Ex-Post Project Evaluation 2019:
Package IV-2 (Pakistan, Nepal)

January 2021

JAPAN INTERNATIONAL COOPERATION AGENCY

Octavia Japan, Co., Ltd.
Foundation for Advanced Studies on International Development (FASID)
(Joint Venture)

EV
JR
20-44

本評価結果の位置づけ

本報告書は、より客観性のある立場で評価を実施するために、外部評価者に　委託した結果を取り纏めたものです。本報告書に示されているさまざまな見解・提言等は必ずしも国際協力機構の統一的な公式見解ではありません。

また、本報告書を国際協力機構のウェブサイトに掲載するにあたり、体裁面の微修正等を行うことがあります。

なお、外部評価者とJICAあるいは相手国政府側の事業実施主体等の見解が異なる部分に関しては、JICAあるいは相手国政府側の事業実施主体等のコメントとして評価結果の最後に記載することがあります。

Disclaimer

This report compiles the result of the ex-post evaluations. These are conducted by external evaluators to ensure objectivity, and the views and recommendations herein do not necessarily reflect the official views and opinions of JICA. JICA is not responsible for the accuracy of the English translation, and the Japanese version shall prevail in the event of any inconsistency with the English version.

Minor amendments may be made when the contents of this report is posted on JICA’s website.

Comments by JICA and/or the Counterpart Agencies may be added at the end of the evaluation report when the views held by them differ from those of the external evaluator.

Islamic Republic of Pakistan

FY2019 Ex-Post Evaluation of Japanese ODA Loan

"Indus Highway Construction Project (III)"

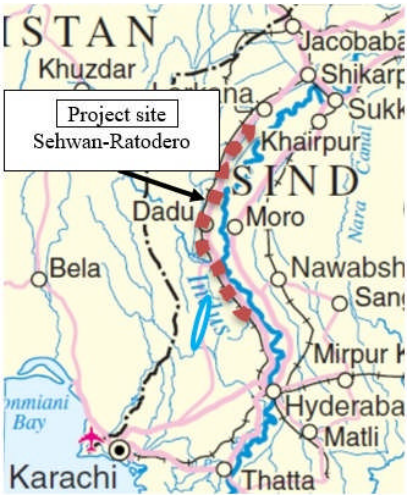
External Evaluator: Kenichi Inazawa, Octavia Japan, Co., Ltd.

0. Summary

This project involved the construction of a road in the underdeveloped section of Sehwan to Ratodero (approximately 200 km) with the aim of addressing the traffic bottlenecks along National Route 55 (hereinafter referred to as the "Indus Highway"), which forms a part of the national trade corridor, thereby contributing to the economic development of the highway as a whole and the areas along the route. The *Medium Term Development Framework* (2005-2010) and the *12th Five-Year Plan* (2018-2023), formulated by the government of Pakistan, recognize National Route 5 and the Indus Highway as strategic main routes of the national trade corridor, while placing the importance on developing and expanding road networks. Considering that there was a need to make the entire sections of the Indus Highway double-tracked (two lanes each way) and increase budgets for the repair and maintenance of National Route 5, as well as the fact that this project was in line with Japan's assistance policy, its relevance is high. Efficiency is fair, although the project cost was within the initial plan budget, the project period was longer than the initial plan, due to delays in the consultant bidding process, paperwork and agreement in terms of consultant selection, land acquisition, construction and final payments to suppliers / contractors. With respect to the quantitative effect indicators, the "annual average daily traffic" exceeded the target, while the "saving in travelling time" primarily met the target figure. Taking into account the comments made in interviews conducted during the field study, it is believed that driving has become safer and more comfortable along the project area and that this project has contributed to the vitalization of the local economy and improved living conditions. Based on the above, effectiveness and impact is judged to be high. It is assumed that there are no major concerns in relation to the institutional, technical and financial aspects of the project or the status of operation and maintenance works carried out by the National Highway Authority (hereinafter referred to as the "NHA") Sindh Office. Therefore, the sustainability of the effects achieved through the implementation of this project is considered to be high.

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

1. Project Description



Project Location

Road Developed by This Project
(Sehwan-Ratodero)

1.1 Background

The volume of traffic on National Route 5 that connects Karachi (Pakistan's main business city) and the northeastern region of the Punjab Province was increasing every year, causing a bottleneck which has impacted on economic activities. The Indus Highway is a main road which is located in the west bank of the Indus river, while National Route 5 is located along the other side (or east bank) of the river. Compared to National Route 5, the Indus Highway had shortened the Karachi-Peshawar (the capital of Khyber Pakhtunkhwa Province) section by approximately 500 km. However, the roads were narrow, and some sections were underdeveloped. Therefore, drivers tended to use National Route 5. For this reason, there was a need to improve the transport capacity of the north-south main route by diverting more traffic from National Route 5 to the Indus Highway, constructing new roads and widening existing roads for the Highway at the same time.

1.2 Project Outline

The objective of this project is to eliminate traffic bottlenecks by constructing an additional road (around 200 km between Sehwan and Ratodero) in the undeveloped section of the Indus Highway (National Route 55) that forms part of the national trade corridor, thereby contributing to the production of the planned effect of the entire Indus Highway and the economic development of communities along this highway.

Loan Approved Amount / Disbursed Amount	19,455 million yen / 17,331 million yen
Exchange of Notes Date / Loan Agreement Signing Date	December 13, 2006 / December 15, 2006
Terms and Conditions	Interest 1.3% Repayment period 30 years (of which grace period is 10 years) Procurement condition: General Untied
Borrower / Executing Agency(ies)	The President of the Islamic Republic of Pakistan / National Highway Authority (NHA)
Project Completion	March 2020
Target Area	Between Sehwan and Ratodero in Sindh Province
Main Contractor(s) (Over 1 billion yen)	Frontier Works Organization (Pakistan)
Main Consultant(s) (Over 100 million yen)	Republic Engineering Corporation (Pakistan) / Techniques Consulting Engineers (Pakistan) / EA Consulting PVT LTD. (EA) (Pakistan) / Techno-Consult International (Pakistan) (JV)
Related Studies (Feasibility Studies, etc.)	Feasibility Study (F/S), NHA (1988)
Related Projects	[ODA Loan] -"Indus Highway Construction Project (I)" (1989) -"Indus Highway Construction Project (II)" (1991) -"Indus Highway Construction Project (II B)" (1993) -"Kohat Tunnel Construction Project (I)" (1994) -"Kohat Tunnel Construction Project (II)" (2001) -"Kohat Tunnel Construction Project (III)" (2003) [Technical Assistance] -"Pakistan Transport Plan Study" (master plan) (2005-2006) [Other Agencies] -"National Highway Development Sector Investment Program" (ADB, 2005)

2. Outline of the Evaluation Study

2.1 External Evaluator

Kenichi Inazawa, Octavia Japan, Co., Ltd.

2.2 Duration of Evaluation Study

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

Duration of the Study: November 2019 – December 2020

Duration of the Field Study: International travel was canceled. The field study was conducted remotely, using a local consultant.

2.3 Constraints during the Evaluation Study

Due to the spread of COVID-19, the external evaluator decided against international travel for this study. Utilizing a local consultant, the evaluator conducted site visits and information / data collection remotely, as well as interviews with project-related personnel and residents, and qualitative surveys. The results were analyzed and used in the decision-making process of the external evaluator.

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

3.1 Relevance (Rating: ③[2])

3.1.1 Consistency with the Development Plan of Pakistan

Before this project began, the government of Pakistan formulated the *Medium Term Development Framework* (2005-2010), which listed the following as strategies for developing the road sector: (1) strengthening the transport capacity of existing road networks through improvements and road widening; (2) selective investment in the construction of new roads that are economically viable, including rural roads; (3) development of road networks that contribute to the promotion of trade with Afghanistan, central Asia and India; (4) promoting the private sector's involvement in the road industry; (5) improvement of road maintenance and the promotion of traffic safety measures; (6) stricter control on overloading and (7) improving the capabilities of the road sector's implementing agencies. In addition, the government chose to construct National Route 5 and the Indus Highway, connecting Karachi, Lahore and Peshawar in a north-south direction, as these are the strategic main routes of the national trade corridor.

At the time of the ex-post evaluation, the government of Pakistan has formulated the *12th Five-Year Plan* (2018-2023), which sets a target of a 9.6% increase in road network length and density annually, and placed the significant importance on infrastructure development. This plan has prioritized the promotion of trade and market access, industrial development, global value chains, socio-economic development and the reduction of poverty. Additionally, *Vision 2025*, formulated by the government in 2014, has focused on establishing an integrated traffic system and improving regional connectivity. Furthermore, the government has developed the *National Transport Policy 2018* in 2018, which views road transport networks as an important provider of promoting access between regions.

Based on the above, there is a need to develop and expand road networks to encourage trade

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

and market access in Pakistan at the time of the appraisal, as well as at the time of the ex-post evaluation. Therefore, this project is in line with national and sector plans in place at the time of the appraisal, as well as those in place at the time of the ex-post evaluation.

3.1.2 Consistency with the Development Needs of Pakistan

Before this project began, road was considered to be the main transport method of the future. Above all, national roads accounted for a large portion of cargo and commercial transport and were expected to play a significant role in the national economy. While National Route 5 was the most important route connecting Karachi Port, the country's main port, and the Punjab Province, the center of the economic activity, it was overloaded with increasing traffic volumes. There was a need to develop the Indus Highway as an alternative to National Route 5. The Indus Highway is on the west bank of the Indus River and runs alongside National Route 5, which is on the east bank. The distance between Karachi and Peshawar is around 500 km shorter on the Indus Highway than on National Route 5. However, the road was narrow, and some sections were underdeveloped. Thus, drivers tended to use National Route 5. For this reason, there was a need to construct a new road in Indus Highway, widen the existing road and encourage more drivers to use the Indus Highway, rather than National Route 5, thereby strengthening the transport capacity of the key north-south route.

According to the NHA, around 20% of the traffic from Karachi (southern region of Pakistan) to the North has been diverted from National Route 5 to the Indus Highway since its completion, some of which is a direct result of this project. Under this project, a new road was constructed which was double-tracked (two lanes each way) in the targeted section (Sehwan-Ratodero) and was around 200 km long. As a result, traffic flows have improved. In addition, at the time of the ex-post evaluation, the government of Pakistan formulated a plan to make the remaining sections of the Indus Highway double-tracked by 2024, with a view to improving its traffic transport capacity. As for National Route 5, which is a north-south route just like the Indus Highway, all sections were double-tracked at the time of the ex-post evaluation. In the near future, measures will be taken to deal with increased traffic volume and larger vehicles, and it is planned to increase the budget for sustainable restoration and maintenance work.

Based on the above, efforts have been made to strengthen the transport capacity of the Indus Highway and National Route 5 at the time of the project appraisal, through to the ex-post evaluation. Therefore, the project is in line with the development needs at the time of the appraisal as well as at the time of the ex-post evaluation.

3.1.3 Consistency with Japan's ODA Policy

JICA formulated the *Medium-Term Strategy for Overseas Economic Cooperation Operations* in April 2005, which listed "a foundation for sustainable growth" as one of the priority areas. JICA also developed the *Country Assistance Strategy* in March 2006, which recognized the need to improve the road sector, in order to support economic development led by the private sector and claimed that JICA would actively support it, with a view to reducing poverty and improving market access. Considering that this project aimed to eliminate traffic bottlenecks by constructing new roads in the underdeveloped section of the Indus Highway, thereby contributing to the economic development of the communities along the highway, it can be stated that this project was in line with the ODA policy of Japan.

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

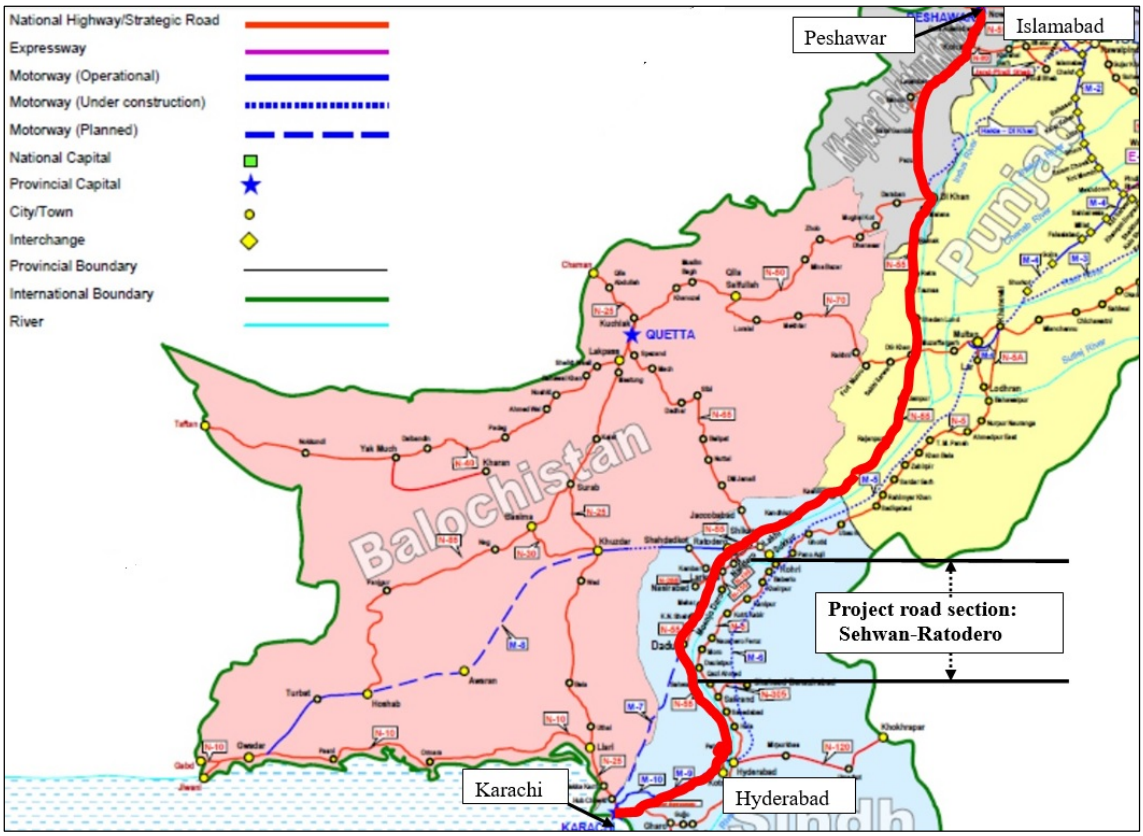


Figure 1: Location of the Project Site (overall map)
(Bolded red line is the Indus Highway: a map provided by the NHA was edited by the evaluator)

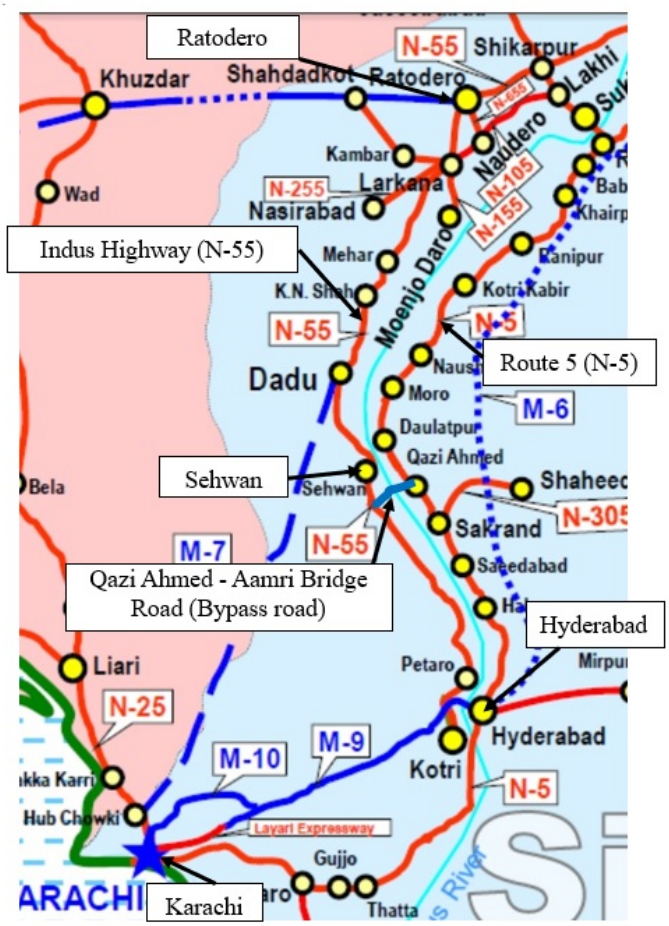


Figure 2: Location of the Project Sites (details of the targeted section)

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The plan and actual outputs at the time of the ex-post evaluation are shown in Table 1. (Underlined are the major discrepancies of the plan)

Table 1: Project's Output Plan and Actual Outputs at the Time of the Ex-Post Evaluation

Plan (at the time of the appraisal in 2006)	Actual (at the time of the ex-post evaluation: 2019-2020)
1) Civil work / equipment procurement a) Construction of a new double-tracked road (around 200 km, 13.3m wide (lane 3.65m x 2, road shoulder 3m x 2), including toll stations) b) Construction of bypasses (eight locations)	1) Civil work / equipment procurement a) Construction of a new double-tracked road (around 197.75 km, 13.3m wide (lane 3.65m x 2, road shoulder 3m x 2), three toll stations) b) Construction of bypasses (<u>13 locations</u>)

c) Development of traffic control centers (truck weighing station, traffic counting system, road information boards, etc.)	c) Development of traffic control centers (*not implemented during this project)
2) Consulting services a) Review of the detailed design, related to civil work b) Bidding assistance c) Construction management d) Detailed design of a traffic control center	2) Consulting services Implemented as planned

Source: JICA document (at the time of appraisal), Project Completion Report and questionnaire answered by the NHA (at the time of the ex-post evaluation)

The differences between the plan at the time of the appraisal and the actual outputs at the time of the ex-post evaluation shown in Table 1 are analyzed below:

1) Civil work / equipment procurement

With respect to the actual outputs, a) a new road was constructed as per the initial plan including a double-tracked (two lanes each way) section of around 200 km; b) the number of bypasses built exceeded those originally planned, as it was expected before this project began that population numbers and the volume of goods being transported, would not only increase in the areas along the Indus Highway but also in major cities, and that building bypasses would improve traffic flow and movement to each destination and c) the "traffic control centers" that aimed to prevent the overloading of trucks and ensure road safety were not developed as part of this project.[3] The reason was that the security around the project sites were not stable and there was a challenge for the land acquisition. As an alternative measure, the NHA allocated funds to develop truck weighing stations in safer locations; both Petaro and Sehwan (north bound) and Petaro and Ratodero (south bound) have been completed. In addition, in order to better regulate traffic rule violations, such as speeding and overweight vehicles, the NHA is coordinating with the Mobile Police Corps for traffic safety measures. Therefore, the "traffic control centers" were not developed as a result of a situation that had not been foreseen at the project planning stage. Nevertheless, speed and weight are regulated at truck weighing stations as a part of the safety measures and the NHA periodically records traffic volumes. Thus, the intended results of this project have been achieved.

