Sri Lanka

FY2021 Ex-post Evaluation Report of
Japanese ODA Loan Project
"Project for the Construction of Major Bridges on National Road Network"

External Evaluator: Tomoko Tamura, Kaihatsu Management Consulting, Inc.

0. Summary

This project was implemented to ensure smooth road transportation by replacing old bridges on major national roads across the country, thereby contributing to promote the nation's economic growth and social development.

The project is consistent with Japan's aid policy, Sri Lanka's development policy and development needs, and has produced the expected outcomes in collaboration with the projects of JICA and others. However, the project required significant changes to its content, such as the bridge types and the kind and number of Japanese technologies to be applied to the construction during its implementation, because the plan of the project at the time of the appraisal was based on limited information. Tied (Special Terms for Economic Partnership (STEP)) [1]were applied to the main contractors of the project with an expectation of application of the Japanese technologies. However, the first round of bidding on civil construction for Package-3 of the project was unsuccessful because Japanese companies did not show much interest. The bid was postponed due to deteriorating security conditions in Sri Lanka.[2] It was finally cancelled as no Japanese companies were interested, and there was little time remaining in the project period. Due to this, although it was planned that the project would construct 37 bridges, it was ended when a total of 18 bridges had been constructed in Packages 1 and 2. The relevance and coherence of the project are moderately low, because, as mentioned above, there were issues with the project plan and approach adopted at the time of the appraisal.

As explained, the output of the project changed from 37 bridges to 18 bridges, but the efficiency, effectiveness, impact and sustainability of the project were analyzed and evaluated for the 18 bridges that were constructed. This change was agreed between JICA and the executing agency and decided through proper procedures.

Both the project cost and project period for the 18 bridges were within the plan and the efficiency is very high.

The project was expected to increase the amount of traffic on the bridges constructed by the project. The estimated annual average daily traffic for the target year of the 18 bridges was 9,255

[1] STEP is applicable to ODA loan projects in which developing countries request the application of these terms and conditions as those that make use of Japan's superior technologies and know-how, and in which the technologies and know-how possessed by Japanese companies are necessary and substantially utilized. STEP projects are subject to procurement conditions of Japan tied for prime contracts and rules on the ratio of materials and equipment procured from Japan. Interest rates are lower than those of general ODA loan projects.

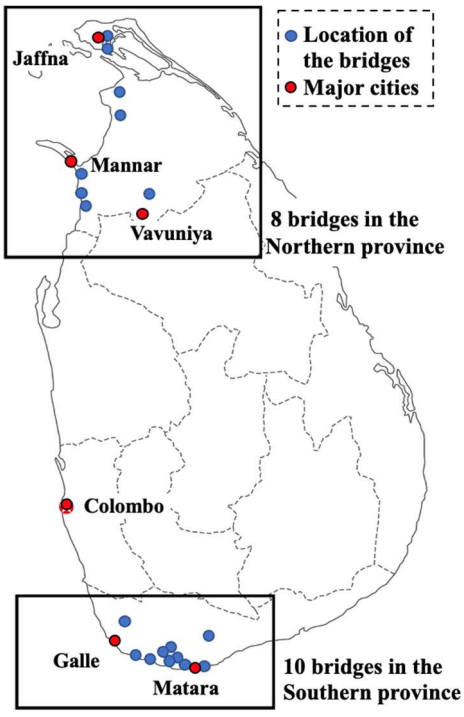
[2] Public security in Sri Lanka deteriorated after a series of bombings in Colombo, Negombo and Batticaloa on April 21, 2019.

vehicles/day, which was 77% of the target. In the years before and after the target year, and also at the time of the ex-post evaluation, the annual average daily traffic was over 70% of the target. Therefore, it can be said that this indicator was largely achieved. The project has helped solve traffic and transport problems in the project area, and has also contributed to an improvement in the lives of citizens and economic activities. In this manner, the expected effects have been achieved through the implementation of the project, and the effectiveness and impacts of the project are high.

