet Province) are employees of two tenant companies in Savan-Seno SEZ. They responded that before the project, many planned and unplanned power outages (up to about one hour) and voltage fluctuations were recorded, often shutting down production lines, but after the project, there has been a significant improvement. The remaining two respondents (an NGO staff member and a family-owned retailer) in the same area also indicated that power supply has been stable after the project.
- Four power users in the area served by Pakbo substation (Savannakhet Province) (all of whom run family-owned retail businesses in residential areas) reported that they have

[15] Interviews were conducted with power consumers (four to six in each service area) who has been economically active in the areas around four substations (Nongdeun, Pakbo, Saravan and Thaothan) developed by the project. The breakdown of their attributes is as follows.

- Nongdeun substation (Savannakhet Province) power supply area (5 people): three from Savan-Seno SEZ, one from local NGO and one retailer.
- Pakbo substation (Savannakhet Province) power supply area (4 people): four retailers.
- Saravan substation (Saravan Province) power supply area (5 people): two from rice mills, one from gas station, one from clinic/ice factory and one retailer.
- Thaothan substation (Saravan Province) power supply area (6 people): three retailers, one manufacturer, one from a restaurant and one auto repair.

In addition, breakdown by gender and age is 10 men (one in 20s, five in 30s, one in 40s and three in 60s or older) and 10 women (four in 20s, three in 30s, one in 50s and two in 60s or older).

not experienced any voltage fluctuations or power outages after the project.

- 11 power users in the area served by Saravan and Thaothan substations (both in Saravan Province) also responded that power supply has been after the project, and that voltage fluctuations have improved and power outages have decreased. They pointed out that before the project, there were power outages that lasted from a few hours to half a day. According to the gas station owner, before the project, every time there was a power outage, gasoline refueling would stop, resulting in a loss of income and need to replace spare parts due to parts failure caused by voltage fluctuations, but such events have not occurred after the project.

Regarding "transmission loss," EDL explained that the reduction of transmission loss has been achieved, promoting a stable and efficient power supply. The actual transmission loss rates in Table 4 above have also met the target values. In addition, results of interviews with power users in both provinces indicated that, as mentioned above, all respondents felt that power supply has stabilized, and that voltage fluctuations and voltage drops has improved. These responses are complementary information to the quantitative data (transmission loss) in Table 4.

3.3.2 Impacts

3.3.2.1 Intended Impacts

As impacts of this project, state of generation of "promotion of rural electrification in the South," "investment promotion and industrial revitalization" and "promotion of economic growth in Laos" were evaluated.

1) Promotion of Rural Electrification in the South

Village electrification rates for Savannakhet and Saravan Provinces are shown in Table 8. Village electrification rate in Savannakhet Province has improved from 64.7% before the appraisal (2010) to 94.8% in 2021, and in Saravan Province from 64.8% before the appraisal (2010) to 97.4% in 2021. Since it is not possible to divide the village electrification rates in each Province into those within and outside the power supply area of the project, it is difficult to attribute the improved situation directly to the project. However, Table 8 is one that the project has promoted rural electrification in the South, since many Districts in each Province are covered by the project's power supply.

Table 8: Village Electrification Rates in Savannakhet and Saravan Provinces

	2010	2018	2019	2020	2021
Savannakhet Province	64.71%	91.03%	94.91%	94.82%	94.82%
Saravan Province	64.75%	90.40%	93.04%	94.67%	97.39%

Source: Results from questionnaire survey of EDL

In addition, interviews with power users in both Provinces have shown that all 20 users indicated that rural electrification has been promoted after the project.

2) Investment Promotion and Industrial Revitalization

Table 9 summarizes the number of enterprises with capital values in Savannakhet and Saravan Provinces. The number of enterprises increased in Savannakhet Province from 2018 to 2020 but began to decline in 2021. The spread of COVID-19 may have had some effects. The capital value of the Province was over LAK 4 trillion in 2019, about LAK 7 billion per enterprise, which is much higher than the capital value per enterprise in other years (2018: about LAK 4.6 billion, 2020: about LAK 1.9 billion, 2021: about LAK 2.3 billion), which suggest that there were large investments. In Saravan Province, the number of enterprises increased annually from 2018 to 2021, but growth slowed in 2020. The capital value in the Province is also significantly higher than the capital value per enterprise in other years (2018: about 2.5 billion LAK, 2020: about 1.8 billion LAK, 2021: about 1.9 billion LAK), with about 7.3 billion LAK per firm in 2019. Since the number of enterprises and capital values in each Province cannot be divided into those within and outside of project's service area, it is difficult to attribute these trends directly to the project. However, since many Districts in each Province are within the project's service area, Table 9 provides one indication that investment has been promoted by the project.

Table 9: Number of Registered Enterprises with Capital Values in Savannakhet and Saravan Provinces

		2018	2019	2020	2021
Savannakhet Province	Number of Registered Enterprises	422	610	752	620
	Capital Values (Unit: mil. LAK)	1,944,820	4,247,191	1,451,013	1,444,219
Saravan Province	Number of Registered Enterprises	244	289	306	353
	Capital Values (Unit: mil. LAK)	613,379	2,111,450	564,685	683,095

Source: National Enterprise Database (http://www.ned.moic.gov.la/)

Note: Data is based on information centrally managed by the National Enterprise Database. Some District data might not be up to date.