[3] The NHA and JICA agreed on the exclusion of this component from the project in February 2013.

2) Consulting Services

These were implemented as per the plan. While the detailed design of the traffic control centers mentioned in "d)" was conducted, the construction was not carried out during this project as mentioned above.

3.2.2 Project Inputs

3.2.2.1 Project Cost

While the planned total cost was 23,079 million yen (of which the ODA loan equated to 19,455 million yen), the actual total cost was 21,098 million yen (of which the ODA loan was 17,331 million yen), which was within the budget of the plan (around 91% of the plan). Although more bypasses were constructed during this project which slightly inflated the cost, the overall cost remained within the budget because (1) the traffic control centers were not developed and (2) the exchange rate changed (the yen became stronger against the rupee). The budget for the "traffic control center" was estimated to be around 705 million yen (or approximately 401 million rupees, using the exchange rate at the time of the appraisal[4]), which is around 3% of the total budget of 23,079 million yen. This component did not account for a significant share compared to other outputs (new road construction, bypass construction) in terms of scale. Although accurate data could not be obtained during this study with regard to the cost breakdown, the total project cost would not have exceeded the plan, even if the "traffic control centers" had been developed.[5] In any case, the total project cost would have been within the plan.

3.2.2.2 Project Period

Table 2 shows the initially planned and actual project periods. At the time of the appraisal, the planned project duration was seven years and one month (85 months) from December 2006 to December 2013.[6] However, the actual period duration was 13 years and four months (160 months) from December 2006 to March 2020. The actual project period constituted around 188% of the plan, which was significantly longer than planned. The main factors accounting for this were as follows: (1) there was a delay in the consulting bidding process; the approval procedures of the NHA and the Ministry of Finance of Pakistan were prolonged, which created delays in the

[4] The source is the NHA Sindh Office.
[5] To explain further, the difference between the planned total project cost (23,079 million yen) and the actual total project cost (21,098 million yen) is around 2 billion yen. Even if the centers had been developed at a cost of around 705 million yen, this would not have exceeded the overall planned cost of the project.
[6] At the time of the appraisal, the completion period of this project was defined as "when the payment is completed after the defect liability period."

selection of consultants and in the signing of agreements; (2) the bid consent and document approval processes within the NHA took longer when selecting a contractor; (3) additional time was required for construction because of the increase in the number of bypasses to be constructed, while land acquisition took longer than planned, resulting in delayed construction. Despite the fact that the defect liability period ended in October 2016, the final payment to the contractor for the facilities on the highway, which was borne by the Pakistani side, has not been completed at the time of the ex-post evaluation (as of March 2020).[7] According to the NHA, the internal audit department is spending a significant amount of time confirming the actual performance of the contractor against the contract and the monitoring department is checking the project sites, as well as verifying and negotiating the details and the amount of the invoice submitted by the contractor. It is considered necessary that the NHA and the contractor finalize the process in a timely manner.[8]

Table 2: Initial Plan and Actual Project Period

	Initial Plan	Actual Project Period
(Entire Project)	December 2006 - December 2013 (85 months)	December 2006 - March 2020 (160 months)
1) Consultant Selection	December 2006 - November 2007 (12 months)	December 2006 - January 2008 (14 months)
2) Consulting Services	December 2007 - December 2013 (73 months)	February 2008 - October 2016 (104 months)
3) Bidding Procedure	January 2008 - June 2009 (18 months)	August 2008 - July 2010 (24 months)
4) Construction	July 2009 - June 2012 (36 months)	December 2010 - June 2014 (43 months)
5) Defect Liability Period and Payment Period	July 2012 - June 2013 (12 months)	June 2014 - March 2020 (70 months) (*Note that the defect liability period ended in October 2016)

Source: Document provided by JICA (initial plan), Project Completion Report and questionnaire answered by the NHA (actual)

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

(Financial Internal Rate of Return (FIRR))

FIRR was not calculated at the time of the appraisal because the nature of this project was not to improve profitability. For the same reason, FIRR was not re-calculated at the time of the ex-post evaluation.

[7] All payments to the contractor for the ODA loan scope have been completed, but payments by the Pakistani side have not been completed. Meanwhile, according to the NHA, the payment is expected to be completed by December 2020.
[8] As of May 2020, the NHA expressed its concern regarding an even further delay due to COVID-19. The NHA estimates that the final payment may take close to a year.

(Economic Internal Rate of Return (EIRR))

At the time of the appraisal, the travel time reduction and the travel expense reduction were used as "benefits" and the project cost and the operation and maintenance costs, were used as "costs", while assuming a project life of 10 years; EIRR was calculated to be 12.2%. EIRR was re-calculated at the time of the ex-post evaluation, with the same conditions as those applied at the time of the appraisal. It transpired that the construction cost could not been recovered within the project life (10 years). More specifically, the "benefits", such as the travel expense reduction and the travel time reduction would not exceed the "costs" incurred over the span of 10 years after the completion of the construction, failing to make the re-calculated EIRR positive.[9] In addition, as the "benefits" and "costs" were calculated in rupees at the time of the appraisal, the re-calculation was also conducted in rupees. As a result, it was found that the depreciation of the currency (weakening rupee)[10] over the period of project implementation, greatly affected the result. For this reason, the "costs", which was in rupees, was inevitably greater at the time of the re-calculation. Since the "benefits" could not cover the "costs" affected by the exchange rate change, the re-calculated EIRR could not be positive. On the other hand, if the standard project life for road projects, 20 years, is applied, the re-calculated rate would be 11.5%.

As previously mentioned, while there was a slight inflation of cost due to the increased number of bypasses, the traffic control centers were not developed and the exchange rate changed during the project implementation (the yen became more expensive against the rupee); thus, the project cost remained within budget. The project period was longer than planned because the consultant bidding procedure, the bid consent and document approval for selecting contractors, the land acquisition and the construction were delayed and the final payment has not been made to the contractor. Based on the above, although the project cost was within the plan, the project period exceeded the plan. Therefore, the efficiency of the project is fair.

[9] It could not be revealed during this study how the project life of 10 years was assumed at the time of the appraisal.
[10] Reference: 1 rupee equated to 1.87 yen at the time of the appraisal (2006). Taking the average over the project implementation period, 1 rupee equated to 1.03 yen, which constitutes a depreciation of around 81%.

Photo 1: Toll Station Developed as a Result of This Project

Photo 2: Truck Weighing Station Developed by the NHA

3.3 Effectiveness and Impact[11] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

Table 3 shows the quantitative effect indicators of this project (baseline, target and actual).

Table 3: Operation and Effect Indicator (Baseline, Target and Actual)

Indicator	Baseline 2005	Target 2014 Two Years after Completion	Actual *Note 3		
			2017 Three Years after Completion *Note 2	2018	2019
1) Annual Average Daily Traffic Volume (Unit: PCU/Day) *Note 1	6,404	11,013	14,805	15,945	16,545
2) Savings in Traveling Time (Unit: minute)	-	108	Passenger Cars and Shared Minibuses: 75-90 Trucks: 30		

Source: JICA document (baseline and target) and answers to the questionnaire (actual)
Note 1: PCU is an acronym for Passenger Car Unit
Note 2: Although two years after completion should have been 2016, the data were not collated properly in 2016. This table shows data starting from 2017 (three years after completion) when appropriate data collection began.
Note 3: According to the NHA Sindh Office, these data were measured using the same methods and under the same conditions as the baselines (2005).

The actual figure for the annual average daily traffic volume after project completion, was higher than that of the target. Since 2017, three years after completion, the traffic volume has exceeded the target and has been on the increase. The reason for this was an increase in logistic

[11] Sub-rating for Effectiveness is to be put with consideration of Impacts.

demand and transport volume, associated with the economic development in the provinces along the Indus Highway. By absorbing the potential traffic demand as per initial expectations, this project is thought to be contributing to the relieving of traffic congestion on National Route 5 which was previously the preferred route.

With respect to the saving in terms of travelling time, it was expected at the time of the project appraisal that the development of the Sehwan-Ratodero section (around 200 km) would shorten travelling time by 108 minutes. It used to take four to five hours to travel along this section. With the construction of the new road and double-tracked road (two lanes each way), the average travelling time has been reduced to around 3.5 hours, after completion of the project. While the time saved in terms of smaller vehicles, such as passenger cars and shared minibuses was 75-90 minutes, the time saving for trucks transporting goods was 30 minutes. The target of 108 minutes could not be achieved for the following reasons: (1) in addition to traffic volume having increased across the entire Indus Highway, a bypass road (Qazi Ahmed-Aamri Bridge Road) was constructed after completion of this project as a result of the surge in traffic on the Highway, connecting National Route 5 and Aamri, located around 35 km south of Sehwan, the starting point of the section targeted by this project, with a view to easing congestion on National Route 5; (2) it takes time for the NHA and the local police to check the weights of trucks at the truck weighing stations.[12] It can be said that the saving in travelling time has, generally, been achieved (actual saving of 75-90 minutes versus target of 108 minutes). Nevertheless, there is a continuous need to take further measures considering the fact that traffic volumes are on the rise. As mentioned in "3.1.2 Consistency with the Development Needs of Pakistan", the NHA is making the entire Indus Highway double-tracked (two lanes each way), which is presumed to lead to significant savings in terms of travelling time.

3.3.1.2 Qualitative Effects (Other Effects)

(Improvement of Safety)

Regarding the safety of vehicles passing the developed section (Sehwan-Ratodero), interviews were conducted as part of the field study of this evaluation.[13] Drivers commented on the safety of the entire Indus Highway, "The road surface is in good condition. There are no holes, and it is

[12] If there is no weight check at the weighing stations, the travelling time of trucks is likely to be more or less the same as that of passenger cars and shared minibuses.

[13] Key informant interviews were conducted targeting four drivers. Interviewees were selected based on the criterion that they could compare the targeted road before the project completion and at the time of the ex-post evaluation, as well as National Route 5 which was used as an alternative route.

comfortable to drive along it. The widening of the road has improved vision." Thus, it is thought that the comfortability of driving has improved, while tiredness during driving has been reduced. It is possible that the number of accidents has been reduced as a result of the improvements made during this project. The number of traffic accidents and overload violations for the entire Indus Highway are shown in Table 4.

(Reference) Table 4: Number of Traffic Accidents and Overload Violations (entire Indus Highway)

Indicator	2016	2017	2018	2019
1) Number of Traffic Accidents	311	296	271	245
2) Number of Overload Violations	N/A	N/A	N/A	8,583

Source: NHA Sindh Office
Note: Data relating solely to the section targeted by this project (Sehwan-Ratodero) were not available.

The data provided in this table are labeled as reference data, because traffic accident data were not collated in 2015 or earlier, and it is difficult to compare the numbers with those before this project began. It can be said that the number has been decreasing every year since 2016. According to the NHA Sindh Office, the Indus Highway is being widened to have two lanes each way, as mentioned in "3.1.2 Consistency with the Development Needs of Pakistan", which is improving traffic safety. In addition, it was pointed out that municipalities periodically organize safety awareness activities for drivers (mainly prevention of accidents, overloading and speeding) and that no problems were reported in relation to the maintenance carried out by the NHA Sindh Office.

With respect to the data regarding overload violations, the number is listed as a mere reference, as there are no data for 2018 or earlier and it is not possible to judge whether the number quoted is too small or too large. The NHA Sindh Office maintains that its representatives are coordinating with local police to impose stricter controls, based on the *National Highways Safety Ordinance 2000*[14] which sets out the rules for safe driving on national roads. More specifically, as mentioned in "3.2.1 Project Outputs", the NHA is using its own funds to check weights at truck weighing stations. The number of such weighing stations is likely to increase in the future, and an even better control of overloaded vehicles is expected. On the other hand, the regulation relating to

[14] NHSO 2000

penalty payments for overloaded vehicles is not being complied, and there are cases of payments not being settled in reality. Apparently, the actual situation is not well documented.[15] This indicates that the NHA headquarters responsible for the regulation and implementing the thorough systems need to strengthen rule enforcement on penalties and payments relating to overloaded vehicles through discussion with the relevant agencies. With the stricter enforcement of penalty payments, the number of penalties is likely to decrease.

As mentioned in "3.2.1 Project Outputs", although the "traffic control centers" were not developed and there were concerns about traffic accidents and overloading, vehicle speed and weights are being checked at the truck weighing stations and road safety measures are being implemented. In addition, traffic volumes are measured by the NHA regularly and the local police is also involved in making traffic safety improvements. Considering the above, it can be said that the improvements in safety, initially intended by this project, have been achieved.

3.3.2 Impacts

3.3.2.1 Intended Impacts

(1) Qualitative Effect

(Contribution to the Production of the Planned Effect of the Entire Indus Highway and the Economic Development of Communities along the Highway)

As a part of the field study of this survey, interviews were conducted to determine whether an improved traffic flow had been realized (relieving traffic congestion, driving comfortability, travel time reduction), whether similar results were being observed along the entire Indus Highway and whether the economy along the highway had been vitalized.[16] Certain comments recorded during the interviews were as follows:

- "Currently the road surface is in a good condition. There are no holes, and we can drive in comfort. The widened roads allow us to see better and travelling time has been reduced." (drivers)
- "Speaking of the entire Indus Highway, I think we could reduce our car maintenance cost by 30% and fuel by 25%, compared to around 10 years ago. We can save cost as well as time." (drivers)

[15] The actual number of unsettled cases was not clear. Throughout the interview, it was confirmed that the crackdown was strengthened, however there was ambiguity relating to the number of people who had settled payments after having received traffic tickets; the actual situation was not well documented.

[16] Key informant interviews and group discussions were conducted targeting 20 people, such as officials of the Sindh Province Government, the NHA Sindh Office, municipalities along the Indus Highway, residents along the highway and drivers who usually use the highway. In a similar manner to the interviews mentioned in "3.3.1.2 Qualitative Effects (Other Effects)", individuals were selected based on the criterion that they were aware of the situation prior to project completion, as well as at the time of the ex-post evaluation.

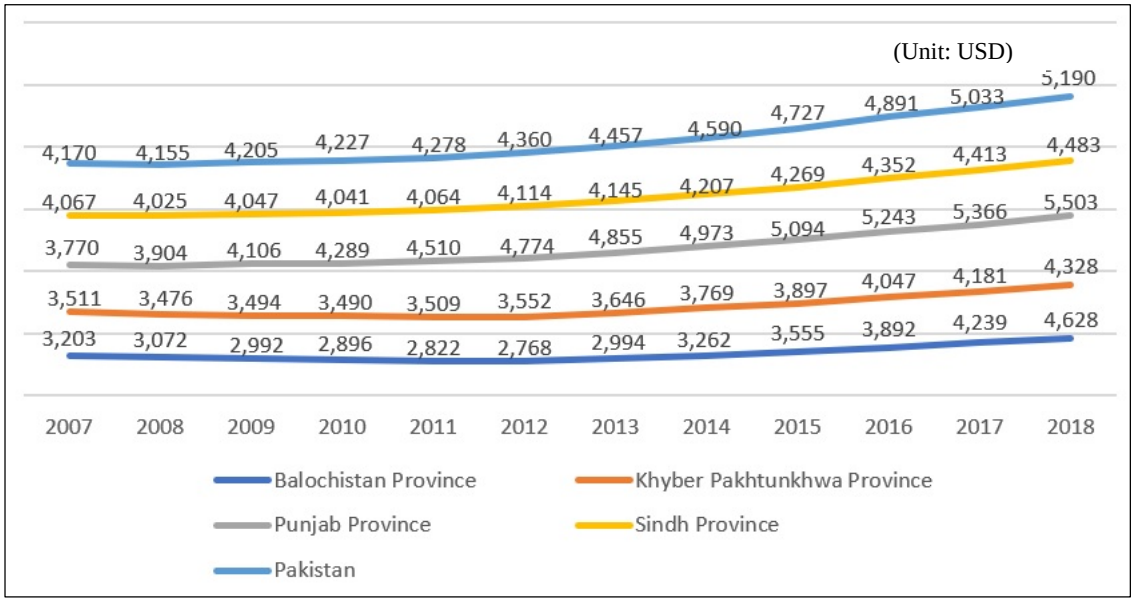
- “It used to take four to five hours to travel between Sehwan and Ratodero (approximately 200 km) before this project began. Now, at the time of the ex-post evaluation, it takes around 3.5 hours on average. Traffic volume is on the rise, the condition of the road surface is improving, we think driving has become more comfortable.” (local residents, NHA Sindh Office)
- “The number of traffic accidents has been decreasing in the sections targeted by this project, because the road has been widened and the road surface has been improved by this project.” (local police, officials of Sindh Province)
- “Security has improved in the section targeted by this project. With new and widened roads, safe passage has been realized. Before this project began, there were cases of mugging and kidnapping for money, which is no longer the case (there are no longer acts of folly, such as stopping cars to commit a crime). It has become easier for police officers to carry out their duties.” (local residents, local police)
- “Thanks to this project’s section, the prices of farmland and residential land are rising. Roughly speaking, I think the prices tripled or quadrupled from the period before this project began until its completion.” (local residents)
- “Access to public facilities such as schools, hospitals, markets and governmental buildings has improved. In addition, access to Hyderabad and Karachi has dramatically improved, which is beneficial with regard to transporting manufactured goods and agricultural products. It is more profitable to trade in big cities like Hyderabad and Karachi, than in smaller neighboring towns and villages.” (local residents, a factory manager)
- “I think the economy has been vitalized along the highway, following the development of the entire Indus Highway. More shops have opened, and we see more trading of agricultural products. There are more opportunities for the residents along the highway to earn income in Karachi and Hyderabad. There were only daily labor jobs in the neighboring villages before. I think the number of options and opportunities to work has increased, as traffic access has improved. It is not only Karachi and Hyderabad; the number of farmers and transporters who sell / buy agricultural products in Balochistan Province and Punjab Province using the Indus Highway is gradually increasing. Factories along the highway have been able to transport their products to Port Qasim (Karachi City) easily. It is likely that they have not only reduced their transportation costs, but also increased their sales greatly. All in all, we think the Indus Highway is contributing to the expansion of business opportunities and economic vitalization.” (officials of Sindh Province)

Taking into consideration the comments above, it can be judged that an improved traffic flow has been achieved in the section of road, targeted by this project. It is also thought that this project

is supporting improved traffic access between regional cities, the rectification of economic disparities within the country and improved living conditions along the Indus Highway.

(2) Quantitative Effect

For reference purposes, the figure 3 shows the changes in the Gross National Income (GNI) of Pakistan and the provinces along the Indus Highway, between 2007 and 2018. While there are no significant differences among the provinces or in national data, GNI per capita in all provinces along the highway has been increasing. In addition to the aforementioned comments, these statistical data show that the development of main roads, such as those improved during this project, is thought to support economic activities in the provinces along the roads and contribute to the increased transportation of agricultural products. It is also thought to contribute to the improved, long-distance transportation of port goods between Peshawar, Hyderabad and Karachi, a main artery of the Indus Highway, supporting the development of the economic zones in these big cities. Taking into consideration the fact that travelling times have been shortened with the development and widening of the entire Indus Highway, it is thought that the contribution of this project is not small.