There are some minor problems in the institutional/organizational and financial aspects, and current status of the operation and maintenance (hereinafter referred to as "O&M"). It is likely that they will be improved or solved. Therefore, sustainability of the project effects is high.

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

1. Project Description



Project Location Map

Polwathumodara Bridge, Matara District, Southern Province

Navatkuli Bridge, Jaffna District, Northern Province

Map was illustrated by the external evaluator; photos were provided by the project consultant.

1.1 Background

Roads play an important role in the economic and social activities of the country in Sri Lanka as 90% of domestic passenger and cargo transportation are conducted by road. The Sri Lankan government has been improving the road network to meet the increasing traffic demand. Many bridges also needed to be replaced due to deterioration, damage, or because they were of insufficient width; however, this was delayed because the unit cost for improvement of bridges is

higher than that for the roads. These bridges had been an obstacle to the smooth flow of road traffic.

1.2 Project Outline

To ensure smooth road transportation by replacing old bridges on major national roads across the country, thereby contributing to promoting the nation's economic growth and social development.

Loan Approved Amount/ Disbursed Amount	12,381 million yen/7,795 million yen
Exchange of Notes Date/Loan Agreement Signing Date	March 2013/March 2013
Terms and Conditions	Interest Rates: Procurement of equipment and civil works: 0.20%, Consulting services: 0.01%. Repayment Period: 40 years (including grace period of 10 years) Procurement conditions: Tied (Special Terms for Economic Partnership (STEP)) Procurement terms and conditions for civil works and consulting services are tied and general untied aid for the prime contractors contract and subcontracts respectively. The rule of country of origin is that the percentage of materials and equipment procured from Japan must be at least 30% of the total price of contracts financed by the STEP loan (including services).
Borrower/Executing Agency	The Democratic Socialist Republic of Sri Lanka/ Ministry of Highways
Project Completion	August 2018
Project Area	All of Sri Lanka
Main Contractors (Over 1 billion yen)	Hazama Ando Corporation (Japan), Wakachiku Construction Co., Ltd. (Japan)
Main Consultant (Over 100 million yen)	Oriental Consultants Global Co., Ltd. (Japan)
Related Study	Data Collection Survey, 2013
Related Project	[Technical cooperation project] The Project for Capacity Development on Bridges Management in the Democratic Socialist Republic of Sri Lanka (2015 - 2018)

2. Outline of the Evaluation Study

2.1 External Evaluator

Tomoko Tamura, Kaihatsu Management Consulting, Inc.

2.2 Duration of Evaluation Study

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

Duration of the Study: September 2021 - October 2022

Duration of the Field Study: January 17, 2022 - February 2, 2022, and April 25, 2022 - April 29, 2022

2.3 Other

[Evaluation and analysis of the efficiency, effectiveness, impact, and sustainability of this ex-post evaluation]

As explained in "0. Summary," the outputs of the project have been changed from 37 bridges to 18 bridges. The efficiency, effectiveness, impact and sustainability of the project were evaluated and analyzed for the 18 bridges constructed by the project, because the change of the output had been agreed between JICA and the executing agency and decided through proper procedures.

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

3.1 Relevance/Coherence (Rating: ②[4])

3.1.1 Relevance (Rating: ②)

3.1.1.1 Consistency with the Development Plan of Sri Lanka

At the time of both the appraisal and the ex-post evaluation of the project, the medium- and long-term national development policy of the Sri Lankan government emphasized the development of economic infrastructure, including roads. The road sector policy also focuses on programs for road construction, rehabilitation, and replacement of bridges, etc. These are consistent with the objective of the project, which is to facilitate road traffic by improving bridges.

3.1.1.2 Consistency with the Development Needs of Sri Lanka

As described in "1.1 Background," at the time of the project appraisal the improvement of bridges had been delayed, hindering the smooth flow of traffic. At that time, some of the bridges to be improved by the project were not wide enough to allow vehicles to pass each other, causing traffic congestion; vehicle traffic on other bridges was restricted because they were

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

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

old; some were flooded during the rainy seasons. In this manner, there was a great need to replace the bridges.