Table 10 shows the number of enterprises in the Savan-Seno SEZ. The number of enterprises has been increasing year by year.

Table 10: Number of Enterprises in Savan-Seno SEZ

2011	2019	2020	2021
23	65	71	73 (as of April) 76 (as of July)

Source: Prepared from various Savan-Seno SEZ related public documents.

Interviews with power users in Savannakhet and Saravan Provinces have shown that all 20 consumers responded that improved power supply as a result of the project was one of the important factors for them to consider continuing or expanding their business. In addition, several family-run business owners explained that they had diversified their businesses after the project.

Existing study[16] have shown that nighttime lights are strongly correlated with economic indicators. Therefore, as an alternative indicator for village electrification rate, number of enterprises and capital values, analysis was made on the changes in nighttime light intensity from 2016 to 2021 in the entire Savannakhet and Saravan Provinces, which are the

[16] Masamitsu Kurata, *Correlation between Nighttime Lights and Socio-Economic Indicators in Low-Income Countries*, Sophia Economic Review, Vol.LXII No.1, 2, March 2017
https://dept.sophia.ac.jp/econ/econ_cms/wp-content/uploads/2016/11/62-2.pdf

beneficiary areas of the project. Specifically, using Google Earth Engine, nighttime light data of VIIRS Nighttime Day/Night Band Composites Version 1 was extracted using the boundary data of administrative Districts of Humanitarian Data Exchange v1.56.0, and annual average nighttime light intensity was calculated. (Figure 2)

Nighttime light intensity increased significantly in 2016, when the facilities developed under the project were put into service, and nighttime light intensity has been increasing since 2017. See Appendix for images of nighttime lights for the entire Savannakhet and Saravan Provinces.

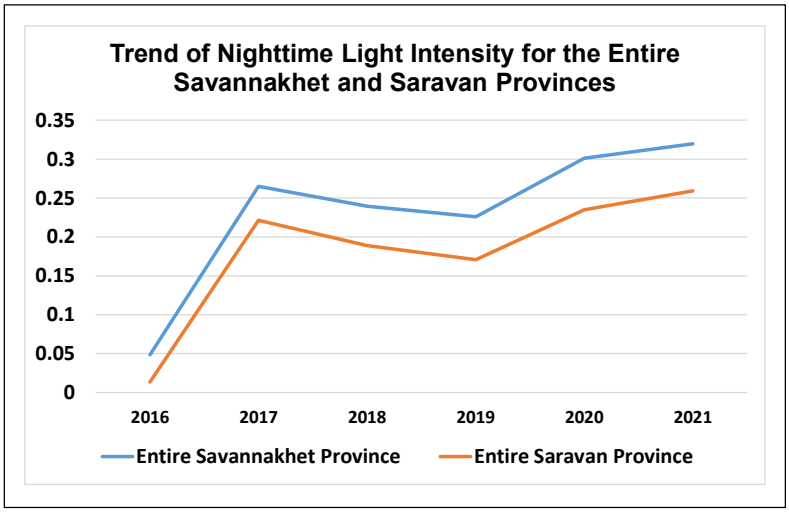
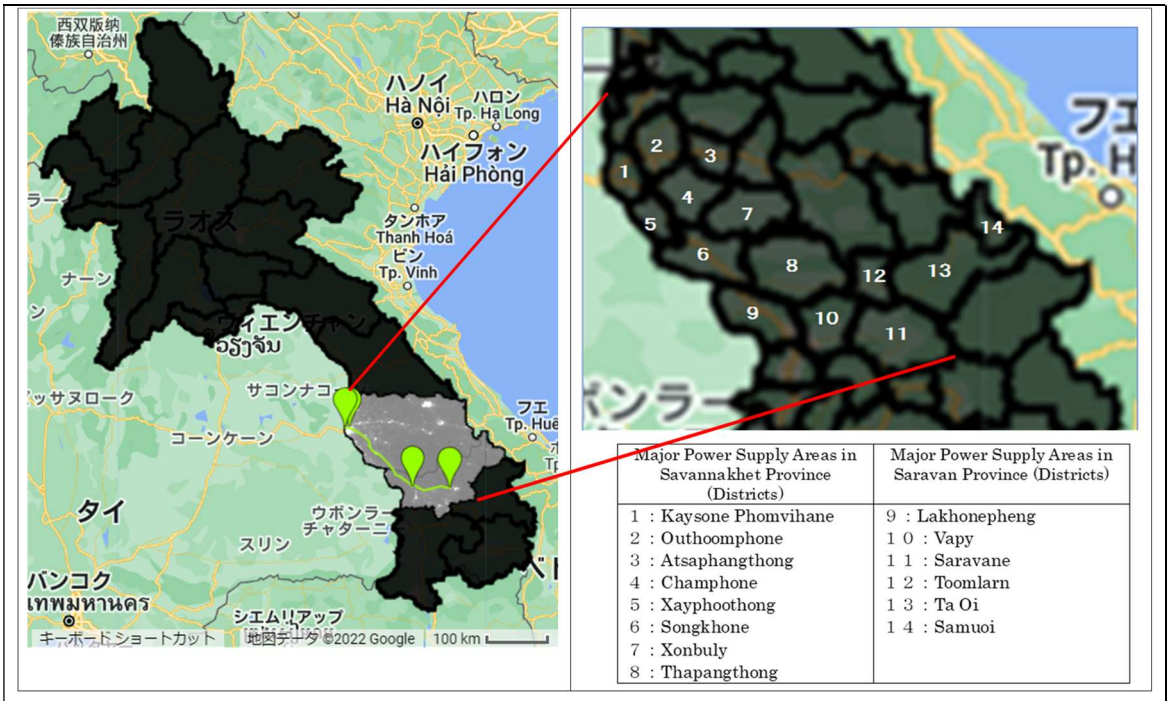