Source: Global Data Lab[17]
Note: GNI refers to "an income residents earned from within and outside the country over the period of a year."

(Reference) Figure 3: GNI per Capita of Provinces along the Indus Highway and in Pakistan as a Whole

[17] https://globaldatalab.org/shdi/gnic/PAK/?interpolation (accessed on July 21, 2020)

3.3.2.2 Other Positive and Negative Impacts

1) Impact on the Natural Environment

This project, which is considered to be a road sector project, was classified as Category A (likely to have a significant adverse impact on the environment) based on the "Japan Bank for International Cooperation Guidelines for the Confirmation of Environmental and Social Considerations."[18]

The Environmental Impact Assessment (EIA) was approved by the Sindh Environmental Protection Agency in October 2005. During the implementation of this project, the NHA was responsible for environmental monitoring and the construction supervision consultant carried out the actual works. At the time of commencing services of project facilities, the monitoring measurement data could not be confirmed. However, according to the NHA, if there is a problem associated with the Indus Highway, the Ministry of Environment would address the matter.

During the implementation of this project, the contractors undertaking the road construction took measures to prevent the natural environment around the Indus Highway being affected. This study confirmed the influence to the environment by means of a questionnaire and interviews with the concerned parties, that there had been no negative influence in particular on the natural environment, including air pollution, noise, vibration and disruption to the ecosystem. On the other hand, traffic volume increased following the project completion, which presumably caused an increase in gas emissions to the areas along the highway. Thus, the NHA has planted trees (around 120,000 trees) along the shoulder of the sections with the highest volume of traffic. It was confirmed during interviews conducted with the NHA and residents along the highway as a part of this study, that there had been no major complaints or discontent regarding issues such as noise, vibration and air pollution. Nevertheless, should the volume of traffic continue to increase in the future, there could be potential negative effects. It has been concluded that measures would be taken when required.

2) Resettlement and Land Acquisition

Over the course of this project, the NHA prepared the Resettlement Action Plan (RAP), based on which, resettlement and land acquisition were conducted with the support of the municipalities around the targeted section. 863 landowners and 143.9 ha[19] (of which 141.5 ha was private land

[18] Established in April 2002.

[19] As a supplementary explanation, 198 households were targeted for relocation at the time of the project appraisal, but the data on the number of residents who actually relocated could not be confirmed. Similarly, the land acquisition area was calculated to be approximately 430 ha at the time of appraisal, but as a result of reviewing the route plan and

and 2.4 ha was state-owned land) were subject to the land acquisition, and 279.66 million rupees were paid as compensation. Other than the landowners, 1,320 households (10,668 family members) were affected by the road construction. The RAP was prepared by the NHA before this project began and approved by the federal government of Pakistan and JICA. According to the NHA, assessments of the people affected and the situation in the areas surrounding the project sites needed to be carried out a number of times and there were many cases of negotiations. There were many reviews and revisions of the initial plan, which took a considerable amount of time.

During the project implementation, the NHA was monitoring the land acquisition and resettlement. Compensation was categorized into different groups, such as payment to the landowners, payment for structure removal and relocation, and compensation for agricultural products. Although the process of resettlement and land acquisition required time, payment for the resettlement. Land acquisition had almost been completed by the time of the ex-post evaluation.[20] The structure removal and relocation, as well as the relocation of gas pipes and utility poles was also time consuming and affected the road construction period.

Before this project commenced, any cultural heritage along the Indus Highway[21] was to be protected according to the national law. The NHA handled the matter according to the aforementioned RAP, as a result of which the cultural heritage was not negatively affected.

In the aforementioned discussions relating to the effectiveness and quantitative effect indicators, the actual "annual average daily traffic volume" of the section targeted by this project (Sehwan-Ratodero) has been higher than the targeted volume. In addition to absorbing the potential traffic demands as expected, the project is also thought to be relieving traffic congestion on National Route 5, which traffic tended to use before commencement of the project. The "saving in travelling time" has been generally achieved, although a certain increase in travelling time and traffic congestion has been observed, caused by the increase in traffic volume. Although the number of traffic rule violations is unknown, it is thought that traffic accidents have decreased in

identifying landowners, the land acquisition area became 143.9 ha.

[20] On the other hand, payment to certain landholders (two or three people) has not been completed. The reason is that these landholders are requesting higher compensation amounts upon realizing that the price of their land has increased, despite the fact that they had already signed agreements with the NHA in relation to the land acquisition and the compensation amount. (After agreeing to relinquish their farmlands at the proposed compensation amounts, they are now requesting compensation amounts for commercial lands, which are of higher value.) The landholders have sued the NHA, and the NHA has submitted all relevant evidence to the court, participated in the public hearing and submitted additional evidence, requested by the court. According to the NHA, this law suit will be resolved soon because the NHA had duly explained the situation to the landowners and entered into agreements with them before beginning the land acquisition process.

[21] These consist mainly of a mosque (masjid) in the old capital, Khudabad and a ruin in Pakho City.

recent years and driving is becoming safer and more comfortable. Taking into account the comments of NHA representatives and residents along the highway that were recorded during the interviews, this project is thought to be supporting the economic vitalization of communities along the highway and improving living conditions. Based on the above, the effectiveness and impact of the project is high.

Photo 3: Overloaded Trucks

Photo 4: Accident Caused by Overloading

3.4 Sustainability (Rating: ③)

3.4.1 Institutional / Organizational Aspects of Operation and Maintenance

The executing agency of this project is the NHA. The NHA Sindh Office is responsible for the operation and maintenance of the targeted section (Sehwan-Ratodero). At the time of the ex-post evaluation (March 2020), the NHA Sindh Office employed around 25 operation and maintenance staff members. The staff of the maintenance units in Dadu and Larkana, under the jurisdiction of the NHA Sindh Office, are responsible for the actual operation and maintenance work. The NHA formulates an annual maintenance plan (AMP) and classifies it into two types: “routine” and “periodic”. The former refers to routine repairs and inspections, while the latter refers to large-scale repairs and restorations that are conducted every few years. In fact, the actual maintenance work is outsourced to local private construction companies.[22] The NHA Sindh Office supervises and monitors the outsourced works. As a result of responses to the questionnaire and interviews with the NHA Sindh Office, it was confirmed that staffing was sufficient at this office, so as were

[22] At the time of the ex-post evaluation (end of March 2020) 10 companies were outsourced. However, the road section is subdivided into 46 maintenance contracts. Regarding the selection criteria, passing the “maintenance contract” qualification examination set by the Pakistan Engineering Council is a prerequisite. A technical evaluation is carried out before the bidding (financial aspect). Maintenance equipment / machinery owned, and the technical level of the company are also subjects of the evaluation. Companies that meet all of these criteria can participate in the bidding (financial aspect) for final selection.

the scale and staffing levels in the outsourced companies. It was observed that staff are placed based on the actual type and volume of the maintenance work required.

With respect to maintenance equipment, this is owned and stored by the outsourced companies. No particular problems were reported in relation to the maintenance work of the targeted section being hindered by a lack of / problems with maintenance equipment.

Based on the above, it can be assumed that there are no problems regarding the institutional/organizational aspects of the operation and maintenance of this project.

3.4.2 Technical Aspects of Operation and Maintenance

The NHA Sindh Office is staffed with personnel who have extensive experience in operation and maintenance.[23] Training is conducted at the NHA headquarters and the Highway Research and Training Center (HRTC[24]) in Islamabad. The courses aim to enhance technical and managerial capabilities and many staff from the NHA Sindh Office attend the courses. On the job training is also provided for newly recruited staff as needed.

It was confirmed during the interviews that the private construction companies, which are responsible for the maintenance work, have provided maintenance training periodically and working toward improving staff capabilities. In addition, it was also confirmed that the staff of the NHA Sindh Office have been visiting the contractors to supervise their work regularly and carry out quality assurance tasks. No defect or problem related to maintenance was reported at the time of the ex-post evaluation.

Based on the above, it may be confirmed that there are no major problems in relation to the technical aspects of the operation and maintenance of this project.

3.4.3 Financial Aspects of Operation and Maintenance

Table 5 shows the operation and maintenance budgets related to the section targeted by this project (Sehwan-Ratodero).

[23] All staff in charge hold a university degree with a major in engineering / technology.
[24] HRTC was developed with the support of JICA, "Project for the Establishment of the NHA's Highway Research and Training Center" (Technical Assistance 2006). The project was also aimed at developing road construction and maintenance standards, as well as training technical personnel.

Table 5: Operation and Maintenance Budget for the Sehwan-Ratodero Section

(Unit: thousand rupees)

Item	2016/17 *Note	2017/18	2018/19
Periodic Maintenance Budget	-	59,807	-
Routine Maintenance Budget	418	183,260	202,418
Emergency Maintenance Budget	10,451	4,440	-
Main Road Safety Measures Budget	33,420	35,147	16,914
Special Maintenance Budget	20,270	-	46,109
Weighing Stations, Toll Stations Operation Budget	-	1,630	332,777
Total	64,559	284,284	597,218

Source: NHA documents, answers to the questionnaire
Note: Pakistan's financial year starts in July and ends in June.

With respect to the operation and maintenance budget, the NHA's on-site supervising staff compile the necessary amounts, which will be examined and approved internally, then allocated. The budget for 2016/17 was small because this was the period immediately after the opening of the road. The periodic maintenance budget is allocated once every few years for major maintenance works, while the routine maintenance budget is allocated every year to the outsourced companies, based on the annual maintenance plan. The other items are requested when needed, which will pass through the NHA's internal procedure before allocation. According to the NHA Sindh Office, "Required budget is sufficiently allocated. Compared to the time before this project began, the cost for repairing the road surface has been reduced thanks to the new road, and we think our maintenance work has become efficient. We are allocating budgets as and when needed." On the other hand, given that the volume of traffic of the Indus Highway is increasing, there was also an indication that future budgets might increase.

Table 6, presented as a reference, shows the revenue from the toll stations, situated within the section targeted by this project, as well as the revenue from all the toll stations along the Indus Highway.

(Reference) Table 6: Revenue Collected at Toll Stations

(Unit: million rupees)

Year	Revenues from Toll Stations Within the Section Targeted by This Project	Revenues from All Toll Stations Aalong the Entire Indus Highway
2015	0 (0%)	38.61
2016	24.66 (24%)	102.61
2017	86.42 (48%)	179.72
2018	96.58 (64%)	150.47
2019	115.15 (70%)	165.68

Source: NHA Sindh Office

Note: The percentages in brackets refer to the proportion of revenue from the section targeted by this project by comparison with the total revenue generated from all sections of the Indus Highway.

The source of the operation and maintenance budget is the federal government's "Road Maintenance Account (hereinafter referred to as "RMA")". Besides toll revenues nationwide, the RMA consists of revenue from land along national highways, fines for traffic rule violations, government budget, etc. The RMA is mainly used to allocate budgets required for road repairs, toll station installations and maintenance. According to the NHA Sindh Office, sufficient budgets have been allocated by the RMA. Table 6 presents the revenue from the toll stations. Both the revenue from the section targeted by this project and that of the entire Indus Highway have been increasing. This is mainly because of the increase in the volume of traffic. Especially in recent years, the proportion of the revenue in the section targeted by this project, by comparison with that of the entire Indus Highway, has been increasing every year, indicating that the maintenance budget for the targeted section is viewed as important.

Based on the above, it can be assumed that there are no particular problems relating to the financial aspects of the operation and maintenance of this project.

3.4.4 Status of Operation and Maintenance

As mentioned in "3.4.1 Institutional / Organizational Aspects of Operation and Maintenance", the operation and maintenance of this project is divided into two categories: routine maintenance and periodic maintenance. The NHA Sindh Office commissions the local private construction companies to carry out maintenance works, such as asphalt repairs and cleaning, while monitoring and supervising the technical aspects. During the field study, such as site inspections and interviews with on-site staff carrying out the maintenance work, no damage that could negatively affect the results of the project, such as road surfaces or bypass structures, were observed. As mentioned previously, the drivers, when interviewed, commented that driving along this section

had become more comfortable and that the maintenance status had improved (by comparison with previously). Therefore, no particular problems are observed in the operation and maintenance status of the section targeted by this project.

No major problems have been observed in the institutional / organizational, technical and financial aspects or relating to the current status of the operation and maintenance. Therefore, the sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project involved the construction of a road in the underdeveloped section of Sehwan to Ratodero (approximately 200 km) with the aim of addressing the traffic bottlenecks along the Indus Highway, which forms a part of the national trade corridor, thereby contributing to the economic development of the highway as a whole and the areas along the route. The *Medium Term Development Framework* (2005-2010) and the *12th Five-Year Plan* (2018-2023), formulated by the government of Pakistan, recognize National Route 5 and the Indus Highway as strategic main routes of the national trade corridor, while placing the importance on developing and expanding road networks. Considering that there was a need to make the entire sections of the Indus Highway double-tracked (two lanes each way) and increase budgets for the repair and maintenance of National Route 5, as well as the fact that this project was in line with Japan's assistance policy, its relevance is high. Efficiency is fair, although the project cost was within the initial plan budget, the project period was longer than the initial plan, due to delays in the consultant bidding process, paperwork and agreement in terms of consultant selection, land acquisition, construction and final payments to suppliers / contractors. With respect to the quantitative effect indicators, the "annual average daily traffic" exceeded the target, while the "saving in travelling time" primarily met the target figure. Taking into account the comments made in interviews conducted during the field study, it is believed that driving has become safer and more comfortable along the project area and that this project has contributed to the vitalization of the local economy and improved living conditions. Based on the above, effectiveness and impact is judged to be high. It is assumed that there are no major concerns in relation to the institutional, technical and financial aspects of the project or the status of operation and maintenance works carried out by the NHA Sindh Office. Therefore, the sustainability of the effects achieved through the implementation of this project is considered to be high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

- Despite the fact that the defect liability period ended in October 2016, the final payment to the contractor for the facilities on the highway, which was borne by the Pakistani side, has not been completed. This is because a significant amount of time has been spent in the internal audit department, confirming the actual performance of contractor against the contract, and in the monitoring department, inspecting the project sites, checking and negotiating the details and the amount of invoice submitted by the contractor, which is on-going at the time of ex-post evaluation. The NHA and the contractor need to make an effort to solve this issue in a timely manner.
- The NHA Sindh Office, which is responsible for this project's operation and maintenance, cooperates with the local police to regulate the overloading of vehicles by weighing trucks in the Indus Highway. It is expected that the number of weighing stations will increase along the Indus Highway in the future, which will impose stricter controls on the overloading of vehicles. On the other hand, there are cases when the penalties for overloading are not complied and fines are not paid. It is thus desirable that the NHA headquarters, which is responsible for ensuring that rules and regulations are complied with, seriously negotiate and collaborate with the relevant agencies, so as to establish a thorough system ensuring the payment of fines.

4.3 Lessons Learned

(The Need to Combine Facility Construction with Capacity Building (e.g., Advocating for Rule and Penalty Compliance) for Optimal Operation)

- As stated above, although the NHA Sindh Office works in coordination with the local police to weigh trucks along the Indus Highway, some fines are not duly paid. While the NHA headquarters is responsible for the compliance to the rules and regulations, the response of the headquarters was not necessarily sufficient at the time of the ex-post evaluation. It was thought that advocacy for rule compliance was necessary. It would have been more effective if the system had been established in the way that the construction of weighing stations (hard component) was combined with capacity building to ensure compliance to the rules (soft component). For future projects of a similar nature, establishing a system in which the construction of structures (hard component), such as facilities, is accompanied by efforts to ensure the compliance to the rules and regulations (soft component), is thought to be key to success, with a view to achieving an optimal operation.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs	1) Civil work / equipment procurement a) Construction of a new double-tracked road (about 200 km, 13.3m wide (lane 3.65m x 2, road shoulder 3m x 2), including toll stations) b) Construction of bypasses (8 places) c) Development of traffic control centers (truck weigh station, traffic counting system, road information boards, etc.) 2) Consulting services a) Review of the detailed design related to civil work b) Bidding assistance c) Construction management d) Detailed design of a traffic control center	1) Civil work / equipment procurement a) Construction of a new double-tracked road (about 197.7 5km, 13.3m wide (lane 3.65m x 2, road shoulder 3m x 2), 3 toll stations) b) Construction of bypasses (13 places) c) Development of traffic control centers (*It was not implemented under this project.) 2) Consulting services Implemented as planned.
2. Project Period	December 2006 – December 2013 (85 months)	December 2006 – March 2020 (160 months)
3. Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total ODA Loan Portion Exchange Rate	 8,972 million yen 14,107 million yen 23,079 million yen (19,455 million yen) 1.87yen / rupee, 112yen / USD (As of May 2006)	 8,228 million yen 12,870 million yen 21,098 million yen (17,331 million yen) 1.03yen / rupee, 98.5yen / USD IFS (IMF) average rate of

		2009-2017 (duration of main expenses)
4. Final Disbursement	June 2017	

Islamic Republic of Pakistan (Pakistan)

FY2019 Ex-Post Evaluation of Japanese Grant Aid Project

"Project for Improvement of Child Health Institute in Karachi"

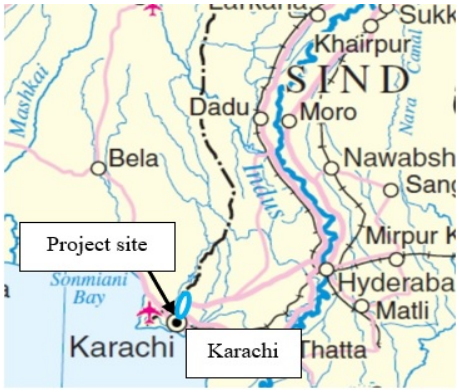
External Evaluator: Kenichi Inazawa, Miyuki Koga, Octavia Japan, Co., Ltd.