As mentioned above, five of the bridges constructed by the project were flooded every year during the rainy season, blocking traffic at the time of the appraisal. Local residents had to walk across the river. The elderly and children had difficulty walking across the river, which caused significant inconvenience to their mobility. The bridges in this project were selected considering the significant inconvenience suffered by residents and socially vulnerable groups in their daily life. In designing the bridges, efforts were also made to minimize the amount of resettlement of residents due to construction.

Thus, the objectives of the project were consistent with the development needs of the country at the time of the appraisal, and the need for improved bridges continued at the time of the ex-post evaluation. Consideration was given to the residents in the selection and design of the bridges of the project.

3.1.1.3 Appropriateness of the Project Plan and Approach

The project was formulated based on the results of the data collection survey, and was started. However, the project plan at the time of the appraisal did not adequately reflect the situation and conditions of the sites where bridges were to be constructed; and therefore, significant changes to the project details were needed - for example, bridge types, and the kind and number of bridges that should apply Japanese technology (see "3.2.1 Project Outputs" in this report for details of the changes).

As the project was expected to utilize Japanese technologies, the STEP was applied to the project, and the procurement conditions became Japan tied for the prime contractors of the civil work. This resulted in favorable lending terms for Sri Lanka, and enabled the project to adopt bridge types that minimized resettlement, with a Japanese company undertaking the construction.[5] However, in Package-3 of the project, there was little interest from Japanese companies in bidding for the package, and the bid was unsuccessful; the bidding process was postponed due to the deteriorating security situation in Sri Lanka. Subsequently, JICA and the executing agency agreed not to implement Package-3 because there were no Japanese companies showing interest in bidding, and there was little time left for the duration of the project. As a result, the project ended when 18 of the planned 37 bridges were constructed, leaving around half of the total project cost - including planned project costs from Japan and from Sri Lanka - unused.

[5] By adopting curved bridges, which require a higher level of erection technology, the extent of road improvements in front of and behind the bridges were reduced as much as possible to minimize resettlement.

3.1.2 Coherence (Rating: ②)

3.1.2.1 Consistency with Japan's ODA Policy

The Country Assistance Plan of the Ministry of Foreign Affairs of Japan "Country Assistance Policy for Sri Lanka" (June 2012) at the time of the appraisal stated that the basic policy was to promote economic growth with consideration for less developed areas, and to support strengthening the network for road transportation and other methods of transport. There is consistency between Japan's aid policy at the time of the appraisal and the objectives of this project.

3.1.2.2 Internal Coherence

In parallel with this project, a technical cooperation project of JICA called "The Project for Capacity Development on Bridges Management in the Democratic Socialist Republic of Sri Lanka" (hereinafter referred to as the "Technical Cooperation Project") was implemented in Sri Lanka, with the aim of strengthening the bridge maintenance management cycle.[6] The outputs of this Technical Cooperation Project were expected to contribute to the maintenance and management of the bridges constructed by the project. At the time of the ex-post evaluation, the Bridge Management System and the Bridge Management and Assessment Unit (BM&AU) established in the Road Development Authority (RDA), which were introduced by the Technical Cooperation Project, and the bridge inspection vehicles provided to the RDA by the Technical Cooperation Project, were contributing to the O&M of the bridges constructed under the project. RDA engineers trained in the Technical Cooperation Project are playing a central role in the maintenance and management of the project's bridges. Thus, as planned, the Technical Cooperation Project is collaborating with the project, and concrete results of the collaboration are being realized.

3.1.2.3 External Coherence

The national highways in the Northern Province were improved with funding from the Asian Development Bank (ADB) and China after the end of the civil conflict in 2009 as restoration and recovery measures. Nevertheless, replacement of bridges had not progressed much, and this has been an obstacle to the smooth flow of traffic. This project replaced some of the bridges on the national highways in the Northern Province, and, as expected, the traffic obstacles were eliminated. The project is complementary to the ADB- and China-supported projects, and the expected outcomes were realized.