Figure 2: Trend of Nighttime Light Intensity (average) in the Entire Savannakhet and Saravan Provinces

Source: Created from VIIRS Nighttime Day/Night Band Composites Version 1, Humanitarian Data Exchange v1.56.0

In addition, the location map of the project's major power supply areas (Districts) in each Province is shown in Figure 2. A similar analysis of nighttime light intensity for these Districts from 2016 to 2021 shows an increasing trend for all Districts. (Figures 3 and 4)



Major Power Supply Areas in Savannakhet Province (Districts)	Major Power Supply Areas in Saravan Province (Districts)
1 : Kaysone Phomvihane	9 : Lakhonepheng
2 : Outhoomphone	10 : Vapy
3 : Atsaphangthong	11 : Saravane
4 : Champhone	12 : Toomlarn
5 : Xayphoothong	13 : Ta Oi
6 : Songkhone	14 : Samuoi
7 : Xonbuly	
8 : Thapangthong	

Figure 2: Location Map of Major Power Supply Areas of the Project (Districts)

Source: Created from VIIRS Nighttime Day/Night Band Composites Version 1, Humanitarian Data Exchange v1.56.0

Note: On the nighttime light figure on the left, the substations developed by the project (from left to right: Pakbo, Nongdeun, Thaothan, and Saravan) are indicated by yellow-green balloons, and the 115 kV transmission lines constructed by the project are indicated by yellow-green lines.

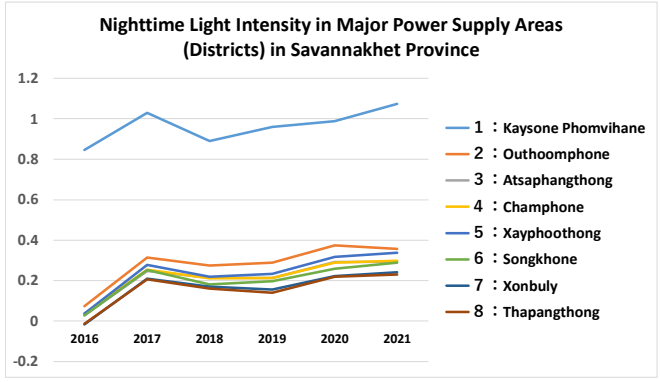


Figure 3: Trend of Nighttime Light Intensity (average) in Major Power Supply Areas (Districts) in Savannakhet Province

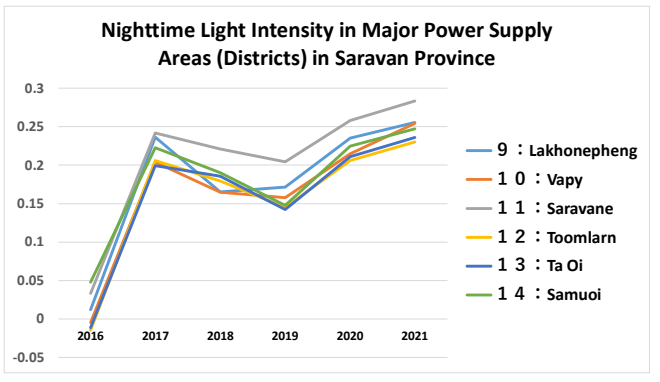


Figure 4: Trend of Nighttime Light Intensity (average) in Major Power Supply Areas (Districts) in Saravan Province

Source: Created from VIIRS Nighttime Day/Night Band Composites Version 1, Humanitarian Data Exchange v1.56.0

Note: Savan-Seno SEZ is located at 1. Kaysone Phomvihane.

Furthermore, major power supply areas (Districts) of the project in each province and the growth rates of nighttime light intensity (2015–2021) for each entire province are summarized in Tables 11 and 12. While the growth rate for the entire Savannakhet Province is 175.0%, the average growth rate for the major power supply areas in the province is 190.0%, which is higher than the figure for the entire province (Table 11). Similarly, while the growth rate for the entire Saravan Province is 261.4%, the average growth rate for the major power supply areas in the province is 284.2%, exceeding the figure for the entire province (Table 12). Since the figures for each entire province include districts within each province other than the power supply areas of this project, the contribution from the project is considered to be reflected in the difference in the growth rate of nighttime light intensity (additional increase in the figures).