0. Summary

The Sindh Government Children Hospital (hereinafter referred to as SGCH) provides secondary medical services in Pakistan's largest city, Karachi. This project aimed to expand the hospital thereby improving the pediatric medical services of the city. The *Poverty Reduction Strategy Paper* formulated by the Government of Pakistan advocated the need to protect the poor and the vulnerable, while the *Heath Sector Strategy* formulated by the Government of Sindh recognized the priorities to be neonatal and pediatric health, nutrition, polio eradication, infection control, etc. There is a continued development need to expand and update medical facilities in the city. Considering that this project was also in line with Japan's ODA policy, its relevance is high. With respect to efficiency, although the outputs and the project costs were mostly as per the plan, the project period slightly exceeded the initial plan due to a deterioration in security in and around Karachi City. This affected progress at the time of the detailed design, after the project commenced. Therefore, efficiency of the project is fair. The quantitative effect indicators such as "number of inpatients", "number of Neonatal Care Unit (hereinafter referred to as NCU) inpatients", "number of biochemistry tests", exceeded the targets. In addition, although these are reference data, "number of surgeries and treatments using the operating rooms" and "usage of the diagnostic imaging device" significantly increased at this hospital, compared to the condition prior to this project, therefore the facility and equipment procured by this project are being utilized. The qualitative interviews confirmed the improvement in the hospital's medical services. Furthermore, it can be concluded that this project has also contributed to strengthening the referral system and improving the pediatric medical services of the city as a whole. Therefore, effectiveness and impact is high. With regard to sustainability, there are no major concerns in the institutional, technical and financial aspects of this hospital. There are no major problems in relation to the operation and maintenance status of the developed facilities or the procured equipment. Therefore, the sustainability of the effects achieved through the implementation of this project is considered to be high.

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

1. Project Description



Project Location


Inpatient Ward Developed by this Project

1.1 Background

Before this project began, Pakistan's national average infant mortality rate and under-five mortality rate were high compared with other South Asian nations and thus required improvement. In particular, the rates of Sindh Province, in which the SGCH is located, were worse than the national averages. This was due to the weak coordination (referral) system among the medical facilities. Although the SGCH was categorized as a secondary medical facility[1], it could only provide limited medical services due to a lack of facilities. There were many cases where patients who should have been treated at a secondary medical facility were transferred to the National Institute of Child Health (hereinafter referred to as NICH), a tertiary medical facility capable of providing high-level pediatric services. This prevented NICH from providing sufficient tertiary medical services to children, undermining its ability to offer high-level medical services to patients with serious conditions. It was therefore an urgent task to improve the facilities of the SGCH, a secondary medical facility.

1.2 Project Outline

The objective of this project is to expand the secondary medical services of the SGCH by improving the facilities of the hospital, thereby contributing to the improvement of the pediatric medical services in Karachi City.

[1] In Pakistan, secondary medical care services entail health promotion/disease prevention, treatment, inpatient, clinical departments (obstetrics and gynecology, pediatric, dermatology, general surgery, otolaryngology, ophthalmology, internal medicine, etc.), transportation and admission of patients. On the other hand, tertiary medical care services include more specialized clinical departments (orthopedics, urology, nephrology, neurology, cardiac surgery, oncology, kinesiology, etc.) and admission of transported patients. With respect to the referral system of medical service facilities, primary medical facilities only have outpatients, while secondary facilities have inpatients and outpatients and undertake surgeries of general kinds. Tertiary facilities provide high-level medical services and accept cases from the secondary and primary facilities. The SGCH provides medical services to children under 13 years old.

Grant Limit / Actual Grant Amount	1,423 million yen / 1,417 million yen
Exchange of Notes Date / Grant Agreement Date	December 2012 / December 2012
Executing Agency(ies)	Health Department, the Government of Sindh
Project Completion	March 2015
Main Contractor	Tobishima Corporation
Main Consultant	Yamashita Sekkei Inc./Binko International Ltd. (JV)
Procurement Agency	Mitsubishi Corporation
Basic Design/ Preparatory Survey	June 2011-May 2012 (preparatory survey)
Related Projects	[Grant Aid Projects] ・ "The Project for Provision of Medical Facilities for Al-Mustafa Medical Center in Karachi, Sindh" (Grant Assistance for Grassroots Human Security Project, 2009) [Technical Assistance] ・ "Expanded Programme of Immunization (EPI)/ Polio Control Project" (2006-2011)

2. Outline of the Evaluation Study

2.1 External Evaluator

Kenichi Inazawa, Miyuki Koga, Octavia Japan, Co., Ltd.

2.2 Duration of Evaluation Study

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

Duration of the Study: November 2019-December 2020

Duration of the Field Study: International travel was canceled. The field study was conducted remotely, using a local consultant.

2.3 Constraints during the Evaluation Study

(Remote Implementation of the Field Study by Utilizing a Local Consultant)

Due to the spread of COVID-19, external evaluators decided against international travel for this study. Utilizing a local consultant, the external evaluators remotely conducted site visits, information/data collection, and interviews with project-related personnel. The results were analyzed and used in the decision-making process by the external evaluators.

(Special Note on the Operational Status and the Sustainability of the SGCH after September 2020.)

In this evaluation, information/data collection, interviews, site surveys, etc., were conducted remotely using a field survey assistant, the results of which were summarized by June 2020. Based on the findings, the sub-rating in relation to sustainability was concluded to be ③(high). However, after September 2020, the Government of Sindh suffered a budget shortage attributed to COVID-19, and the SGCH, which depends on the provincial government for funding, could not secure funds. As a result, the hospital was forced to cease operation. It is necessary to carefully monitor the situation surrounding the provincial government and the management of the hospital going forward.

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

3.1 Relevance (Rating: ③[3])

3.1.1 Consistency with the Development Plan of Pakistan

The Government of Pakistan advocated the need to protect the poor and the vulnerable in the *Second Poverty Reduction Strategy Paper* (PRSP-II) formulated in 2009 before the project commenced. In addition, the *National Health Policy* approved by the Government in 2010 identified improving medical and health services for poor and socially vulnerable people as a priority. Furthermore, the Government of Sindh formulated a health policy in 2005, which listed improving pediatric medical services as a priority.

At the time of the ex-post evaluation, the Government of Pakistan has developed the *National Health Vision* (2016-2025) with an aim to improve access to quality medical services and to establish an advanced medical system, thereby promoting the health of its citizens, especially women and children. In addition, the Government of Sindh formulated the *Poverty Reduction*

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

[3] ③: High, ②: Fair, ①: Low

Strategy[4] in 2018, which places importance on its contribution to health and welfare, maintaining consistency with the framework of the Sustainable Development Goals (SDGs). In particular, the strategy recognizes health and hygiene as a basis for saving lives and securing basic living conditions. Furthermore, the provincial government has a comprehensive medical sector strategy as stipulated in the *Health Sector Strategy* (2012-2020). The strategy has identified issues such as neonatal and pediatric health, nutrition, polio eradication and controlling infectious diseases as priorities, while placing importance on measures to provide cost-effective quality medical services and to improve the health of the citizens. In addition to enhancing health systems in rural areas, the province also plans to focus on primary healthcare in cities, particularly for the least developed areas.

Based on the above, at the time of the ex-post evaluation the Federal Government of Pakistan as well as the Government of Sindh value healthcare measures including those for children. This project was implemented with a view to improving the secondary pediatric medical facilities at the SGCH. Therefore, this project is in line with national and sector plans in place at the time of the planning, as well as those in place at the time of the ex-post evaluation.

3.1.2 Consistency with the Development Needs of Pakistan

Before this project began, Pakistan's national average infant mortality rate was 70 per 1,000 live births and the under-five mortality rate was 87 per 1,000 live births (2009 data). These figures were higher than those in other South Asian counties. In Sindh Province in particular, the infant mortality rate was 78 and the under-five mortality rate was 100 in 2009, both of which were higher than the national averages. This could be explained by the poorly functioning coordination system (referral system) among medical facilities. Although the SGCH was the only secondary medical facility in the city, its medical services were limited due to lack of facilities. Some patients were transferred to the tertiary medical facility, NICH, capable of providing advanced pediatric treatments. This meant that adequate medical services could not be provided at the secondary level; while the referral system collapsed, NICH were unable to provide advanced medical services to patients with serious conditions. Therefore, there was an urgent need to improve the facilities of the SGCH.

At the time of the ex-post evaluation, the SGCH is still the only secondary medical facility in

[4] The Government of Pakistan has been gradually promoting measures for decentralization and delegation of authority since 2001. While it was the federal government that developed the poverty reduction paper at the time of the planning, it is each provincial government that develops its own paper at the time of the ex-post evaluation.

the city. As a result of the provision of medical equipment and construction of hospital buildings by the project, the secondary medical services have expanded, attracting many patients including ones transferred from primary medical facilities. The hospital continues to play an important role in the pediatric care in Karachi City. On the other hand, at the time of the ex-post evaluation, Pakistan's national average infant mortality rate is 57 (source: World Bank's 2018 data) and the under-five mortality rate is 69 (source: 2018 data from Statista.com), while for Sindh Province the infant mortality rate is 62 and the under-five mortality is 74 (source: 2018 data of the Redefining Primary Healthcare, a Pakistani NGO). All the figures above are per 1,000 live births. Whilst the rates have improved in Sindh Province, infant mortality rate and under-five mortality rate are still higher than the national averages and therefore require continued improvement. The hospital aims to further expand its secondary medical facilities so as to provide tertiary medical services in the future. To be more specific, an NGO called Poverty Eradication Initiative (hereinafter referred to as PEI) which has been managing the hospital since the end of 2016 through the Public Private Partnership (hereinafter referred to as PPP) is aiming to expand and update the facilities of the Palliative Care Unit (hereinafter referred to as PCU) and NCU that are currently operating at the secondary medical service level so that the hospital can eventually provide advanced tertiary medical care. Considering that NICH is still the only tertiary medical facility in the city at the time of the ex-post evaluation, such an upgrade is expected to further enhance the referral system, strengthening the pediatric medical system of the entire city, contributing to the reduction of infant mortality rates.

Based on the above, there is a continued need to expand and update the medical services and facilities of the SGCH at the time of the ex-post evaluation. Therefore, this project is consistent with the development needs at the time of the planning, as well as at the time of the ex-post evaluation.

3.1.3 Consistency with Japan's ODA Policy

The *Country Assistance Program for Pakistan* formulated by Japan's Ministry of Foreign Affairs in 2005, focused on human security and human development as a direction of the assistance strategy, claiming that Japan would work toward reducing disparities in basic healthcare. As a concrete policy, the document said it would be essential to secure primary healthcare services, to ensure links with secondary medical services and to develop human resources in the area of healthcare service administration. In addition, the *Rolling Plan for Pakistan* also recognized "securing primary healthcare services" as one of the development issues

under a priority area, “ensuring human security and human development.” This project aimed to expand secondary medical services through the improvement of the pediatric facilities. It was implemented to contribute to the improvement in pediatric services of Karachi City and therefore was in line with the ODA policy of Japan.

Based on the above, this project has been highly relevant to Pakistan’s development plan and development needs, as well as Japan’s ODA policy. Therefore, its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

Table 1 shows the plan and actual outputs of this project, which were generally as per the initial plan.

Table 1: Project’s Output Plan and Actual Outputs at the Time of the Ex-Post Evaluation

At the Time of the Plan (2012)	Actual Outputs (2019-2020)
<Planned Inputs by the Japanese Side> [Civil Work, Equipment to be Procured] - Construction of new buildings (ward department, surgery department, specialized outpatient department, emergency department, diagnostic imaging department, etc.) (total approximately 4,600m^2) - Anesthesia apparatus, automatic biochemical analyzer, patient monitors for operating rooms, etc. (procurement of approximately 140 items in total)	<Actual Outputs by the Japanese Side> [Civil Work, Equipment Procured] Implemented almost as planned. - Construction of new buildings (ward department, surgery specialized outpatient department, emergency department, diagnostic imaging department, etc.) (total approximately 4,609m^2) - Anesthesia apparatus, automatic biochemical analyzer, patient monitors for operating rooms, etc. (procurement of 135 items in total)
<Planned Inputs by the Pakistani Side> - Construction-related matters (land preparation of the site, planting in the premises, acquisition of construction permit, infrastructure connection work, replacement of existing drainage pipeline, moving from existing facility to the targeted facility, renovation of the existing facilities) - Maintenance-related matters (maintenance of consumables and spare parts such as general furniture not covered by Japan) - Process-related matters (fees associated with banking arrangements and payments, costs related to notification of authorization to pay and amend authorization, processing building permit and other permits/authorizations, duty	<Actual Outputs by the Pakistani Side> Implemented as planned.

exemption, custom clearance, timely arrangement of inland transportation, processing tax free privileges for the involved Japanese companies and Japanese nationals, necessary arrangements for Japanese personnel entering and staying in Pakistan, all necessary expenses that are not covered by Japan, safety and security of the Japanese involved in this project.	

Source: JICA documents and answered questionnaire

In this project, the outputs were almost as planned. The number of procured items was slightly less than the plan (140 planned vs. 135 procured) mainly because it was proven at the time of the detailed design that these items did not need to be procured because they could be substituted with other items/methods. The five items were: blood warmer, baby cots (with tables), a rehabilitation chair, a nerve stimulator and a cycle (ergometer)[5]. The outputs by the Pakistani side were also as per the plan.

Photo 1: Procured X-Ray Recording Device (Right), X-Ray Device for Inpatients (Left)

Photo 2: Biochemical Testing Device

[5] According to the interview with the main consultant, “the plan was changed because it was agreed that a blood warmer could be substituted with a washbasin with warm water of body temperature, baby cots (with tables) and rehabilitation chairs with existing furniture, a nerve stimulator with existing equipment, a cycle (ergometer) with a physical exercise to train leg strength. The Pakistani side and the Japanese side were in agreement with the changes at the time of the detailed design, after the project commencement.” According to the SGCH staff, “the alternative tools/methods are being utilized without problems.” Based on such comments, it can be judged that the concerned parties made an appropriate change with a view to efficient procurement.

3.2.2 Project Inputs

3.2.2.1 Project Cost

With respect to the total cost of this project, the initial plan was approximately 1,442 million yen (of which the Japanese side was to contribute 1,423 million yen and the Pakistani side approximately 19 million yen). The actual total cost could not be captured, as detailed records of the amount covered by the Pakistani side were not available at the Health Department of the Government of Sindh or the SGCH. The actual cost borne by the Japanese side was approximately 1,417 million yen. As mentioned earlier, the outputs by the Pakistani side were almost as initially planned. Considering that the planned amount (about 19 million yen) was only approximately 1% of the total project cost, its impact on the planned and actual cost analysis would be minimal. Therefore, efficiency of the project cost was analyzed based on the comparison between the planned and actual amounts borne by the Japanese side. That is, while the plan was 1,423 million yen, the actual cost was 1,417 million yen, which was generally within the plan (approximately 100%).

3.2.2.2 Project Period

This project was planned to begin in February 2013 and end in January 2015 (24 months). The actual duration of the project was from February 2013 to March 2015 (26 months), which was slightly longer than planned (approximately 108% of the plan). The main factor accounting for this was security deterioration in Karachi City during the detailed design after this project began which affected commencement of the work. Following the deterioration in security, movement was restricted and the main consultant was unable to leave the hotel freely. This affected the consultant's ability to attend meetings with local partners and as a result delayed the progress of the project[6].

As stated above, the outputs and the cost of this project were generally as per the plan. However, the project duration was slightly longer than planned. This was mainly due to the deterioration in Karachi's security during the detailed design after the project commencement; this affected progress. In summary, although the project cost was within the plan, the project period exceeded the plan. Therefore, efficiency of the project is fair.

[6] Even before the detailed design began, JICA exchanged information with the main consultant concerning the security and its influence on the implementation and was fully aware of the progress of the project. Although the deterioration in security was unavoidable, necessary security measures were taken and both parties had an established communication and reporting system. This indicates that the project was properly managed.

3.3 Effectiveness and Impacts[7] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

Table 2 shows the quantitative effect indicators of this project (baseline, target, actual). In addition, the number of surgeries and treatments using the operating rooms, as well as the use of the diagnostic imaging device (baseline, actual) are shown in Table 3 as reference data to indicate the status of the secondary medical service provision at the SGCH.

Table 2: Operation and Effect Indicator of SGCH (Baseline, Target and Actual)

Indicator	Baseline 2011	Target 2017 Three Years after Completion	Actual				
			2015 Year of Completion	2016	2017	2018 Three Years after Completion[8]	2019
① Number of inpatients (excluding NCU) (Unit: person/year)	2,276	4,100	No data	No data	5,306	6,323	9,036
② Number of NCU inpatients (Unit: person/year)	0	190	No data	No data	754	783	806
③ Number of biochemistry tests (Unit: test/year)	851	1,490	No data	No data	43,818	45,075	73,293

Source: JICA document (baseline and target) and answers to the questionnaire (actual)

(Reference) Table 3: Number of Surgeries and Treatments Using the Operating Rooms, Usage of the Diagnostic Imaging Device

Indicator	2011 Before Project Commencement: Baseline	Actual		
		2017	2018	2019
① Number of surgeries and treatments using the operating rooms (Unit: number of surgeries/year)	50	1,788	2,110	2,295
② Usage of the diagnostic imaging device (Unit: number of times used/year)	X-ray: 200	X-ray: 11,508	X-ray: 11,382	X-ray: 12,747
	Ultrasound: 200	Ultrasound: 4,495	Ultrasound: 5,177	Ultrasound: 3,965

Source: Answers to the questionnaire and data from the SGCH

[7] Sub-rating for Effectiveness is to be put with consideration of Impacts.

[8] At the time of the planning, this project was expected to complete in 2014, which meant 2017 was the target year, three years after its completion. However, as discussed in "3.2.2.2 Project Period", there was a delay and the actual completion was in 2015. Therefore, the actual and targeted figures are compared based on 2018, three years after the project's completion.

As shown in Table 2, actual figures in relation to all of the "①number of inpatients (excluding NCU)", "②number of NCU inpatients" and "③number of biochemistry tests" have increased up to the time of the ex-post evaluation (2019), largely exceeding the baselines (2011) and targets (2017). With respect to Table 3, the actual figures at the time of the ex-post evaluation in relation to "①number of surgeries and treatments using the operating rooms" and "②usage of the diagnostic imaging device" also greatly exceed the baselines (2011). The Health Department of the Government of Sindh and PEI gave the following reasons: 1) the hospital could only provide limited medical services, given the scale and the types of the facilities that existed before the project began. The facilities and equipment developed by this project are more advanced and therefore the hospital can provide a wide range of medical services and surgeries for the patients, 2) the PEI made a managerial effort and made registration and consultation (fee of which used to be collected), free of charge; this means that any pediatric patient in the area can access quality consultation and treatment without payment, 3) the PEI recruited pediatricians from external organizations so as to respond to more cases with a view to improving the level of satisfaction of the outpatients and inpatients[9]. Other than that, the actual figures in Tables 2 and 3 presumably increased because 4) Karachi City has a high population growth rate[10] (reference information: the population was approximately 12.6 million before the project began in 2010 and grew to approximately 16 million by 2020, the time of the ex-post evaluation). This population growth caused the increase in the number of patients requiring pediatric consultation and treatment. In addition, there is a relatively large proportion of poor families with many children living near the hospital. While the need for pediatric medical care already existed, as the hospital began offering better medical services, the hospital absorbed the potential need. While the "③number of biochemistry tests" in Table 2 greatly increased compared with the target, the "①number of surgeries and treatments using the operating rooms" and "②usage of the diagnostic imaging device" in Table 3 significantly increased compared to the baselines because the procured medical equipment played a role in expanding the medical services. In addition, the PEI upgraded the outpatient department (herein after referred to as OPD) emergency services (open 24 hours a day, 365 days a year) since 2017. Based on the above, this project is assumed to have achieved more results than expected. This is not only due to the development of facilities and procured medical

[9] The main consultant, when interviewed for reference information, commented, "At the design stage of this project, there was simply not enough space, equipment or human resources to respond to the medical needs. Through this project, the ward facilities were expanded and the hospital could increase the number of medical staff, which made it possible to respond to more cases."