[6] A cycle consists of bridge inspection, diagnosis, repair and maintenance, and reporting and feedback.

The project is consistent with Japan's aid policy, and expected outcomes were realized through collaboration with complementary projects of JICA and others, as mentioned above. The project is also consistent with development policy and development needs of Sri Lanka. However, it was judged that the relevance and coherence of the project are moderately low because there were issues with the project plan and approach at the time of the project appraisal.

3.2 Efficiency (Rating: ④)

3.2.1 Project Outputs

(1) Change in number of bridges

A total of 18 bridges were constructed by the project, ten in the Southern Province in Package-1, and eight in the Northern Province in Package-2 (Table 1, Figure 1).

Table 1: Detailed Information of the Bridges Constructed by the Project

Number		Bridge Name	Bridge Type	Number of lanes	Bridge width (m)	Bridge length (m)
Southern Province (Package-1)	1	Polwathumodara 1	PC	4	21.3	165
	2	Polwathumodara 2	Box culvert	4	21.3	7
	3	Goviyapana	PC	4	21.2	60
	4	Kathaluwa	PC	4	21.2	70
	5	Polwatta	PC	2	10.4	120
	6	Wellamadama	PC	4	21.2	19
	7	Kole Danda	PC	2	11.4	57
	8	Kihimbi Ela	PC	2	10.4	57
	9	Denipitya	PC	2	11.4	57
	10	Denagama	Steel box girder	2	10.4	90
Northern Province (Package-2)	11	Kaithadi	PC	2	14.0	76
	12	Navatkuli	PC	2	14.0	76
	13	Cheddikulam	PC	2	13.0	38
	14	Mandai Kallar	PC	2	10.4	95
	15	Pali Aru	PC	2	10.4	76
	16	Aru Kuli	PC	2	10.4	57
	17	Arippu	PC	2	10.4	76
	18	Marichchukkaddi	PC	2	10.4	95

Source: Documents provided by JICA and RDA, and confirmed during the field survey.