Table 11: Major Power Supply Areas of the Project in Savannakhet Province and Growth Rates of Nighttime Light Intensity in the Entire Province

Major Power Supply Districts of the Project in Savannakhet Province	Growth Rate of Nighttime Light Intensity (2015–2021)
1. Kaysone Phomvihane	30.9%
2. Outhoomphone	140.5%
3. Atsaphangthong	195.7%
4. Champhone	183.8%
5. Xayphoothong	203.3%
6. Songkhone	194.7%
7. Xonbuly	295.8%
8. Thapangthong	275.2%
Average of Major Power Supply Districts of the Project in the Province	190.0%
Entire Savannakhet Province	175.0%

Source: Created from VIIRS Nighttime Day/Night Band Composites Version 1, Humanitarian Data Exchange v1.56.0

Table 12: Major Power Supply Areas of the Project in Saravan Province and Growth Rates of Nighttime Light Intensity in the Entire Province

Major Power Supply Districts of the Project in Saravan Province	Growth Rate of Nighttime Light Intensity (2015–2021)
9. Lakhonepheng	250.6%
10. Vapy	335.4%
11. Saravane	180.2%
12. Toomlarn	255.5%
13. Ta Oi	328.7%
14. Samuoi	354.6%
Average of Major Power Supply Districts of the Project in the Province	284.2%
Entire Saravan Province	261.4%

Source: Created from VIIRS Nighttime Day/Night Band Composites Version 1, Humanitarian Data Exchange v1.56.0

3) Promotion of Economic Growth in Laos

Table 13 summarizes GDP trends for the entire Laos from the World Bank's World Development Indicators. Although it is difficult to verify a direct causal relationship between economic growth of a country and the project because various factors other than the project affect the economic growth of a country, and it is difficult to measure the effect of the project by the trend of GDP. However, as mentioned above, based on the trends in the number of enterprises and capital values in Savannakhet and Saravan Provinces, trends in the number of tenant enterprises in Savan-Seno SEZ, results of interviews with power users in the two provinces, and trends in the growth rate of nighttime light in major power supply areas by the project, the project has been contributing to "investment promotion and industrial revitalization," and thereby contributing to an increase in GDP.

Table 13: GDP Trends in Laos

	2015	2016	2017	2018	2019	2020
Real GDP (USD million, 2015 basis)	14,426	15,440	16,504	17,535	18,492	18,585
Its Growth Rate	7.27%	7.02%	6.89%	6.25%	5.46%	0.50%
Real GDP per capita (USD, 2015 base)	2,135	2,250	2,368	2,477	2,573	2,546
Its Growth Rate	5.66%	5.39%	5.24%	4.62%	3.87%	-0.96%

Source: Created from World Bank's World Development Indicators
Note: In 2020, the real growth rate declined due to the spread of COVID-19.

3.3.2.2 Other Positive and Negative Impacts

1) Impacts on the Natural Environment

The project was classified as Category B based on the *JICA Guidelines for Confirmation of Environmental and Social Considerations* (April 2010) since it does not fall under any sensitive sectors/characteristics or sensitive areas, and its undesirable effects on the environment were considered to be not significant. According to EDL, it was not obligatory to prepare Environmental Impact Assessment (EIA) report due to minor impact on natural environment. Initial Environmental Examination (hereinafter referred to as "IEE") and Environmental Management Plan (hereinafter referred to as "EMP") were approved by the Ministry of Natural Resources and Environment on May 16, 2012.

According to EDL, no negative impacts on natural environment have been confirmed as a result of environmental monitoring. For monitoring during construction, a team consisting of EDL, consultants in charge of construction supervision, and related organizations at the central and local levels was formed to carry out quarterly environmental monitoring of air, water quality, waste, noise, vibration, etc. According to EDL, water was sprayed at the construction site three to four times a day as a measure against air pollution (dust, etc.) during construction, and waste separation tanks were set up at the construction workers' base camp as a measure against waste disposal. The construction sites were located away from the community and no complaints have been received with no noise or vibration issues. Interviews with power users and the results of project site inspections indicate that there have been no major problems with natural environment.

2) Resettlement and Land Acquisition

According to EDL, 2.89 ha of land for the tower construction was acquired as originally planned, and compensation was paid to the land owners based on the agreed unit price between the project and the provinces concerned. Specifically, they are as follows. According to EDL, the amount of compensation was based on the reacquisition price and was consistent with Laotian laws[17] and *JICA Guidelines for Confirmation of Environmental and Social Considerations*.

- Savannakhet Province (421 households): total 632,269,095 LAK
- Saravan Province (469 households): total 736,461,694 LAK

In addition, tall trees were cut down on 50 ha of land within the width of the site under

[17] Decree on Compensation and Resettlement of People Affected by Development Projects No. 192/PM dated 7 July 2005.

the transmission lines. At the occasion of cutting trees in private properties, compensation was paid to the land owners. According to EDL, no specific complaints have been received regarding land acquisition and cutting of the trees. Resettlement did not occur.

3) Gender Equality

The project contributes to improving access to electricity for the poor through collaboration with the World Bank's Rural Electrification Project, and benefits to women have been confirmed in the World Bank's project. See "6) Unintended Positive/Negative Impacts" below for details.

4) Marginalized People

The project contributes to improving access to electricity for the poor through collaboration with the World Bank's Rural Electrification Project, and is generating tangible effects. See "6) Unintended Positive/Negative Impacts" below for details.

5) Social Systems and Norms, Human Well-being and Human Rights

None.

6) Unintended Positive/Negative Impacts

<Synergies with World Bank's Rural Electrification Project>

As mentioned in "3.1.2.3 External Coherence," at the time of the appraisal, this project was expected to collaborate with the World Bank project. Collaboration was actually carried out, and the project is considered to have contributed to promotion of rural electrification and increase of access to electricity for the poor.