[10] The source is the World Population Review cf. https://worldpopulationreview.com/world-cities/karachi-population/ (*Accessed on 22 June 2020).

equipment by this project, but also to the PEI's improvements of the medical services and system by accurately capturing the medical needs.

The "no data" (actual figures after 2016) in Table 2 is there because the facilities and equipment were not utilized immediately after the handover. Around the time of the detailed design, the Health Department of the Government of Sindh decided to transfer the management of the hospital to an NGO based on PPP[11]. The Japanese side and the Pakistani side had to confirm the management policy, and a significant amount of time was required for the Pakistani side to complete NGO selection and internal procedures. Management of the hospital by the NGO began in December 2016, more than one year after the project completion (March 2015). With regard to the commencement of the operation, the selected PEI signed an agreement on the management with Sindh Province, while an MOU was signed between the Health Department of the Government of Sindh and JICA (September 2016)[12]. It is not unusual for confirmation and processes associated with a change in a management policy to take time. In fact, the details should be reviewed carefully. Nevertheless, it is desirable that the side providing assistance evaluates the recipient's post-completion operation system and that the recipient (responsible for the actual operation), promptly decides on the operating system with a view to minimizing the loss of any project benefits.

3.3.1.2 Qualitative Effects

3.3.1.2.1 Improvement of the Medical Environment at the SGCH

At the time of the planning of this project, it was expected that unnecessary movement of staff would be reduced and that the medical environment would be improved as this project would arrange necessary rooms based on the flow lines of the medical staff. The achievement was confirmed through site inspections and interviews with medical staff at the SGCH. The medical environment is considered to have improved as per the results of the interviews and site inspections below:

- A biometric[13] system (see Photo 3) was introduced to the facilities through this project, which enabled proper management of the movement of medical staff and the smooth flow of staff. A mechanism has been established such that unnecessary movement of staff is minimized.

[11] The Government of Sindh decided to commission NGOs to manage the province's secondary medical facilities.
[12] It was confirmed through JICA's documents that JICA properly followed up on the introduction of PPP, coordinated with the Pakistani side, checked the required procedure and processes, and cooperated with the embassy of Japan in Pakistan.
[13] This refers to a technology/process of personal identification based on information related to physical and behavioral features. The data are collected and pre-registered, and compared with the information obtained through the sensors at

- This project has made it easier to manage cleanliness of the hospital as clean areas and contaminated areas are clearly separated. Waste from medical treatments are also properly sorted and treated (see Photo 4). In addition, the waste treatment stations are placed far from the wards, preventing transmission of contaminated sources. Furthermore, a cleaning checklist is placed at all relative locations such as wards and washrooms, while cleaning staff properly carry out their tasks based on the checklist. Inside the hospital, sanitizers are installed on the walls at essential places. It is assumed that this project is also contributing to the prevention of in-hospital infections.

Photo 3: Introduced Biometric System

Photo 4: Waste Sorting and Disposal

3.3.1.2.2 Strengthening the Treatment Capability of NCU at the SGCH

At the time of planning, it was expected that development and expansion of the SGCH would enable the treatment of patients in need of NCU. Through this project, eight incubators[14] were introduced to the SGCH as they were essential for the NCU treatments (see Photo 5). As the number of patients increased, the PEI purchased additional incubators using its own funds[15]. It can be stated that consequently the NCU treatment system has been enhanced and the medical services have expanded. In addition, as a part of the PEI's management policy, neonatologists with specialized training in neonatal care were recruited in order to provide highly specialized treatments. In other words, the introduction of the necessary incubators in the NCU by this project, together with the placement of specialized neonatologists by the PEI, resulted in the enhancement of the NCU's capability at this hospital.

the time of identification, for the purpose of authentication.

[14] Medical apparatus used to maintain environmental conditions suitable for a neonate. It is not only used for maintaining the optimal temperature and humidity, but also for oxygen therapy, observation, isolation and infection prevention.

[15] Eight incubators were procured through this project, and four were added after the completion, which made 12 in total.

Photo 5: Introduced Incubator

Photo 6: Treatment at the SGCH

3.3.2 Impacts

3.3.2.1 Intended Impacts

3.3.2.1.1 Contribution to the Improvement and Enhancement of the Pediatric Services and the Referral System Across Karachi City

In order to see the ways in which the results of this project are related to the improvement and enhancement of the pediatric services and referral system of the entire Karachi City, this survey looked into the number of patients and the proportion of patients transferred between the primary, secondary and tertiary medical facilities. In addition, interviews were conducted with the SGCH, the Health Department of the Government of Sindh, and NICH. Firstly, Table 4 shows the "① number of patients who were transferred from a primary medical facility inside Karachi City to the SGCH" as well as the "②number of patients who were transferred from the SGCH to NICH in Karachi" in the last three years. Following project completion, ① increased dramatically. In reality, the hospital had operated in such a limited capacity before the project that the department responsible for emergency surgery could only accept patients from 8:00 to 14:00 due to a shortage of medical equipment and human resources. With this project, the facilities were expanded and more medical equipment became available. On top of this, the PEI allocated necessary medical resources, which enabled the acceptance of patients 24 hours a day, 365 days a year. As a result, the hospital's operational aspect was upgraded and the number of patients transferred from primary medical facilities soared. Whilst no detailed data were available in relation to ②, according to the hospital the proportion of the transferred patients decreased from 80% to 30% in recent years. Secondly, positive comments were recorded during the interviews. "Before the project commencement, Karachi City's pediatric cares relied excessively on NICH, a tertiary

medical facility. Due to insufficient facilities, human resources, and medical equipment, the city could only offer limited medical services. However, through the implementation of this project, the latest and advanced medical equipment was introduced, and patients can now receive advanced emergency pediatric services." "Before (the project commencement), NICH received many patients who should have been treated at the secondary medical facility. The outpatient and inpatient buildings were always overcrowded. Now, the SGCH is offering pediatric services to patients who should indeed be treated at the secondary medical facility, enabling NICH to focus on the tertiary-level medical services." "The SGCH is increasingly motivated to provide care and services to its patients." Based on such comments, it is assumed that the environment surrounding the pediatric medical system of Karachi City including NICH, has been improved by this project, contributing to the improvement of the referral system in the city.

(Reference) Table 4: Number of Patients Transferred from Primary Medical Facilities in Karachi City to the SGCH,
Number of Patients Transferred from the SGCH to NICH
(past three years)

(Unit: Person)

	2017	2018	2019
① Number of patients transferred from primary medical facilities in Karachi City to the SGCH	60	240	2,500
② Number of patients transferred from the SGCH to NICH (proportion)	In recent years the proportion has decreased from 80% to 30%.		

Source: The SGCH
Note: There were no recorded data for 2016 or earlier.

3.3.2.1.2 Improvement of Maternal and Child Health Indicators for Pakistan Nationwide as well as for Sindh Province (Consideration on How They Relate to this Project)

Table 5 shows the comparisons of ①infant mortality rate and the ②under-five mortality rate of Pakistan nationwide and that of Sindh Province before the project commenced (2009) and after completion (2018). All figures are per 1,000 live births. The ①infant mortality rate and the ② under-five mortality rate of Sindh Province, in which Karachi City is located, are higher than the national averages in 2009 as well as in 2018. Whilst the numbers continued to drop until 2018, the rate of the decrease was slightly greater in Sindh Province. Given the scale of this project, conclusions regarding direct correlations and impact cannot be explicitly drawn. However, before this project began, the pediatric services of the SGCH were limited. Based on such a situation,

the hospital buildings were developed and medical equipment was procured for pediatric physiotherapy enabling comprehensive medical services through this project. As a result, the medical standard has risen[16]. The project is therefore presumed to have played a role in the reductions of ① and ②.

(Reference) Table 5: Infant Mortality Rate and Under-Five Mortality Rate
Comparisons of Pakistan Nationwide and Sindh Province
Before the Project Commencement (2009) and After Completion (2018)

(Unit: per 1,000 live births)

		2009	2018
① Infant Mortality Rate	Pakistan (nationwide)	70	57 (declined by 18.6%)
	Sindh Province	87	69 (declined by 20.7%)
② Under-Five Mortality Rate	Pakistan (nationwide)	78	62 (declined by 20.5%)
	Sindh Province	100	74 (declined by 26.9%)

Source: JICA document, the World Bank, Statista.com, Redefining Primary Healthcare (NGO) document

[16] Through the interviews with the SGCH and NICH, comments such as the following were received: "There are many congenital malformation and infantile paralysis cases in Pakistan. Physiotherapy is extremely important at a children's hospital." With the procurement of medical equipment for pediatric physiotherapy, the hospital is presumably responding to congenital malformation and infantile paralysis in a better manner compared to before the start of the project.

Box. (Reference) The SGCH's Response to COVID-19

At the time of the ex-post evaluation (as of the end of June 2020), COVID-19 is a critical issue for Pakistan. The SGCH is not a designated COVID-19 treatment facility intended to treat patients who test positive. Although no patients have been suspected to be positive for COVID-19 until today, the hospital has two isolation rooms with 10 beds in case suspected patients are identified. In addition, medical personnel are kept up to date with the information and the government's instructions concerning COVID-19 measures on a weekly basis, and are fully prepared to engage in medical work. The hospital also makes efforts to provide information to its patients (children 12 years old or younger) and their parents as needed. Many people are anxious about COVID-19 in Karachi City due to its large population. Moreover, with the economy slowing down, parents of the patients (children) are assumed to have reduced incomes. Therefore, the existence of the SGCH providing quality medical services for free is presumably comforting to patients who do not have to fear for their health and to parents who do not have to pay for quality treatment.

Photo 7: Medical Staff with COVID-19 Prevention Measures at the SGCH

3.3.2.2 Other Positive and Negative Impacts

1) Impact on the Natural Environment

This project was expected to have minimum undesirable influences on the environment based on the *JICA Guidelines for Environmental and Social Considerations* (adapted in April 2010). The Environmental Impact Assessment (EIA) was not necessary for a medical facility development such as this project, as it only applies to manufacturing facilities such as factories.

It has been confirmed through the questionnaire, interviews with the SGCH and site visits to

the areas surrounding the hospital, that there was no negative environmental impact (including noise, vibration and negative influence on the ecosystem) during the implementation of the project or after project completion. Similarly, there had been no complaints from the residents near the hospital.

With regard to the environmental monitoring system at the SGCH, the Quality Assurance Team and the Administration Department are responsible. The monitoring duties include managing medical waste, controlling infections, checking the status of cleaning and maintenance of the medical equipment. As for medical waste management, a waste management plan has been formulated, and as per the policy of the Waste Management Committee, waste is properly sorted and disposed of by the cleaning staff. The hospital has signed a service agreement with the Karachi Metropolitan Cooperation, according to which medical waste is collected, disposed of/burnt by the cooperation every other day. On the other hand, liquid medical waste and laboratory drainage are discharged directly to the sewage system[17]. According to the hospital, they have no treatment facility for liquid waste, and it would be very costly to contract an external company such as a medical waste liquid collection service provider. At the time of the ex-post evaluation, no problems have been reported in the proximity of the hospital. There have been no complaints from the neighbors nor has there been a negative impact on the ecosystem. Nevertheless, medical and laboratory waste needs sterilization and the issue requires immediate attention. According to the hospital and the city government of Karachi, a discussion has begun to establish an appropriate mechanism for treating medical and laboratory waste liquid (as of the end of June 2020). However, a concrete measure has to be examined.

2) Resettlement and Land Acquisition

This project did not require resettlement or land acquisition. As the project site is located within the premises of the SGCH, there was no need to acquire new land or to request resettlement.

< Effectiveness and Impact>

The quantitative effect indicators to measure effectiveness, such as “number of inpatients”, “number of NCU inpatients”, “number of biochemistry tests”, exceeded the targets. In addition, although they are reference indicators, “number of surgeries and treatments using the operating

[17] According to the SGCH and the Health Department of the Government of Sindh, there is no regulation in relation to medical wastewater in Karachi City and most medical facilities are discharging it into the sewage line directly. Whilst they say it almost meets the country’s standard, no data have been collected.

rooms" and "usage of the diagnostic imaging device" significantly increased compared to before the project. This indicates that the facility and equipment developed through this project are being utilized. The qualitative interviews confirmed the improvement of medical services in this hospital. In addition, it can be concluded that this project is contributing to the enhancement of the referral system as well as to the improvement of the pediatric services of Karachi City as a whole. Based on the above, effectiveness and impact of the project is evaluated as high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional/Organizational Aspects of Operation and Maintenance

The executing agency of this project is the Health Department of the Government of Sindh. The Government of Sindh decided to utilize PPP and the private sector's know-how to achieve efficient operation and solid cost management of the SGCH. As a result, the PEI took control of the management[18]. The PEI's organizational policy is "to provide cost-effective or free medical services using the latest facilities, and to reduce the burden of patients through the placement of highly qualified medical staff"[19]. According to the Health Department of the Government of Sindh and Karachi Health Office, there is no problem with the operation capability of the PEI[20].

Table 6 shows the plan and actual number of medical staff at the SGCH at the time of the planning, as well as at the time of the ex-post evaluation. There are more staff members at the time of the ex-post evaluation (2020) because the PEI has responded to the increasing number of patients, surgeries and treatments in a timely manner. The Health Department of the Government of Sindh and the PEI commented: "It is imperative to secure medical staff so that we can provide quality medical services that are needed. More staff will be needed as we continue to expand the inpatient department (hereinafter referred to as IPD) and OPD in the future. The hospital is

---

[18] The Government of Sindh and the PEI agreed that the PEI would manage the SGCH "for a period of 10 years from 2016". The selection criteria included relevant experiences and financial capability, based on which the PEI among a few others was selected after an evaluation by the Government of Sindh. A legal basis for the selection and management through PPP is the Government of Sindh PPP Act, 2010. The PPP management contract is extendable, subject to the evaluation of the operation status and performance. At the time of the ex-post evaluation, a decision has not yet been made regarding the operation arrangements after 2026, the end of the 10-year agreement.

[19] The PEI is a nonprofit organization working at a policy level as well as at a community level. Since its establishment in 2002, the organization has specialized in areas such as healthcare, health, education, nutrition, gender and poverty reduction, carrying out activities for social development of low-income communities. It often works with governmental organizations in different localities and has carried out a wide range of activities. (For more information, refer to its website: http://peipk.com/.)

[20] Both the Health Department of the Government of Sindh and Karachi Health Office supervise PEI's work. The PEI submits monthly reports, while these two governmental bodies inspect the hospital periodically to monitor the status of the operation and management. (The Health Department of the Government of Sindh is higher in the governmental structure than the Karachi Health Office. The former overseas the entire province, while the latter overseas the health issues of the entire city. As will be discussed in "3.4.3 Financial Aspects of Operation and Maintenance", the SGCH's operation and maintenance budgets are allocated by the Government of Sindh, while the supervision is carried out by both the provincial and city offices.)

considering increasing the number of staff for a more stable operation." In addition, it was confirmed through answers to the questionnaire, interviews with persons in charge, and the site inspections, that the right medical person is placed in the right place while the medical equipment was sufficiently utilized by the staff.

Table 6: Changes in Number of Medical Staff at the SGCH

	Prior to Project Commencement (2012)	At the Time of the Ex-Post Evaluation (2020)
Doctor	56	136
Paramedic / Nurse	55	245
Management	37	92
Total	148	473

Source: JICA document, answer to the questionnaire

With respect to the maintenance of the developed IPD, OPD and NCU facilities and the procured medical equipment, staff in charge of maintenance management (medical technologists) do the rounds and conduct preventive maintenance, diagnosis, operational status checks, and periodic inspections. However, matters that require specialist knowledge and cannot be attended to by these members of staff (as well as large-scale inspections and repairs) are outsourced to the manufacturers or the agents of medical equipment. Therefore, the maintenance system of the SGCH, including the outsourcing option, has been functioning. No problems have been reported in this regard.

Based on the above, it is assumed that there are no major problems in the systematic or organizational aspect of the operation and maintenance at the time of the ex-post evaluation.

3.4.2 Technical Aspects of Operation and Maintenance

The interviews with medical staff of the SGCH confirmed that the hospital's staff had ample medical work experience and were highly aware of the importance of medical equipment maintenance[21]. In fact, the right staff with extensive experience were placed at the right places. The interviews also confirmed that the staff were highly knowledgeable about and accustomed to outsourcing maintenance of medical equipment to manufacturers and agents. In addition, as

[21] Medical equipment is maintained based on the Standard Operating Procedures (SOP) developed by the Government of Sindh. It was checked that the manual relating to the operation and maintenance is placed in each department in the SGCH and is utilized as needed.

discussed in "3.3.1.1 Quantitative Effects (Operation and Effect Indicators)", the PEI has been recruiting pediatricians from outside in order to better satisfy the needs of outpatients and inpatients.

Training for the medical staff is held periodically. In 2019, for example, a wide range of themes were covered by the training, such as the response to infantile asthma, the role of cefotaxime sodium in community-acquired pneumonia, improving communication skills based on a patient's first concept, the role of genetics, the response to acute flaccid paralysis (AFP), chest X-ray diagnosis, the response to burns, vitamin D deficiency disease. Each training is attended by 20-40 staff members. In addition, on-the-job training is given to newly recruited staff, and information is shared with a view to improving the medical examination and treatment techniques.

Based on the above, it can be judged that there are no major problems in relation to the technical aspect of the operation and maintenance of this project

3.4.3 Financial Aspects of Operation and Maintenance

Table 7 shows the changes in SGCH's operation and maintenance budget in the last four years. The operation budget is used to cover costs related to administration, salaries, utilities and communication, while the maintenance budget is used to maintain the facilities and medical equipment[22]. The source of the fund is the Government of Sindh's budget.

Table 7: Changes in Operation and Maintenance Budget for SGCH

(Unit: Pakistani rupees)

Item	2016/17 *Note 1	2017/18	2018/19 *Note 2	2019/2020
Operation Budget	186,275,518	347,406,104	88,478,832	755,874,374
Maintenance Budget	8,080,757	5,437,870	2,862,905	4,147,200
Total	194,356,275	352,843,974	91,341,737	760,021,574

Source: The Health Department of the Government of Sindh

Note 1: The accounting year of Pakistan starts in July and ends in June. Budgets are prepared accordingly, thus the year is displayed this way.

Note 2: The actual numbers for the first half of 2019 (January-June 2019) is being audited at the time of the ex-post evaluation (March 2020), thus these numbers only reflect that of half a year (July-December 2018).