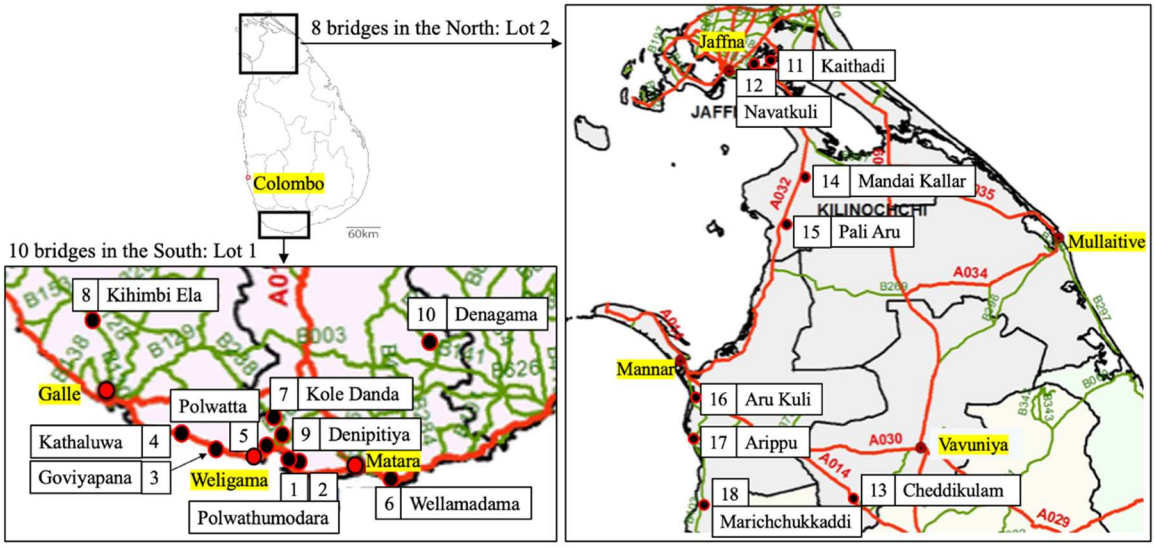


Figure 1: Location Map of the Bridges Constructed by the Project

Source: Prepared by the external evaluator

In this project, Package-1 was implemented first, followed by Package-2. Since the contract price for these packages exceeded the planned price,[7] it was assumed to be difficult to construct the 37 bridges at the planned cost of the project. Therefore, the executing agency and JICA estimated the remaining project cost, and announced Package-3 for the 3 bridges in the Western Province.[8] In this manner, the project aimed to construct a total of 21 bridges in Packages 1, 2 and 3. As mentioned above, the bid for the Package-3 was cancelled, and the outputs of the project were eventually 18 bridges. Table 2 shows the planned and actual number of bridges in each package.

[7] In particular, the contract price for Package-1 was significantly higher than the estimated cost (76% more than the plan). According to the analysis of the Bidding and Financial Evaluation Committee of the bidding, the reason for the significant excess of bid and contract prices over the estimated cost was that the estimated cost did not consider domestic taxes, and the unit prices for boring and concrete work were too low compared to market prices (source: Documents provided by JICA).

[8] The bid for Package-3 was announced with a plan for three bridges. At the re-tender, a fourth bridge was added to the package, because Japanese companies said that it was not sufficiently profitable for them to participate in a bid for replacement of small bridges in scattered sites.

Table 2: Planned and Actual Number of Bridges in the Packages

Package	Plan at time of the project appraisal		Plan at the time of the detailed design		Actual	
	Location	No. of bridges	Location	No. of bridges	Location	No. of bridges
1	Southwestern area	23	Southern Province	11	Southern Province	10
2	Central area	6	Northern Province	8	Northern Province	8
3	Northern area	8	Other	18	Western Province	0
Total		37		37		18

Sources: Documents provided by JICA for plans at the time of the project appraisal and the detailed design; documents provided by RDA and conformation during the field survey for the actuals.

(2) Change of the bridges and bridge types

The proposed bridges were reviewed in the detailed design. As a result, 8 of the 37 bridges planned at the time of the appraisal were removed from the project, and other bridges were selected instead.[9] According to the project completion report of the project, the reasons for excluding the 8 bridges from the project were that they had no structural problems and did not require improvement (5 bridges), improvement work had been implemented (2 bridges), and improvement work was planned (1 bridge).

Bridge types were also reviewed in the detailed design (Table 3). The "two or three steel plate girders" and "extra-dose" bridge types were not adopted. For the 19 bridges that were planned for these types, pre-stressed concrete (PC), steel box girder and box culvert were adopted. It was planned that two or three steel plate girder bridges would be applied to all the steel bridges. This was not adopted because this bridge type would increase the girder height, would need to raise the height of the existing road accordingly, and would increase the scope of road improvements and thereby require large-scale land acquisition and resettlement. The extra-dose bridge was not adopted because it was found that this technology was not necessary according to the length of span adjusted to suit the conditions at the bridge location and considering the economy.

The above-mentioned changes to the bridge types in the detailed design were made to ensure that the bridge structure and construction methods were economical and optimal, meeting the conditions of the construction site and design criteria for the bridges.

[9] According to the project appraisal report, the 37 bridges selected in the Data Collection Survey were "candidate bridges." It was agreed in the minutes of discussions between JICA and the executing agency that the bridges for the project would be finalized in the detailed design. Changes to the bridges were implemented based on this agreement.

Table 1: Planned and Actual Bridge Types

Bridge types	Number of bridges		
	Plan at the time of:		Actuals
	Appraisal	Detailed design	
PC[10]	18	31	16
Two or three steel plate girders	18	0	0
Extra-dozed[11]	1	0	0
Steel box girders	0	3	1
Box culvert	0	3	1
Total	37	37	18

Sources: Documents provided by JICA, and confirmation during the field survey.