According to World Bank's information,[18] Rural Electrification Project targeted 525 villages in seven provinces[19] in south-central Laos, where many poor people and small business workers are located. The World Bank project includes the beneficiary areas of Savannakhet and Saravan Provinces in its project scope, where a total of 47,255 households have gained new access to on-grid and off-grid electricity for the entire project. The following results are mentioned in the World Bank's information.

- Increase in household income (tripled on average)
- Reduction of women's housework hours (from 60 minutes or more per night to 23 minutes per night)
- Promotion of women's employment

[18] Implementation Completion and Results Report (ICR3582) and IEG's Implementation Completion Report (ICR) Review

[19] Bolikhamxai, Khammouan, Savannakhet, Attapu, Xekong, Saravan, and Champasak Provinces.

・ Reduction of CO^2 emissions by approximately 300 kilotons annually, etc.

Four substations in Savannakhet and Saravan Provinces have been developed and expanded under this project, resulting in more stable power supply. This project is considered to have contributed to poverty reduction indirectly through collaboration with the World Bank's Rural Electrification Project.

<HIV/AIDS Control>

HIV/AIDS prevention program was implemented for construction workers in the project. HIV/AIDS control was also included in the environmental monitoring plan, and preventive program was conducted during construction of transmission lines. According to EDL, education and awareness-raising activities were carried out, and awareness of people involved in HIV/AIDS countermeasures was increased.

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

3.4 Sustainability (Rating: ②)

3.4.1 Policy and System

According to EDL, there is no change in policy regarding priorities and goals set forth in the Lao government's *Ninth Five-year National Socio-Economic Development Plan* and *Vision 2030* and there is no change in the policy to improve and strengthen interconnections between domestic grids and to neighboring countries, to increase flexibility of power interchange, and to increase power exports.

Regarding system, EDL is undergoing a major reorganization at the time of the ex-post evaluation. In addition to changes in EDL's organizational structure, system changes in the Lao power sector are expected in the future,[20] including involvement of Chinese company[21] in the operation of the high-voltage transmission line sector of 230 kV and above. JICA is currently implementing a technical cooperation project, "Project for Improvement of Power Utility Management of Electricite du Laos," scheduled for 2021–2024. Through this project, JICA is providing support to strengthen EDL organization, but it will take some time before the effects are realized.

From the above, sustainability of policy of the project is assured. While sustainability of

[20] EDL has been restructuring its operations due to its deteriorating financial situation, such as expansion of external debt, and in September 2020, high-voltage transmission division of 230 kV and above was separated, and a joint venture company, Electricite du Laos Transmission Company Limited (EDL-T), was established with China Southern Power Grid. (Source: JETRO Business Brief, "Private construction giant to acquire 24% stake in power generation company affiliated with Electric Power Corporation" (October 13, 2020))

[21] China Southern Power Grid is actively participating in the development of "One Belt, One Road" and strengthening power cooperation with Greater Mekong Subregion (GMS) countries.

system will need to be assessed based on the results of ongoing technical cooperation project, it is expected to be ensured once the project objectives[22] are achieved.

3.4.2 Institutional/Organizational Aspect

Operation and maintenance of transmission lines and substations after project completion is undertaken by EDL's regional transmission system division. Specifically, the Central 2 Transmission System and Southern Transmission System are in charge, while operation and maintenance works in the field are conducted by EDL Savannakhet Office and Saravan Offices under the management of these systems.

Seven to eight staff members in charge of operation and maintenance are assigned to each of the substations in Nongdeun, Pakbo, and Thaothan, which were developed under this project, and are engaged in daily operations. Saravan substation supervises and manages Thaothan substation and operates and maintains a total of six 115kV transmission lines, including two 115kV transmission lines developed by the project, with 15 staff members in charge of operation and maintenance. Each substation has four shifts per day (two people assigned to each shift) for 24-hour operation and maintenance work. According to each substation, personnel required for daily operation and maintenance work has been secured and there are no particular problems.

Division of duties, roles, coordination, and decision-making processes at each provincial office and substation that undertake operation and maintenance work are clear, and communication and coordination among personnel in the field and between the field and EDL headquarters are well organized.

In light of the above, EDL is undergoing a large-scale organizational restructuring, and although effects on the project's operation and maintenance system and personnel allocation is unknown, it can be considered that there are no particular problems with the current institution and organization.

3.4.3 Technical Aspect

According to EDL, staff in charge of operation and maintenance at the site have graduated from civil engineering vocational schools and colleges, and have accumulated the experience and knowledge necessary for daily operation and maintenance work through on-the-job training. In addition, a training center is located on the premises of EDL headquarters, and staff in charge of operation and maintenance attend training once or twice a year to improve their technical skills.

[22] Project objectives: Strengthen the operation and management ability of EDL by constructing suitable corporate strategies and improving management mechanisms.

According to EDL, new technologies are emerging in the inspection of transmission lines, etc., and it is necessary to improve technical skills to keep up with evolving technologies and new equipment. Specifically, in Laos, drones are used to inspect equipment on IPP-dedicated transmission lines, and EDL is also introducing drones to improve efficiency of inspection work on transmission lines that are difficult to access in mountainous areas. EDL has pointed out technical issues related to the use of drones, which are expected to affect timely repairs in the event of problems with transmission lines, and thus the necessity for enhancing technological capacity is recognized.