With respect to the changes in the operation and maintenance budgets in the past four years, the budget increased from 2016/2017 to 2017/2018 while it decreased in 2018/2019. This is because: ①the numbers shown in 2018/2019 only cover half a year (July-December 2018) as the

[22] The operation maintenance budgets discussed here are allocated budgets and not actual expenses. The data on expenses could not be obtained.

other half is being audited at the time of the ex-post evaluation (March 2020)[23], ②the allocation of July-December 2018 budget was delayed by the Government of Sindh, which resulted in a temporary confusion. According to the Health Department of Sindh Province, ② was a temporary problem and that budget will be allocated as per the need, taking into consideration the increasing number of hospital beds and patients. Further increases are likely considering that the number of OPD patients significantly increased from the previous year and the average occupation rate of the IPD is 95%. In reality, the budget for 2019/2020 is greater than the previous year or the year before that. A person in charge at the SGCH commented: "Every year, sufficient and necessary budgets are allocated for the operation and maintenance works. The hospital side requests the budgets, and the provincial government reviews it before determining the allocation. No maintenance work has been delayed due to a budget shortage." With respect to the decreasing maintenance budget from 2016/2017 to 2017/2018, the same person in charge commented: "As 2016/17 was right after the commencement of the works, we needed a large amount to manage the facilities. On the other hand, the necessary budget was allocated generally for 2017/2018." In addition, it was mentioned that the distinction between the operation budget and the maintenance budget was not clear at that time and that the numbers could not be compared to the previous year or the following year. At the time of the ex-post evaluation, maintenance works have not been delayed due to a budget shortage as mentioned above. Therefore, it is concluded that there are no major problems in the financial aspect of the operation and maintenance.

3.4.4 Status of Operation and Maintenance

At the time of the ex-post evaluation, it is the SGCH's staff who carry out preventive maintenance, diagnosis, operational status checks and periodic inspections of the medical equipment procured by this project. Large-scale inspections and repairs requiring specialist knowledge are being appropriately managed by outsourcing them to external manufacturers or agents. The hospital staff maintain facilities such as IPD, OPD and NCU. As mentioned earlier, large-scale maintenance and matters requiring specialist knowledge are outsourced to external construction companies. In principle, maintenance of medical equipment follows the Standard Operation Procedures (SOP) developed by the Government of Sindh. While frequency of maintenance depends on the type and service life of the item, based on the medical equipment ledger it was confirmed that periodic inspections and maintenance was being properly conducted.

[23] This means that the period January-June 2019 is being audited and not included in the figure.

The SGCH does not always procure or store medicine and spare parts of their medical equipment. In principle, they are not always stocked; private service agents visit the hospital regularly and replenish or replace items as needed.

During the field survey, no major problems were found in relation to the operational status of the facilities or the utilization status of the medical equipment. No items, including large pieces of equipment, were left unattended or unrepaired. In addition, it was also confirmed that all facilities such as IPD, OPD and NCU were kept clean.

Based on the above, no major problems have been observed in the institutional/organizational, technical and financial aspects or relating to the current status of the operation and maintenance system. Therefore, the sustainability of the project effects is high.

Photo 8: Inside the SGCH (Lobby)

Photo 9: Inside the IPD

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The SGCH provides secondary medical services in Pakistan's largest city, Karachi. This project aimed to expand the hospital thereby improving the pediatric medical services of the city. The *Poverty Reduction Strategy Paper* formulated by the Government of Pakistan advocated the need to protect the poor and the vulnerable, while the *Heath Sector Strategy* formulated by the Government of Sindh recognized the priorities to be neonatal and pediatric health, nutrition, polio eradication, infection control, etc. There is a continued development need to expand and update medical facilities in the city. Considering that this project was also in line with Japan's ODA policy, its relevance is high. With respect to efficiency, although the outputs and the project costs were mostly as per the plan, the project period slightly exceeded the initial plan due to a

deterioration in security in and around Karachi City. This affected progress at the time of the detailed design, after the project commenced. Therefore, efficiency of the project is fair. The quantitative effect indicators such as “number of inpatients”, “number of NCU inpatients”, “number of biochemistry tests”, exceeded the targets. In addition, although these are reference data, “number of surgeries and treatments using the operating rooms” and “usage of the diagnostic imaging device” significantly increased at this hospital, compared to the condition prior to this project; the facility and equipment procured by this project are being utilized. The qualitative interviews confirmed the improvement in the hospital’s medical services. Furthermore, it can be concluded that this project has also contributed to strengthening the referral system and improving the pediatric medical services of the city as a whole. Therefore, effectiveness and impact is high. With regard to sustainability, there are no major concerns in the institutional, technical and financial aspects of this hospital. There are no major problems in relation to the operation and maintenance status of the developed facilities or the procured equipment. Therefore, the sustainability of the effects achieved through the implementation of this project is considered to be high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

With respect to the treatment of liquid medical waste and laboratory drainage, while no major problems, complaints or negative influence on the ecosystem have been reported in the proximity of the hospital at the time of the ex-post evaluation, a risk to or influence on the natural environment is not completely ruled out. The SGCH needs to discuss this with Karachi City and the Health Department of Sindh Province to address the issue of treating liquid medical waste and laboratory drainage (including thorough disinfection) as soon as possible.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

(Necessity of Promptly Deciding on Management System After the Project Completion in order to Prevent Loss of the Project’s Benefits)

In the case of this project, the facilitiy and medical equipment were not utilized immediately

after the handover; the utilization finally began after the completion of the defect liability period (October 2016). It is because the Health Department of the Government of Sindh decided that an NGO would manage the hospital based on the PPP. It required considerable time for the Japanese side and the Pakistani side to check the management policy based on the PPP, as well as for the Pakistani NGO selection and internal procedures. It is usually the case that confirmation and procedures associated with a change in management policy take time. Whilst a careful response is needed, it is desirable that JICA identifies a post-completion management system for the recipient country and that the recipient country, as the party responsible for the actual management, promptly determines the post-completion management system to avoid losing the benefits of the project.

Federal Democratic Republic of Nepal

FY2019 Ex-Post Evaluation of Japanese Grant Aid Project

"The Project for Micro-Hydropower Improvement in Western Area"

External Evaluator: Ruiko Hino

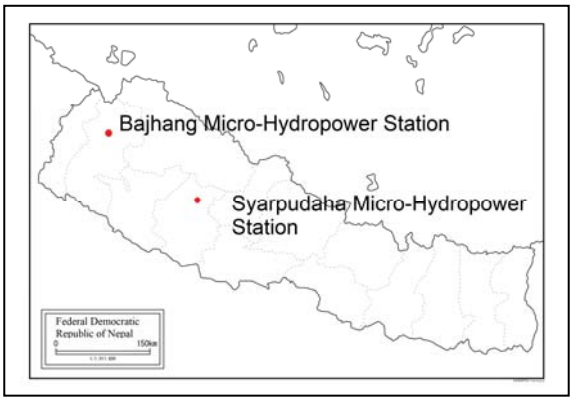
Foundation for Advanced Studies on International Development

0. Summary

This project aims to respond to tight power supply-demand balance in the rural area by rehabilitating the existing aged micro-hydropower stations in the area (Bajhang District and West Rukum District) that are not connected to the main transmission/distribution system, thereby contributing to the enhancement of the regional economy and public welfare. As this objective was consistent with the development plan and development needs of Nepal as well as Japan's ODA policy, the project relevance is high. Although the project cost was within the plan, the project period exceeded the plan. Therefore, the efficiency of this project is fair. Regarding the three operational indicators set in this project, the target values for average power output (kW) and annual generated energy (kWh/year) were not achieved at the Bajhang and Syarpudaha Micro-Hydropower Stations, and that for the annual generated operation hours (h/year) was not achieved at the Bajhang Micro-Hydropower Station. Regarding the qualitative effects on the effectiveness and the impacts, certain effects were confirmed. Therefore, this project has achieved its objectives to some extent, and effectiveness and impacts of the project are fair. Some minor problems have been observed in terms of the project's technical and financial aspects and current status of operation and maintenance. Therefore, sustainability of the project's effects is also fair.

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

1. Project Description



Project Locations

Intake of Syarpudaha Micro-Hydropower Station

Bajhang Micro-Hydropower Station's Generator

1.1 Background

Nepal has abundant water resources, and at the time of planning, it was estimated to have a hydropower capacity of 83,000 MW and an economically effective hydropower capacity of 42,000 MW. Despite having such resources, the hydroelectric power generation capacity in 2012 was only about 758 MW, and it was suffering from chronic power shortages such as the inability to cover the peak power demand of 1,095 MW. Therefore, planned power outages of up to 16 hours a day was carried out. As a result, the annual electricity sales per capita were 115 kWh (2011)—the lowest level in the world. Furthermore, Nepal Electricity Authority (hereinafter referred to as "NEA"), which was the executing agency of this project, predicted that peak demand would grow at an annual rate of about 9%. The electrification rate in rural areas was as low as 61% (as of 2011), and especially that in the Mid-Western and Far-Western regions as low as 45%. In addition, even in the national transmission system, there were areas where unplanned power outages occurred frequently due to aging power generation facilities and insufficient capacity, which had seriously hindered the lives and economic activities of citizens, so a stable power supply was an urgent issue.[1]

The Government of Nepal had positioned economic infrastructure development, including electricity, as a priority area in the *Three Year Interim Plan* (FY 2013/2014 - 2015/2016), which

[1] Ex-ante evaluation paper, p. 1

was at the top of the national development strategy; implementing power development of 15,000 kW of small and micro hydropower over three years and supplying power to rural areas were also planned. In addition, the Government of Nepal formulated the *Renewable Energy Policy* in 2009, which positioned small and micro hydropower as necessary to supply electricity to rural areas that were not connected to the national transmission system.[2]

Under these circumstances, the Government of Nepal requested the Government of Japan to rehabilitate existing aged micro-hydropower stations in the target area that were not connected to the main transmission and distribution system.

1.2 Project Outline

The objective of this project was to respond to tight power supply-demand balance in the rural area by rehabilitating the existing aged micro-hydropower stations in the area that were not connected to the main transmission/distribution system, thereby contributing to the enhancement of the regional economy and public welfare.

Grant Limit/Actual Grant Amount	1,571 million yen/1,129 million yen
Exchange of Notes Date / Grant Agreement Date	April 2014/April 2014
Executing Agency	Nepal Electricity Authority
Project Completion	January 2017
Target Area	Bajhang District and West Rukum District[3]
Main Contractor	Marushin Shitaka Construction Co., Ltd.
Main Consultant	Nippon Koei Co., Ltd.
Procurement Agency	None
Preparatory Survey	July 2013 – March 2014

[2] Ex-ante evaluation paper, p. 1

[3] At the time of planning, the site was located in Rukum District; however, at the time of the ex-post evaluation, Rukum District was divided into two districts; thus, the site is currently located in West Rukum District.

Related Projects	ODA Loan: “Kali Gandaki ‘A’ Hydroelectric Project” (1996 – 2002, co-financing with Asian Development Bank), and “Tanahu Hydropower Project” (2013 – 2021, co-financing with Asian Development Bank) Technical Cooperation: “Project for the Nationwide Master Plan Study on Storage-Type Hydroelectric Power Development in Nepal” (2011 – 2013) Grant Aid: “The Project for Introduction of Clean Energy by Solar Electricity Generation System” (2010 – 2012)

2. Outline of the Evaluation Study

2.1 External Evaluator

Ruiko Hino, Foundation for International Development Organization

2.2 Duration of Evaluation Study

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

Duration of the Study: November 2019 – January 2021

Duration of the Field Study: February 23, 2020 – March 13, 2020

2.3 Constraints during the Evaluation Study

In response to the global pandemic of COVID-19, the evaluator did not visit the field for the second field survey scheduled for this evaluation; instead, the local assistant collected additional information, provided feedback on the content of the evaluation to the related organizations, and gathered comments. Through online meetings, the evaluator and local assistant shared information on the evaluation, including the evaluation framework and the survey method of the project, collected all the necessary information, and facilitated smooth communication with related organizations. By these measures, they tried to ensure the quality of the study.

3. Results of the Evaluation (Overall Rating: C[4])

3.1 Relevance (Rating: ③[5])

3.1.1 Consistency with the Development Plan of Nepal

In the *Thee Year Interim Plan* (FY 2013/2014-2015/2016), which was positioned at the top of Nepal's national development strategy at the time of the ex-ante evaluation, economic infrastructure development, including that on electricity, was a priority area, and it was indicated that the Government of Nepal would implement the power development by small and micro hydropower of 15,000 kW within those three years. In 2009, the Government of Nepal formulated the *Renewable Energy Policy*, which stated that small and micro hydropower would be required to supply electricity to rural areas that were not connected to the national transmission system.

At the time of the ex-post evaluation, electric power development remained one of the main goals of the *15th National Development Plan* (FY 2019/2020-2023/2024), which was Nepal's national development strategy. However, under this policy, small and micro hydropower was positioned as an alternative energy, and its position seemed to be changed. Furthermore, for the areas connected to the national transmission system, the policy was shown to connect (synchronize) alternative energies, such as small and micro hydropower, solar and wind power generation, and bioenergy, to the national transmission system.

In this way, electric power development has been one of the priority areas in the country's national development, from the time of planning to the ex-post evaluation. Although the position of small and micro hydropower was changed to an alternative energy source at the time of the ex-post evaluation, the project, which aimed to respond to the tight power-demand balance in the rural area by rehabilitating the existing aged micro-hydropower stations in the project area, is highly consistent with the development policy of Nepal.

3.1.2 Consistency with the Development Needs of Nepal

At the time of the ex-ante evaluation, the electrification rate in the rural area of Nepal was as low as 61% (2011), and it was even lower at 45% in the Midwestern region where Bajhang District is located and the Far Western region where West Rukum District is located.[6]

At the time of the ex-post evaluation, since the national transmission system was connected to both areas, the power supply area of the micro-hydropower stations rehabilitated in this project was smaller than that expected at the time of planning. However, when the power supply from the national transmission system is interrupted for a long period of time, power is transferred from the micro-hydropower stations to the power supply area of the national

[4] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory.
[5] ③: High, ②: Fair, ①: Low.
[6] Ex-ante evaluation paper, p. 1.

transmission system in the districts, and so the micro-hydropower stations function as a backup power source for the national transmission system.[7]

From the above, it is confirmed that the consistency with the development needs of this project in Nepal and the target area is high.

3.1.3 Consistency with Japan's ODA Policy

The *Country Assistance Policy for the Federal Democratic Republic of Nepal* (2012) stipulated "improvement of social infrastructure and institutions for economic growth" as one of the priority areas and asserted that the urban environment on such things as power shortages—which were becoming more serious year by year—would have a serious impact on the lives of citizens. In addition, the Rolling Plan attached to the *Country Assistance Policy* in Priority Area 3, "Social environment and infrastructure development for sustainable and balanced economic growth," pointed out the following: Nepal relied on hydropower for 99% of its electricity supply; the electricity demand had grown rapidly in recent years (8% annually), significantly exceeding the supply and forcing planned power outages of up to 16 hours a day; and the electricity shortages hindered the country's commercial and industrial activities as well as its economic and industrial development, posing a serious obstacle to its activities and directly affecting the living standards of the people in various areas such as emergency medical care and security concerns.

In this light, it can be said that this project was in line with Japan's aid policy at the time of planning of the project.

3.1.4 Appropriateness of the Project Plan and Approach

(1) Change the scope

The project included the Bajura Micro-Hydropower Station in Bajura District at the time of planning; however, the power station was excluded from the scope of the project due to the floods that occurred in the Bajura District in August 2014. After the construction/machinery procurement was postponed, the consultant carried out a reinvestigation and additional design and consequently revealed that it was difficult to carry out the construction and equipment procurement of the Bajura Micro-Hydropower Station within the exchange of notes (E/N) grant limit. Therefore, the scope of the project was changed to exclude the Bajura Micro-Hydropower Station from the plan. Regarding the change of scope, the minutes of the discussion (M/D) were signed by NEA, the Ministry of Finance of Nepal, and Japan International Cooperation Agency (hereinafter referred to as "JICA") after consultations with the executing agency and the Ministry of Finance of Nepal in July 2016. From the above, it can be said that the scope change

[7] Questionnaire responses from the executing agency and interview survey results from the executing agency.

was carried out through the appropriate process.

(2) Setting the target values of the operational indicators

The target values of the operational indicator “average power output (kW)” in this project were set without consideration of the point that both of the micro-hydropower stations in Bajhang and Rukum were not operating at 100% of their installed capacity (200 kW) because they were normally operated as single systems.[8] In single systems of micro-hydropower stations, it is necessary to adjust demand so that it does not exceed supply and to supply power that falls below the installed capacity. In addition, even though the maximum demand during peak hours at night was about 180 kW, the power demand during off-peak hours of the daytime decreased significantly, so it was impossible to operate constantly with the installed capacity. Thus, the target values were overestimated. Furthermore, since the target values for “average power output” were excessive, the target values for the operational indicator “annual generated energy” were also excessive. This point will be described again in section 3.3, on effectiveness and impacts.

As described above, it can be said that appropriate procedures were taken according to the proper process for changing the scope of this project. In regards to setting the target values of the operational indicators, the conditions under which the targeted micro-hydropower stations would be operated may not have been sufficiently examined at the time of planning. This is considered to be the factor that caused the setting of excessive target values for the indicators.

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

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

This project implemented the construction and equipment procurement of the micro-hydropower generation facilities as well as the soft component (capacity building program by the consultant) of the facilities’ operation and maintenance for the personnel involved in. As shown in Tables 1 and 2 below, the planned outputs were implemented almost as planned, but as stated in Section 3.1.4 (1), the scope of this project has changed since the time of planning, so the changed scope shall be considered as the planned values.

[8] Both micro-hydropower stations were physically connected to the national transmission system but not synchronized. They normally supplied power by an independent distribution network as single systems. On the other hand, when the power supply from the national transmission system was stopped for a long period of time, they were connected to the main transmission system and served as backup power sources for it.

Table 1 Comparison of the Planned and Actual Scope of the Project

(Facilities and Main Equipment)

<table>
<tr><th>Item</th><th>Planned</th><th>Actual (differences)</th></tr>
<tr><td>Water intake</td><td>Construction of two intake weirs for micro-hydropower stations (Bajhang and Syarpudaha)</td><td>As planned.
However, the type of sand drainage gates at both micro-hydropower stations[9] and the construction method for the left bank of the intake weir of the Syarpudaha Micro-Hydropower Station[10] were changed.</td></tr>
<tr><td>Headrace</td><td>Rehabilitations of the existing headraces and powerhouses, partial rehabilitations of water tanks and penstocks of the two micro-hydropower stations.</td><td>As planned</td></tr>
<tr><td>Power generation equipment</td><td>Update of water turbines/generators (2 units each), control devices, input valves, main transformers, etc. at the two micro-hydropower stations.
<table>
<tr><td></td><td>Bajhang Micro-Hydropower Station</td><td>Syarpudaha Micro-Hydropower Station</td></tr>
<tr><td>Installed capacity[11]</td><td>200 kW[12]</td><td>200 kW</td></tr>
<tr><td>Power generation method</td><td>Run-of-river type</td><td>Run-of-river type</td></tr>
<tr><td colspan="3">Water wheel</td></tr>
<tr><td>Type</td><td>Cross flow</td><td>Belton</td></tr>
<tr><td>Effective head</td><td>37.043 m</td><td>265.6 m</td></tr>
</table></td><td>As planned</td></tr>
</table>

Source: Documents provided by JICA and interviews with the consultant

[9] The type (rack) assumed at the time of planning was changed to the general (spindle) type because there was no production record in Nepal and it was assumed that maintenance after implementation would be difficult.