According to EDL, maintenance manuals have been developed and updated to meet the needs of the field, and are referred to and used in daily operations, especially for on-the-job training and guidance for newcomers. EDL headquarters provides guidance in the development and updating of manuals, which are utilized after final approval by the respective offices in the province which is responsible for operation and maintenance in the field.

From the above, it is considered that staff in charge of operation and maintenance at the site have necessary technical skills to carry out their daily work. On the other hand, there are some points that need to be improved in terms of handling new technologies and equipment.

3.4.4 Financial Aspect

Table 14 summarizes EDL's financial situation. EDL's gross profit (segment result) is broadly flat. Operating profit and profit for the year have been declining year after year, resulting in a difficult financial situation. According to EDL Annual Report (2021), dividends from affiliate and joint venture investments nearly doubled from the previous year, as many of the domestic IPP projects in which EDL has a stake performed better than expected. On the other hand, depreciation of local currency LAK resulted in a foreign exchange loss (loss ballooned to 13.5 times the previous year's loss), which significantly reduced operating profit and profit for the year in 2021.

Table 14: Financial Situation of EDL (2018–2021)

(Unit: million LAK)

	2018	2019	2020	2021
Revenue from sale	1,137,430	1,217,530	1,167,375	1,196,664
Cost of sales	-532,735	-582,870	-567,894	-585,971
Segment result	**604,695**	**634,660**	**599,481**	**610,693**
Other income	26,476	31,270	44,092	55,292
Operating and administrative expenses	-169,215	-154,849	-198,319	-154,090
Foreign exchange loss, net (Note)	-29,050	71,524	-45,389	-612,913
Share of profit from investment in associate and joint ventures	626,001	339,377	498,703	960,715
Operating profit	**1,058,907**	**921,982**	**898,568**	**859,697**
Finance costs	-588,553	-724,366	-741,125	-855,815
Profit before income tax expense	470,354	197,616	157,443	3,882
Income tax expense	-	-	-	-
Profit for the year	**470,354**	**197,616**	**157,443**	**3,882**

Source: Prepared based on EDL Annual Reports

Note: According to the Annual Report (2021), foreign exchange losses occurred for interest payments on long-term debt, bonds, and short-term debt.

Major financial ratios of EDL are shown in Table 15. In 2021, net profit margin, return on equity, and return on assets decreased significantly from the previous year, while the debt to equity ratio increased. According to the Annual Report (2021), foreign exchange losses were the main reason for the decline in profits, as depreciation of local currency LAK caused foreign currency debt to swell. Earnings per share in 2021 are significantly lower than in the previous year by about one-fiftieth.

As described above, EDL's financial situation is seriously deteriorating.

Table 15: Major Financial Ratios of EDL (2020–2021)

	2020	2021
EBITDA Margin (Note)	85.4%	90.1%
Net Profit Margin	9.2%	0.2%
Return on Equity：ROE	1.7%	0.04%
Return on Assets：ROA	0.7%	0.02%
Debt to Equity Ratio：D/E	1.66	1.88
Earnings Per Share：EPS	94.49 LAK	2.62 LAK

Source: Prepared based on EDL Annual Report (2021)

Note: Earnings Before Interest, Tax, Depreciation and Amortization Margin. Calculated excluding net foreign exchange losses.

Behind the severe financial situation are the structural problems that EDL is facing. Specifically, since most of the power purchase agreements with IPPs are based on take-or-pay contracts, EDL has no choice but to purchase from IPPs surplus domestic power that the IPPs cannot sell overseas at a reverse price. In addition, Lao government has pushed forward with investment without conducting thorough analysis of domestic and international power supply and demand, procurement, and contract management, resulting in an increase in debt due to excessive capital investment, and the debt is further inflated by foreign exchange losses due to the depreciation of the local currency, LAK.[23] Furthermore, since EDL is a state-owned enterprise in the power sector and is a core enterprise responsible for economic and social development of Laos and the lifeline for the people, government regulations do not allow EDL to raise electricity rates at its discretion. In May 2020, Lao government decided to reduce electricity rates by 3% as a countermeasure against COVID-19.[24] Despite a 2% increase in electricity rates for households and small and medium businesses in March 2021,[25] EDL's financial situation remains tight.

According to an article in the local media Vientiane Times, in April 2022,[26] Lao government established the "EDL Reform Committee" to deal with these problems. The committee is expected to make recommendations for improving EDL's financial health, but no specific timing or other details are available.

[23] Source: From the related information of the technical cooperation project, "Project for Improvement of Power Utility Management of Electricite du Laos."
[24] Source: From the World Bank Report *Linking Laos, Unlocking Policies, Lao PDR Country Economic Memorandum,* 2022
[25] Source: The Laotian Times, New Electricity Rates Set This Month, March 5, 2021 https://laotiantimes.com/2021/03/05/new-electricity-rates-set-this-month/
[26] Vientiane Times, EDL chief explains reasons behind loses, July 7 2022 https://www.vientianetimes.org.la/freeContent/FreeConten2022_EDL129.php

From the above, EDL's financial situation is becoming increasingly difficult. Lao government and EDL are taking measures to restore financial soundness, and JICA is providing support through the ongoing technical cooperation project, "Project for Improvement of Power Utility Management of Electricite du Laos" but the prospects for improvement cannot be predicted at the time of the ex-post evaluation. Therefore, it is considered that there are concerns about the financial aspect of operation and maintenance.