[10] When the excavation was carried out on the back of the retaining wall on the left bank of the intake weir after the start of the project, it became clear that it would be difficult to perform excavation with the construction method chosen at the time of planning, and so the construction method was changed.

[11] The installed capacity of the existing micro-hydropower station was 200 kW in both Bajhang and Syarpudaha.

[12] Water turbine output (for one) was 115 kW at Bajhang and 120 kW at Syarupudaha. Generator-end output (for one) was 100 kW (125 kVA (standard capacity) × 0.8 (power factor)) at both Bajhang and Syarupudaha. Therefore, the installed capacity was 200 kW.

Table 2 Comparison of the Planned and Actual Scope of the Project

(Soft Component)

Planned	Actual (differences)
Guidance on operation and maintenance Operation and maintenance of electrical machinery equipment Operation and maintenance of civil engineering equipment	As planned
Guidance on financial statement preparation	As planned

Source: Documents provided by JICA

3.2.2 Project Inputs

3.2.2.1 Project Cost

The cost of this project was the grant limit of the E/N (1,571 million yen); however, as mentioned above, the scope of this project was changed, and the project cost excluding the Bajura Micro-Hydropower Station at the time of planning was 1,136 million yen. This amount shall be the planned project cost. The total project cost on the Japanese side of this project was 1,129 million yen (99% of the plan). Regarding the amount borne by the Nepalese side, the planned and actual costs were 2.3 million Nepalese rupees (equivalent to about 2.3 million yen,[13] 100% of the plan). Regarding the obligations to be implemented by the Nepalese side, there was a delay in tax exemption measures, customs clearance work, and advice on authorization to pay (A/P), but others were implemented as planned.[14]

From the above, the project cost was within the plan.

3.2.2.2 Project Period

The planned project period after the scope change was from April 2014 to May 2016 (26 months), but the actual project period was from April 2014 to July 2016 (28 months), slightly exceeding what was planned (108% of the planned period). One factor behind the difference was the delay in the main construction and the installation work; the delay in the main construction owed to the impact of the two-month border blockade with India, which was caused by the security concerns in October 2015, and water leakage that occurred outside the scope of work during the test period and the restoration work for the damaged area. In addition to the blockade of the Indian border, the delay in the installation work was caused by the suspension of shipping due to a significant delay in the conclusion of bank arrangements (B/A) and the issuance of authorization to pay (A/P), which were obligations on the Nepalese side.

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

[13] 1 Nepalese rupee = 1.082 yen (as of August 2013)

[14] Questionnaire responses from the executing agency.

3.3 Effectiveness and Impacts[15] (Rating: ②)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

Regarding the three operational indicators set in this project, both micro-hydropower stations failed to achieve Indicator 1, "average power output," and Indicator 2, "annual generated energy." Indicator 3, "annual generated operation hours," was achieved only at the Syarpudaha Micro-Hydropower Station.

Table 3 Baseline Values, Target Values, and Actual Values of Operation and Effect Indicators

	Baseline	Target	Actual		
	2012	2019	2017	2018	2019
		2 Years After Completion	Completion Year	1 Year After Completion	2 Years After Completion
Indicator 1 Average power output (kW)					
Bajhang Micro-Hydropower Station	100	200	130	127	33(*1)
Syarpudaha Micro-Hydropower Station	100	200	65	70	76
Indicator 2 Annual power generation (kWh/year)					
Bajhang Micro-Hydropower Station	810,000	1,704,000	759,200	603,010	276,705(*2)
Syarpudaha Micro-Hydropower Station	780,000	1,704,000	560,000	603,120	659,986
Indicator 3 Annual generated operation hours (h/year)					
Bajhang Micro-Hydropower Station	810,000	1,704,000	759,200	603,010	276,705(*2)
Syarpudaha Micro-Hydropower Station	780,000	1,704,000	560,000	603,120	659,986

Source: Documents provided by the executing agency

Note: At both micro-hydropower stations, the operating hours and power generation output were not aggregated monthly or yearly, so it is necessary to make a certain reservation for the reliability of the data. The average power output and annual generated energy include the power generation amount when both power stations generated power as the backup power source for the national transmission system.

(*1) The electricity demand in the Bajhang Micro-Hydropower Station supply area in 2019 was 10 kW to 20 kW and based on this information, the average power output is calculated to be 12 kW (24-hour average of the demand per day ((20 kW x 3 hours) + (10 kW x 17 hours) + (15 kW x 4 hours))).

(*2) According to the chief of NEA Bajhang Distribution Center, the figures were read from the generator panel. Therefore, the value was the amount of power generated by the generator, not the amount of power transmitted. Calculated using the above estimation of power demand, the value is 100,620 kWh.

(*3) At the time of planning, for both micro-hydropower stations, the target values of the annual operating hours were set under the following assumptions: (1) they were operated as single systems, (2) their demand exceeded the installed capacity (200 kW), and (3) the power generation flow rate was sufficient to generate 200 kW, which was the maximum installed capacity. Under these assumptions, the annual maintenance period of the generators was expected to be 10 days; thus, the target value of the annual operating hours was set (355 days x 24 hours = 8,520 hours).

[15] Sub-rating for Effectiveness is to be put with consideration of Impacts.

The reasons why the three abovementioned operational indicators were not achieved are as follows.

(1) Indicator 1: Average power output (kW)

There were two main reasons why the actual values did not reach the target values of 2019, two years after completion. At the Bajhang Micro-Hydropower Station, the first factor shown below had a significant effect, and at the Syarpudaha Micro-Hydropower Station, the second factor provided the impact significantly.

Firstly, the power supply areas at both micro-hydropower stations were reduced due to the connection of NEA's main transmission system.[16] As a result, the electricity demands were lower than expected at the time of planning. In particular, the decrease in the electricity demand at the Bajhang Micro-Hydropower Station was remarkable. Table 4 shows the changes in the number of contractors for both micro-hydropower stations and in the electricity demand during peak hours between the time of planning and the time of the ex-post evaluation.

Table 4 Number of Contractors and Electricity Demand during Peak Hours for the Micro-Hydropower Stations

	Number of contractors		Peak electricity demand (kW)	
	At the time of planning (2013)	At the time of the ex-post evaluation (2020)	At the time of planning (2013)	At the time of the ex-post evaluation (2020)
Bajhang Micro-Hydropower Station	1,821	Approximately 150	Approximately 400	Approximately 20
Syarpudaha Micro-Hydropower Station	3,948	Approximately 2,500	Approximately 500	Approximately 180

Source: Preparatory survey report, interview with the executing agency

As mentioned in Relevance, small and micro hydropower was positioned as an alternative energy source in Nepal at the time of the ex-post evaluation, and small- and micro-hydropower stations were said to supply power to areas where the national transmission system was not connected. According to NEA, the policy of promoting local electrification by expanding the national transmission system has been strongly promoted since FY 2017/2018, and it can be said that the connection of the national transmission system to both districts was a part of this policy. Therefore, it can be said that it was difficult to assume at the time of planning the connection of

[16] The NEA main transmission system was connected to the capital of the Bajhang District, Chainpur, where the Bajhang Micro-Hydropower Station was located, around November 2018, and to the capital of the West Rukum District, Musikot, where the Syarupudaha Micro-Hydropower Station was located, in October 2016.

the national transmission system to both areas.

Secondly, as mentioned above, the target values were overestimated. Although the two micro-hydropower stations constructed in this project were operated as independent systems, the target values (200 kW) were set without consideration that they would not be operated at 100% of the installed capacity (200 kW). When a micro-hydropower station is operated as a single system, power demand must be adjusted so that it does not exceed the power that can be supplied. It is necessary to provide a certain amount of buffer, and even if there is a peak power demand of 200 kW, actual operations shall be performed below 200 kW. In addition, the peak and off-peak power demands of both micro-hydropower stations differed substantially, but the target values were set without consideration of this point.[17]

In addition, before the target year (2019), the national transmission system was not connected to Bajhang District, and there was no major change in the power supply area of the Bajhang Micro-Hydropower Station compared to the time of planning. However, the actual values for 2017 and 2018 have not reached the target values. This is because there were several issues with water intake, besides the second factor mentioned above (the target values were excessive). It was confirmed that the micro-hydropower station did not have sufficient water during the dry season. In addition, during the period excluding the dry season, sufficient amount of water could not be obtained because of the bar screen's clogging and because of the simple water conveyance due to the damage of the headrace caused by the landslide in 2018, which has not yet been solved at the time of ex-post evaluation. These points were also considered as the factors.[18]The three factors that caused the water intake problem are described in detail below, but it is probable that it was difficult to assume any of the factors at the time of planning.

Analysis of water volume during the dry season: At the Bajhang Micro-Hydropower Station, verification of whether sufficient water volume could be obtained during the dry season was carried out through the examination of expansion potential in the preparatory survey. In the examination, the water flow observations were carried out, and the measurement results included data that indicated that the Bajhang Micro-Hydropower station could not operate at the maximum output (200 kW). As a result of analyzing rainfall data for 30 years that was available at that time and interviewing local residents, the consultant comprehensively judged that the period of measurement of the flow rate (late October 2013 to early February 2014) was a dry

[17] The peak power demand at the ex-post evaluation of the Bajhang Micro-Hydropower station was 20 kW, while the off-peak (daytime) power demand was 15 kW and the demand of the lowest time was around 10 kw. The demand for 20 kW was 3 hours/day, the demand for 15 kW was 4 hours/day, and the demand for 10 kW was 17 hours/day. At the time of the ex-post evaluation, the peak (night) power demand was about 180 kW, the off-peak (daytime) power demand was 80 kW, and the midnight/early morning power demand was about 40 kW at the Syarpudaha Micro-Hydropower Station. In addition, the demand for 180 kW was 2 hours/day, the demand for 80 kW was 15 hours/day, and the demand for 40 kW was 7 hours/day (interview with the executing agency).

[18] The bar screen is made by fixing circular or square rods or plates to the outer frame at regular parallel intervals and has the function of removing dust and foreign matter.

year. There was no flow data before the time of the planning in the target area, and the hydrological data were extremely limited. It was very difficult to verify whether the measurement period was a dry year and whether the existing micro-hydropower station sufficiently operated at the maximum output. As described above, the consultant conducted the analysis to the extent possible at that time, but it was difficult to conduct precise analysis on the amount of water during the dry season due to the large restrictions on the available data.

Bar screen clogging: The water intake design adopted in this project is based on the technology researched and established in Japan; however, bar screen clogging is an unavoidable problem in terms of function and structure, and bar screen cleaning is done manually even in Japan.

At the Bajhang Micro-Hydropower Station, cleaning to remove gravel was carried out once every one or two months during the dry season and two or three times a day during the rainy season, as confirmed at the time of the ex-post evaluation. In addition, the bar screen was still clogged, which was a factor in reducing water intake efficiency.[19] To estimate the scale of clogging that occurred at the Bajhang Micro-Hydropower Station at the time of planning, it was necessary to conduct a survey to measure the amount of sediment contained in river water during the rainy season, measure the sizes of particle and concentration of sediment in the river water, and then conduct further experiments to confirm the status of screen clogging, which necessitated a span of multiple years. Therefore, it was difficult to assume the situation of bar screen clogging at the Bajhang Micro-Hydropower Station at the time of planning.

Landslide damage to the headrace: At the Bajhang Micro-Hydropower Station, the landslide in 2018 damaged part of the headrace (60 m). At the time of the ex-post evaluation, a simple repair was carried out on this part, and since water was taken in that situation, the water intake efficiency was poor and a sufficient amount of water could not be obtained.

(2) Indicator 2: Annual power generation (kWh/year)

Since indicators 1 and 3 have not been achieved, the target values have not been achieved at either micro-hydropower station.

Bajhang Micro-Hydropower Station
Landslide location

(3) Indicator 3: Annual generated operation hours (h/year)

The main reason for the Bajhang Micro-Hydropower Station's failure to reach the target values in the target year of 2019 was the problem of water intake. In the Bajhang

[19] During the rainy season in 2016, a large amount of gravel blocked the entire surface of the bar screen, causing the water intake function to stop, and one bar was then removed from the bar screen around February to March 2017. Since then, clogging has not occurred to such an extent that the water intake function has stopped.

Micro-Hydropower Station, as described above, insufficient water was obtained during the dry season. Furthermore, the water intake efficiency was reduced due to the clogging of the bar screen and the simple water conveyance. Therefore, it was sometimes necessary to restore the water level in the water tank in order to generate electricity that met the power demand. Each time, the operation was stopped for about 45 minutes on average and then restarted. Also, in 2018, a landslide damaged headrace, and power could not be generated for about 45 days. This incident was also a factor in lowering the actual value for the year. In addition, compared with the actual values of the annual generated operation hours in 2017 and 2018, an improvement was shown in 2019. This is due to several factors: the fact that the national transmission system was connected to the Bajhang District around November 2018, then the electricity demand of the micro-hydropower station decreased significantly in 2019. As a result, the required water level has dropped and the frequency of shutdowns to restore water levels has decreased.

3.3.1.2 Qualitative Effects (Other Effects)

In the ex-ante evaluation paper, three points were observed as the outcomes of this project: stable power supply, stable night lighting, and stable voltage and frequency of the power supply.

(1) Stable power supply

As mentioned earlier, upon completion of this project, the national transmission system was connected to the capitals of Bajhang District and West Rukum District, where the micro-hydropower stations are located, and the power supply areas of both micro-hydropower stations were reduced. Therefore, the power demand in the power supply areas of both facilities at the time of the ex-post evaluation was within the range of the installed capacity of the power generation, and it was not necessary to limit the power load. In fact, the Bajhang Micro-Hydropower Station produces electricity on average 18 hours a day, during which no load restrictions (power outages) are applied. At the Syarpudaha Micro-Hydropower Station, power outages occur 5 to 10 times a month on average due to problems such as the maintenance of the distribution network, but these only last about 2 hours in total. In addition, from the results of interviews with the residents (hereinafter referred to as “informants”) who used the electricity of the micro-hydropower stations constructed in this project, it was clear that long-term load restrictions were not implemented at the time of the ex-post evaluation. Therefore, it can be said that power was supplied stably to a certain extent in the power supply areas of both micro-hydropower stations at the time of the ex-post evaluation.

(2) Stable night lighting

In the field survey, 11 informants in Bajhang District and 8 in West Rukum District were interviewed. In both districts, all informants answered that power outages were reduced

compared to before completion of the project and that power was stably supplied at night at the time of the ex-post evaluation. Although it is the result of hearing from a limited number of informants, night lighting is being used stably.

(3) Stable voltage and power supply frequency

In the field survey, when the evaluator visually confirmed with the instruments of the power stations, no significant fluctuations in voltage or frequency were confirmed. Specifically, the voltage fluctuation range at the Bajhang Micro-Hydropower Station was 400 V to 420 V, and the frequency was almost unchanged. The voltage fluctuation range at the Syarpudaha Micro-Hydropower Station was 400 V to 410 V, and the frequency fluctuation status was 50 Hz to 52 Hz.

Therefore, it was confirmed that the voltage and frequency were stable.

3.3.2 Impacts

3.3.2.1 Intended Impacts

At the time of the ex-ante evaluation, the qualitative effects "improvement of public services by stable power supply to public facilities," "promotion of community activities by stable night lighting," and "reduction of motor failures by stable voltage and frequency of power supply" were expected.[20] In addition, the purpose of the project was to "contribute to enhancement of the regional economy and public welfare." Based on these expected impacts, the following three points were verified as the qualitative impacts in this evaluation.

(1) Is there a stable power supply in the public facilities (health facilities, schools)?
As a result, have the learning environment and health services been improved?

In the field survey, we visited one health post (clinic) and one public school each in Bajhang District and West Rukum District, and conducted the interviews. The results of the interviews are shown in Table 5.

[20] ex-ante evaluation paper, pp. 2-4

Table 5: Results of Interviews with the Public Facilities

	Bajhang District (one each)	West Rukum District (one each)
Health post (clinic)	Because the facility was established in 2019,[21] it was not possible to compare with the situation before the implementation of the project; however, the electricity was stably supplied and the medical services could be provided without any problems.	The power supply has been stable since it was connected to the system of the Syarpudaha Micro-Hydropower Station. The new medical service that uses electricity has been preparing to provide.
Public primary and secondary schools	Since the national transmission system was connected to the district capital, the power supply has been stable and the computers have been used stably, mainly by teachers. There was no lighting equipment in the school classrooms.	Power outages have decreased compared to before, and the power supply situation has improved. As a result, the school principal felt that the learning and teaching environment has improved and children's motivation and interest in learning have increased. He also felt that it was safer in terms of security because the electricity was stably supplied and lighting could be used. In addition, the neighboring villagers have also started new businesses, and the principal said that it has led to increases in income.

As mentioned above, although based on limited information,[22] the teaching and learning environments were improved through the stable supply of electricity in the public primary and secondary schools. In addition, although improvement in the health services was not confirmed, there were signs of it.

(2) Are power outages reduced and is stable lighting available at night in the community? Are nighttime activities (children's learning, community activities, etc.) thereby promoted?

In the field survey, 11 informants in Bajhang District and eight in West Rukum District were interviewed. The results of the interviews are shown in Table 6.

[21] In Bajhang District, there was only one health post, which was established in 2019, as a contractor of the micro-hydropower station, so it was not possible to confirm the situation before the project.

[22] In Bajhang District, the number of public facilities supplied by the Bajhang Micro-Hydropower Station was extremely limited, and the number of public facilities that could be visited in the field survey in both districts was also limited. As a result, the number of facilities visited was small.

Table 6 Results of the interviews with the informants

	Bajhang District (11 people)	West Rukum District (8 people)
Reduction of power outages	All informants answered that power outages were reduced compared to before the completion of this project and that power was stably supplied at night at the time of the ex-post evaluation.	
Increase in children's learning time	Nine out of nine valid respondents said their children's learning time increased.	Three of the seven valid respondents said their children's learning time increased. In addition, four respondents answered that their children were learning at night, although it was not possible to compare with the situation before the implementation of this project.
Increase in community activities	In both districts, four respondents each answered that activities within the communities such as parties and weddings increased, which made it easier to prepare for a party. They also answered that in the past it was necessary to hold a party in another place because there was no electricity, but at the time of the ex-post evaluation, it was said that it could be held in or near the house.	
Easiness of daily life	Seven respondents in each district answered that the stable power supply had made their daily lives easier. Specifically, it was easier to clean and cook because lighting could be used stably at night and sufficient brightness could be obtained. It was easier to cook because rice cookers, electric water heaters, electric stoves, etc. could be used. There was also a comment that the time spent on required tasks had shortened and that leisure time, such as for watching TV, reading, or writing, had increased.	
Others (increase in income)	Four respondents said that their income had increased due to the stable power supply. Informants who processed wood using electric planes were able to work for a long time, including at night, and their income had increased. In addition, it was said that stores could be opened at night and that new products could be sold (ice cream for refrigerators, etc.), which led to an increase in income.	One respondent said that the stable supply of electricity improved his income.

From the above, it was confirmed that power outages decreased in both Bajhang District and West Rukum District County compared to before the implementation of the project and that power was stably supplied at night at the time of the ex-post evaluation. It was said that children's learning time has increased compared to before the project was implemented. Regarding community activities, it was confirmed that opportunities such as parties and weddings have increased, and it was also confirmed that the use of electrical appliances has increased, daily life has become easier, and leisure time has increased. In addition, although the number of cases was limited, an increase in income was confirmed.

(3) Did voltage and frequency stabilize compared to before the project was implemented, and as a result, did the number of motor failures decrease?

In the field survey, one company in Bajhang District and two in West Rukum District that used motors were interviewed.[23]

The furniture supplier, the only contractor of the micro-hydropower station in Bajhang District, opened up for business just five months ago, and although it was not possible to confirm the situation before the project was implemented, the business opened near the micro-hydropower station. The supplier pointed out two reasons for this: availability of customers and obtaining stable power. He stated that the power was being supplied in a stable manner, and it was confirmed that there were no failures in the equipment used.

A furniture company in West Rukum District replied that the power supply was stable and there was no breakdown of the electrical equipment used. In addition, the metalworking company, which opened up for business one year ago, replied that electricity was being supplied in a stable manner, was more reliable than the main transmission system, and has had no negative impact on machinery.

As shown in the section on effectiveness, the voltage and frequency of the power supply areas of both micro-hydropower stations were stable. As mentioned above, from the scope of this survey, no reduction in the failure of electrical equipment, including among electric motors, was confirmed, but equipment failures due to fluctuations in the voltage and frequency of the supplied electricity were similarly not confirmed.

3.3.2.2 Other Positive and Negative Impacts

(1) Impact on the natural environment

At the time of the ex-ante evaluation, it was assumed that the project target area did not correspond to vulnerable areas such as national parks or their surroundings and that undesired impacts on the natural environment were minimal.[24] At the time of the ex-post evaluation, we confirmed that environmental monitoring was carried out by NEA, and no negative impact on the natural environment was confirmed.[25]

[23] In Bajhang District, there was only one contractor for the micro-hydropower station, so we could not confirm the situation before the start of this project.
[24] Ex-ante evaluation paper, p. 2
[25] Interviews with executing agency and informants.

(2) Resettlement and land acquisition

In this project, there was no relocation of residents, but there was a possibility that land acquisition would be required in Bajhang.[26] In February 2014, NEA formulated the *Land Acquisition and Compensation Plan*.[27]

In the field survey, it was confirmed two land acquisitions at the Bajhang Micro-Hydropower Station and no land acquisition at the Syarpudaha Micro-Hydropower Station. Compensation for land[28] was paid by the executing agency for land acquisition at the Bajhang Micro-Hydropower Station.[29] Also, through interviews with the two former landowners, it was confirmed that both of them received compensation.

(3) Benefits to the residents

At the time of planning, "improvement of living environment through stable power supply in poor areas" was expected as the impact on the promotion of poverty reduction. At the time of the ex-post evaluation, as mentioned above, signs of increases in income through the improvement of daily life and the activation of small-scale businesses were confirmed in the target areas of the project, although limited. Therefore, a certain degree of improvement in the living environment was confirmed.

(4) Other

As mentioned earlier, both Bajhang District and West Rukum District were connected to the main national transmission system at the time of the ex-post evaluation, and the areas where the micro-hydropower stations supplied power were limited. In both districts, the power supply from the national transmission systems sometimes interrupted for a long period of time, and the micro-hydropower stations constructed in this project serve as backup power sources for the main transmission system.[30] In addition, at the Bajhang Micro-Hydropower Station, maintenance was underway to expand the power supply area at the time of the ex-post evaluation. As of July 2020, the installation of four transformers has being implemented. Once these installations are complete, it will be possible to supply electricity to 500 new households.[31]

This project has achieved its objectives to some extent. Therefore, effectiveness and impacts of the project are fair.

---

[26] Preparatory Survey Report, pp. 2-56
[27] Preparatory Survey Report Appendix 6.
[28] Based on the land re-acquisition price shown in the land acquisition and compensation plan. It also included compensation for living support.
[29] Questionnaire responses from the executing agency.
[30] Interview with the executing agency.
[31] Installation of three has already been completed.

3.4 Sustainability　(Rating: ②)

3.4.1 Institutional/Organizational Aspect of Operation and Maintenance

At the time of planning, the facilities of the Bajhang Micro-Hydropower Station were leased to the electric operating company, and the facilities of the Syarpudaha Micro-Hydropower Station were leased to the electric cooperatives; it was supposed that these organizations could continue to operate and maintain the facilities.

At the time of the ex-post evaluation, NEA Bajhang Distribution Center (hereinafter referred to as "NEA Bajhang DC") operated and managed the Bajhang Micro-Hydropower Station because it was connected to the national transmission system. NEA Bajhang DC has one chief, 15 technicians, and 12 temporary staff. Four staff members were engaged in the operation and maintenance of the Bajhang Micro-Hydropower Station, including the maintenance of transmission lines, distribution, customer service, and the operation of the generators. In the interviews with the staff who worked on the operation and maintenance, they did not confirm any shortage of personnel for the daily operation and maintenance, but there were comments regarding the shortage of personnel for cleaning the water tank during the rainy season.[32]

NEA Rukum West Distribution Centre (hereinafter referred to as "NEA Rukum West DC") operated and maintained the Syarpudaha Micro-Hydropower Station. The Rukum West DC has 15 permanent staff, including the chief and two supervisors, and 38 temporary staff. Seven full-time personnel were involved in the operation and maintenance of the micro-hydropower station, and four other personnel (mainly transmission line management) performed additional duties. According to the chief of NEA Rukum West DC, the number of personnel who maintain the micro-hydropower station's operation was sufficient at the time of the ex-post evaluation. There was a shortage of personnel who maintain the distribution network, including the national transmission system.

From the above, NEA's DC operated and maintained both of the micro-hydropower stations at the time of the ex-post evaluation. At the time of the ex-post evaluation, no major shortage of personnel for maintenance of the micro-hydropower station was confirmed.

Therefore, it can be said that the institutional and organizational aspect of the operation and maintenance of the micro-hydropower station rehabilitated in this project are secured to a certain extent.

[32] Interview with the executing agency.

3.4.2 Technical Aspect of Operation and Maintenance

At the time of planning, the electric operating company and the electric cooperatives had experience in the operation of power supply, and it was thought that the operation after the project's completion could be carried out. However, regarding the maintenance capacity, it was pointed out that the records of the inspections and repairs were not managed and maintained, that NEA regional offices that controlled the areas lacked leadership in the maintenance technics, and that the procurement plan related to the parts was insufficient from a financial perspective. Against such a background, the implementation of soft components was planned for the purpose of improving the operation and maintenance capabilities of NEA staff and the staff of the electric operating companies and electric cooperatives.[33]

At the time of the ex-post evaluation, the operation records were managed at both of the micro-hydropower stations, but the inspection records, maintenance records, and accident records were not managed. The ledger of replacement parts and spare parts was managed at the Syarpudaha Micro-Hydropower Station but not at the Bajhang Micro-Hydropower Station. In addition, the manuals provided by the soft component were not kept and used at both micro-hydropower stations, and the financial statements were not prepared. At both micro-hydropower stations, the water volumes, issues such as clogging, maintenance status, and so on were described on the operation log, and the records were referred to as necessary. Regarding the operation and maintenance of micro-hydropower stations, there were no technical issues at the time of the ex-post evaluation.[34]

Behind the fact that the inspection records were not managed and the manuals were not kept and used, the executing agency for the operation and maintenance changed from the electric operating company and the electric cooperatives to NEA by connecting the national transmission system. Due to such change, the deliverables and knowledge of the soft components were not inherited. Therefore, at the time of the ex-post evaluation, staff at both DCs were unaware of the existence of the formats of inspection records, maintenance records, and accident records. In addition, it was confirmed that there were no major problems in the operation and maintenance at both micro-hydropower stations and that there was no need to record accidents. Both DCs commented that they would like to obtain the formats and manuals of each inspection records again and use them.

In summary, regarding the technical aspect of operation and maintenance, the inspection records, maintenance records, accident records, and financial statements for which technical support was provided through the soft components have not been implemented, and the provided manuals have not been utilized. In this respect, it can be said that there were some

[33] Preparatory survey report, pp. 2-7, 3-25-3-26
[34] Interview with the executing agency.

problems.

3.4.3 Financial Aspect of Operation and Maintenance

At the time of the ex-ante evaluation, NEA was in the red for more than 10 years. Electricity charges were increased in September 2012, but in FY 2012/13, the deficit was 4,515.48 million Nepalese rupees. It was said that this was largely due to the rise in the price of power purchase agreements with India, in addition to the increase in import volume due to the increase in domestic demand. In NEA income statement, the operation and maintenance costs of "other expenses," including general and administrative expenses, were on the rise, and that budget item included the budget allocated to the Distribution and Customer Service Bureau, which was in charge of facilities maintenance after this project's completion. Therefore, the operation and maintenance costs of distribution facilities were on the rise, and it was expected that the maintenance costs after this project's completion would be secured within the same budget.

At the time of this project's completion, it was pointed out that the maintenance of power generation facility other than the power generation equipment at the power stations may not be practiced due to the cost issues rather than their technics.[35]

At the time of the ex-post evaluation, according to NEA's profit and loss statement confirmed for three years (FY 2016/2017, 2017/2018, and 2018/2019), the surplus was 1,502 million Nepalese rupees (about 1.4 billion Japanese yen) in FY 2016/2017, 2,897 million Nepalese rupees (about 3.2 billion Japanese yen) in FY 2017/2018, and 7,204 million Nepalese rupees (about 7.3 billion Japanese yen) in FY 2018/2019.[36] This indicates that their business situation is sound. In addition, "other costs," including the operation and maintenance costs of the distribution facilities, continue to increase.[37]

Table 6 shows the annual budget for the operation and maintenance of the Bajhang Micro-Hydropower Station, and a sufficient budget for daily operation and maintenance was allocated.

Table 6 Operation and Maintenance Budget Required for Bajhang Micro-Hydropower Station

Routine maintenance cost	2,000
Periodic maintenance costs	3,000
Repair costs	50,000
total	55,000

(Unit: Nepalese rupee)

[35] Documents provided by JICA.
[36] For exchange rate, JICA's monthly exchange rate is used.
[37] Questionnaire responses from the executing agency.

However, as shown later in 3.4.4, Status of Operation and Maintenance, a part of the headrace was damaged, and at the time of the ex-post evaluation, water was conveyed using the high-density polyethylene pipes, and the repair budget was insufficient. NEA Bajhang DC applied for the budget (4 million Nepalese rupees) required for this repair to NEA Regional Office, which is a superior organization, but the budget was not allocated at the time of the ex-post evaluation.

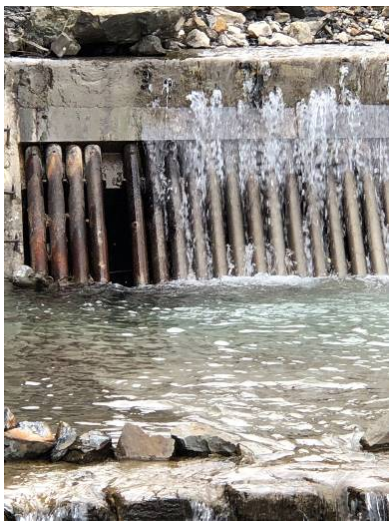
At the Syarpudaha Micro-Hydropower Station, it was not possible to obtain the information on the allocation status of the operation and maintenance budget, but it was said that the cost for daily operation and maintenance was sufficient.[38] However, as with the Bajhang Micro-Hydropower Station, when the headrace was damaged in the past, it was not possible to make a repair budget within NEA, and repairs were carried out with the support of the local government. When large-scale repairs/renovations are required , the budget may be insufficient.

According to the Community & Rural Electrification Department, Distribution & Consumer Services Directorate, which is in charge of this project, when large-scale repairs are required, the branch office makes a request to the regional office. Then, in response to the application from the regional office to the headquarters, the headquarters would decide to allocate the budget.

From the above, although the daily operation and maintenance costs were sufficient, there was a budget shortage when large-scale repairs were required, and it was confirmed that there were some problems in the financial aspect of operation and maintenance.

[38] Interview with the executing agency.

3.4.4 Status of Operation and Maintenance



Bajhang Micro-Hydropower Station bar screen in which one bar was removed

At the time of the ex-ante evaluation, the electric cooperatives and electric operating company carried out the small-scale partial repairs of the equipment. However, the overhaul inspection and maintenance of the water turbines and generators and renewals or repairs of the important equipment were not carried out. In the event of failures, the existing equipment was put into operation by repeating the partial repairs as symptomatic treatments. Under these circumstances, the power generation facilities and equipment were aging and continued to operate in a state of failure or damage.[39]

At the time of the ex-post evaluation, the generators were functioning without problems at the Bajhang Micro-Hydropower Station. As for the intake, clogging caused by gravel accumulation during the rainy season continued to occur. In response to the indication during the defect inspection, one bar was removed from the bar screen from February to March 2017 to secure the amount of water, which then alleviated clogging of the bar screen. On the other hand, the amount of stones and gravel that invaded the headrace and water tank increased. Under these circumstances, NEA Bajhang DC cleaned the bar screen to remove gravel once every one or two months during the dry season and two or three times a day during the rainy season, and it regularly cleaned the headrace and water tank. The method of cleaning the bar screen is to go behind the screen and removing gravel, which is highly dangerous during the rainy season when the amount of water increases. In addition, in order to prevent the invasion of gravel as much as possible during the rainy season, measures are taken to change the water intake destination to a tributary. As for the headrace, as mentioned above, a part of the headrace (60 m) was damaged by the landslide that occurred from June to August 2018. At the time of the ex-post evaluation, a high-density polyethylene pipe was temporarily used for the water conveyance, and there were situations where a sufficient amount of water could not be obtained.

At the Syarpudaha Micro-Hydropower Station, the two generators were operating without problems and there were no problems with the intake, which allows for generating electricity for almost 24 hours. A part of the headrace (25 m) was damaged by the landslide that occurred in October 2019, but it had been repaired by the time of the ex-post evaluation, and there was no problem with the headrace function. There is a water leak in a part of the penstock pipe, but it

[39] Preparatory survey report, pp. 1-4

does not affect the power generation capacity. There are no problems with other facilities.

From the above, it was confirmed that there are some issues in the status of operation and maintenance.

Based on the above, some minor problems have been observed in terms of the technical aspect, the financial aspect, and the current status. Therefore, sustainability of the project effects is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project aims to respond to tight power supply-demand balance in the rural area by rehabilitating the existing aged micro-hydropower stations in the area (Bajhang District and West Rukum District) that are not connected to the main transmission/distribution system, thereby contributing to the enhancement of the regional economy and public welfare. As this objective was consistent with the development plan and development needs of Nepal as well as Japan's ODA policy, the project relevance is high. Although the project cost was within the plan, the project period exceeded the plan. Therefore, the efficiency of this project is fair. Regarding the three operational indicators set in this project, the target values for average power output (kW) and annual generated energy (kWh/year) were not achieved at the Bajhang and Syarpudaha Micro-Hydropower Stations, and that for the annual generated operation hours (h/year) was not achieved at the Bajhang Micro-Hydropower Station. Regarding the qualitative effects on the effectiveness and the impacts, certain effects were confirmed. Therefore, this project has achieved its objectives to some extent, and effectiveness and impacts of the project are fair. Some minor problems have been observed in terms of the project's technical and financial aspects and current status of operation and maintenance. Therefore, sustainability of the project's effects is also fair.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

(1) Renovation of the headrace of the Bajhang Micro-Hydropower Station

As shown in sections of Effectiveness and Sustainability, the headrace damaged by the landslide at the Bajhang Micro-Hydropower Station was simply repaired, so the water supply capacity and thus the flow rate required for power generation were not sufficient. Immediate repair of the headrace is required to secure the power generation capacity. NEA Bajhang DC needs to coordinate with its superior organization, NEA Regional Office, to ensure that the budget required for the repair is secured within NEA. If it is difficult to secure a budget

within NEA, another effective method is to work with local governments to secure the budget, as was done at the Syarpudaha Small Hydropower Station.

(2) Examination of connectivity to the main transmission system of the Micro-Hydropower Stations

As shown in the relevance section, at the time of the ex-post evaluation, Nepal has indicated a policy of connecting (synchronizing) small and micro hydropower stations to the main transmission system. In addition, both micro-hydropower stations are in a situation where their original power generation capacity is not fully utilized because the area to be supplied with electricity has been reduced from the time of planning. Therefore, it is proposed to consider the technical connectivity and then connect to the main transmission system if possible, in order to maximize the power generation capacity of the micro-hydropower stations rehabilitated in this project. In that case, one must pay sufficient attention not to impair the backup functions of the micro-hydropower stations to the main transmission system. It is also important to review the synchronous cases that NEA has implemented with the similar small and micro hydropower stations, and utilize the lessons learned from those experiences. If it is technically impossible, it is proposed to consider alternatives, such as the expansion of the power supply area being implemented by the Bajhang Micro-Hydropower Station at the time of the ex-post evaluation. In addition, in consideration of the decentralization system in Nepal and the remoteness of the sites, it is desirable that the Regional Offices, which are the superior organizations of the DCs, take the lead in conducting these studies.

4.2.2 Recommendations to JICA

As for the recommendation to the executing agency shown in 4.2.1(2) above "examination of the possibility of connecting the Micro-Hydropower Stations to the national transmission system," it is proposed that JICA support the smooth implementation of the above examination by collecting and providing the necessary information to the executing agency in response to the request from them. In that case, it will be more effective if specialized advice is provided while appropriately communicating with the generator manufacturer and consultants.

4.3 Lessons Learned

Setting the target values of the operational indicators reflecting on the actual situation

The target values of the operational indicators set in this project were excessive. The two aspects; (1) the micro-hydropower stations are operated as single systems, so they cannot be operated at all times with 100% power generation capacity, and (2) the power demand in the target area differs greatly between nighttime and daytime, were not taken into consideration. When setting the target values of the operational indicators at the time of planning, it is

important to properly understand the conditions under which the target project will be operated, to extract and analyze the factors that affect the indicator, and then to reflect the results of that analysis in the target value.