3.4.5 Environmental and Social Aspect

As a result of confirming with EDL, there were no unexpected environmental and social considerations.

3.4.6 Preventative Measures to Risks

It is not possible to predict the impacts of EDL's major reorganization at the time of the ex-post evaluation. However, there is a possibility that sustainability of the project effects may be greatly affected by changes in the operation and maintenance system of the project and allocation and distribution of various resources such as budget and staffing. Thus, it is important to continuously monitor EDL situation through ongoing technical cooperation project.

3.4.7 Status of Operation and Maintenance

As a result of interviews with EDL and field surveys of the project sites, transmission lines and distribution facilities developed by the project are well maintained and generally operated smoothly.

According to EDL, one cooling fan in the 115 kV control/relay panel at the Nongdeun substation has malfunctioned, and the door of the control/relay panel is left open all the time. The cause is currently under investigation.

Operation and maintenance staff assigned to each substation conduct daily maintenance, periodic maintenance every three months, and maintenance when problems occur. The problem with the cooling fan mentioned above is being dealt with as maintenance when problem occurs, and operation and maintenance personnel are dispatched from the regional control center to the site to handle the problem.

Maintenance manuals have been prepared for each substation, and staff in charge of operation and maintenance use these manuals on a daily basis. According to EDL, the manual is revised and utilized at least once a year in response to changing conditions and needs in the field. In addition, each substation is required to inspect its equipment and facilities and check its inventory of spare parts and tools, etc. and submit a report to the regional control center

annually. For spare parts, regional control center submits applications to EDL headquarters, and EDL headquarters procures the parts centrally.

From the above, there are some problems in the operation and maintenance status at the time of the ex-post evaluation, but as a whole, there is no problem because facilities are properly operated and maintained.

Some minor issues have been observed in the technical, financial and the current status of operation and maintenance. They are not expected to be improved/resolved. Therefore, sustainability of the project effects is moderately low.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project constructed 115kV power transmission lines and related facilities in the southern region of Laos with the aim of ensuring stable power supply in Savannakhet Province and its surrounding areas. The project, which connects the country's fragmented main power system, is consistent with Laos' development policy and development needs. The project is also consistent with Japan's development cooperation policy, and concrete results can be confirmed through collaboration with organizations outside of JICA. Therefore, relevance and coherence of the project are high. In terms of project implementation, there were some changes from the original plan, such as increase in total length of transmission lines, but all of these changes were based on the site conditions at the time of detailed design, and were appropriate changes. Both project cost and project period were within the plan and thus efficiency of the project is very high. Regarding project effects, of the indicators of quantitative effects set at the time of planning, "annual electric supply" was not achieved as planned but the remaining indicators, "maximum power flow" and "transmission loss" were mostly achieved as planned. Regarding impacts, results of interviews with EDL and electricity consumers in the project area, as well as related data and trends of nighttime light intensity indicate that the project is facilitating rural electrification, investment promotion, and industrial revitalization in the southern region. No negative impacts on natural environment have been reported. Land acquisition was carried out without any particular problems, and resettlement did not take place. The project is also contributing to improving access to electricity for the poor through its collaboration with the World Bank's Rural Electrification Project. Therefore, effectiveness and impacts of the project are high. Regarding sustainability, some minor issues have been observed in the related technical and financial aspects, and the current status of operation and maintenance, sustainability of the project effects is moderately low.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

It is desirable to improve efficiency of monitoring and inspection operations of transmission lines by improving technical capabilities to cope with technological advancements and new equipment, such as conducting drone inspections of transmission lines constructed by the project.

At Nongdeun substation, one cooling fan in the 115kV control/relay panel is malfunctioning, and prompt investigation of cause and response is desired.

4.2.2 Recommendations to JICA

A major reorganization of EDL is underway, and institutional changes in the Lao power sector are expected in the near future. Improving management and financial situation of EDL is an urgent issue, and it is important that JICA continuously monitor the situation through the ongoing technical cooperation project, "Project for Improvement of Power Utility Management of Electricite du Laos," etc.

4.3 Lessons Learned

Importance of reviewing the adequacy of power demand forecasts in the existing development plans, etc.

The actual figures of the indicator "annual electric supply" set at the time of the appraisal have fallen far short of the target for this project. It is pointed out that power demand forecast referenced at the time of the appraisal was excessive as a reason. The power demand forecast was the demand forecast in the Lao government's Power Development Plan at the time. Lao government has set goals to improve flexibility of power grid interchanges between the country and neighboring countries and to increase power exports, and power development in the country needs to take into account relationship with the power development plans and demand forecasts of neighboring countries. These variables could change power supply and demand situation significantly in the future. Therefore, when similar projects are implemented in the future, it is important to carefully examine and confirm the adequacy of data such as demand forecasts described in existing development plans, etc., at the time of preparatory studies and project appraisals. It is important to hold sufficient discussion with the counterpart country/executing agency the possibility of variable factors and set target values for quantitative effects after careful scrutiny and consideration.

END

Appendix

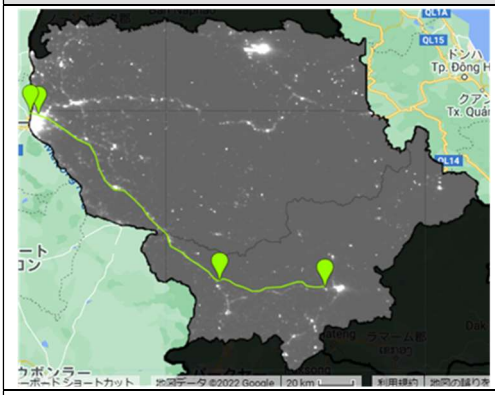
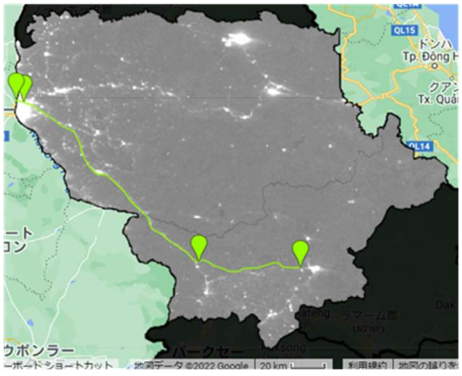
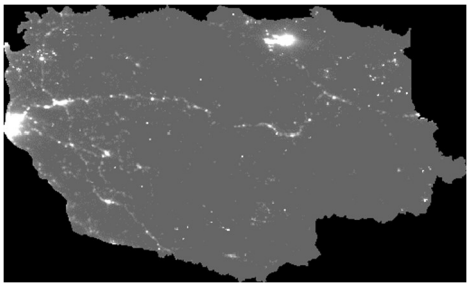
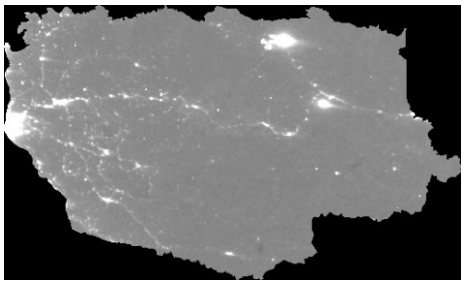
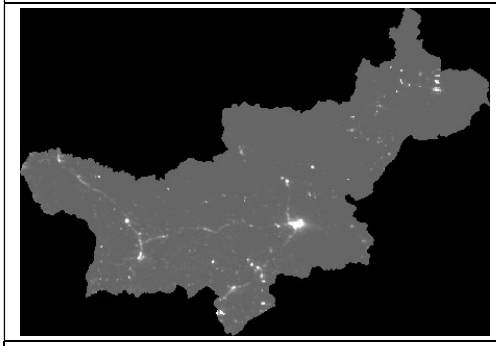
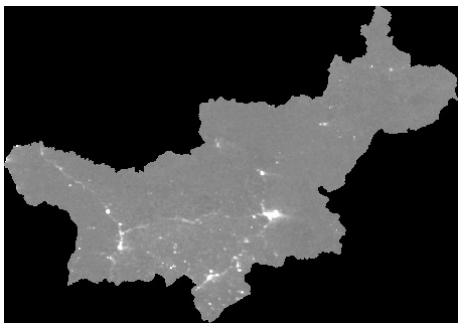
2016	2021
	
Savannakhet Province & Saravan Province (Note 1)	Savannakhet Province & Saravan Province (Note 1)
	
Savannakhet Province	Savannakhet Province
	
Saravan Province	Saravan Province

Figure: Images of Nighttime Lights in Savannakhet and Saravan Provinces

Note: Note: On the nighttime light figure, the substations developed by the project (from left to right: Pakbo, Nongdeun, Thaothan, and Saravan) are indicated by yellow-green balloons, and the 115 kV transmission lines constructed by the project are indicated by yellow-green lines.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs	1) Civil Works, Procurement of Equipment etc. ・ Construction of Transmission Lines (115kV, Two lines) (Total length about 200km) ・ Development of Nongdeun Substation Facilities (Installation of four 115 kV transmission line bays for Pakbo and Thaothan Substations) ・ Development of Pakbo Substation Facilities (Installation of two 115 kV transmission line bays for Nongdeun Substations) ・ Development of Saravan Substation Facilities ・ Construction of new Thaothan Substation 2) Consulting Services ・ Detailed Design, Preparation of Bid Documents ・ Tendering Assistance ・ Construction Supervision ・ Environmental Measures ・ Completion and Defect Inspections	1) Civil Works, Procurement of Equipment etc. ・ Construction of Transmission Lines (115kV, Two lines) (Total length about 226.74km) ・ Development of Nongdeun Substation Facilities (Installation of three 115 kV transmission line bays for Pakbo and Thaothan Substations) ・ Development of Pakbo Substation Facilities (Dismantling of one existing 115 kV line and installation of one 115 kV transmission line bay for Nongdeun Substation) ・ As planned ・ As planned 2) Consulting Services ・ As planned ・ As planned ・ As planned ・ As planned ・ As planned
2. Project Period	March 2012–August 2016 (54 months)	March 2012–June 2016 (52 months)
3. Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total ODA Loan Portion Exchange Rate	 2,829 million yen 1,832 million yen (190,705 million LAK) 4,660 million yen 4,173 million yen 1LAK=0.0096 yen (As of December 2011)	 4,164 million yen 475 million yen (37,284 million LAK) 4,639 million yen 4,164 million yen 1LAK=0.01274 yen (Average between 2012 and 2016)
4. Final Disbursement	July 2019	

END