(3) Changes in the application of Japanese technologies

Table 4 shows the planned and actual application of Japanese technologies. At the time of the appraisal, 5 kinds of Japanese technologies were planned to be applied to 24 bridges. However, it was decided that only the atmospheric corrosion resistant steel and the waterproofing membrane would be adopted, as a result that the bridges to be constructed and bridge types were reconsidered during the detailed design by analyzing the environment of the location of the bridges and cost effectiveness. Finally, the waterproofing membrane was only adopted for one bridge (Denagama bridge) as a result of further study of the environment at the bridge construction sites and reduction in the number of bridges.

[10] PC bridge: prestressed concrete bridge.

[11] The extra-dozed bridge is an outer cable-structured bridge that supports the main girder with main towers and diagonals.

Table 2: Planned and Actual Number of Bridges for Application of Japanese Technology

Japanese technology	Number of bridges			Reason not applied
	Appraisal	Detailed design	Actual	
Atmospheric corrosion resistant steel[12]	19	1	0	It was not appropriate to apply the technology due to the environment of the construction site.[13]
Waterproofing membrane[14]	4	3	1	The technology was not applicable to 1 bridge of 4 planned at the appraisal stage due to a change in bridge type. The other two were not constructed due to a reduction in the number of bridges.
Extra-dozed bridge	1	0	0	It was decided not to apply due to environmental and economic considerations at the bridge construction site.
Steel pipe sheet pile[15]	1	0	0	The environment at the bridge construction site was not appropriate for the application of the technology, and there was no economic advantage.
Epoxy-coated reinforcement steel bar[16]	4	0	0	It was found difficult to perform the covering operation at the plant in Sri Lanka planned at the appraisal stage.

Sources: Documents provided by JICA and the executing agency, interviews with the consultants of the project.

The Data Collection Survey conducted prior to the appraisal was intended to select the bridges for the project and gather basic information about them. As mentioned in 3.1.1.3 of this report, the Survey did not include a geological survey of the bridge sites or an examination of the road connections before and after the bridges, and therefore, may not have included sufficient information to accurately determine the applicability of the Japanese technologies.[17]

[12] Atmospheric corrosion resistant steel: Steel sheet containing copper, nickel, etc. to form a protective coating on the steel surface.

[13] A certain distance between the steel plate and the water surface is required for formation of protective rust coating on the surface, but this condition was not met at the bridge construction site - water levels rise and fall significantly.

[14] Waterproofing membrane: A material for deck slab with waterproof effect that prevents graveling of the concrete slab and rusting of internal reinforcing bars due to rainwater penetration.

[15] Steel Pipe Sheet Pile: This method is suitable for constructing piers in rivers, where steel pipes are connected to form sheet piles and merged to prevent the inflow of river water. Rapid construction is possible because there is no need to construct temporary cofferdams and landfilling.

[16] Epoxy-coated reinforcement steel bar: Steel bars that are covered with epoxy resin to prevent rust.

[17] JICA's Data Collection Survey is conducted to collect and analyze basic information on the prerequisites for formation of projects. In case of a survey for bridge construction, generally, bridges that may be eligible for construction are selected, a schematic study of the size, span length, and bridge type of each bridge is conducted, and a general drawing of the bridges is prepared. The survey for this project was conducted in the same manner, and there were no shortcomings in the data collection survey. As noted in the lessons learned in this report, it would have been desirable

Although not planned at the time of the appraisal, a construction technique using work platforms was proposed by the contractor, and introduced for the first time in Sri Lanka, for the construction of the 10 bridges in the Southern Province. This is a technique where temporary work platforms are placed along the bridges, instead of reclaiming the river and building scaffolding. The threat of flooding was minimalized, and there was less impact on the environment as the river was not blocked during the rainy seasons. There was no need to remove the platform during construction, as is the case with reclamation. This technique had the effect of protecting the environment and improving construction efficiency.

(4) Appropriateness of applied construction methods and quality and effectiveness of construction

Overall, the construction methods applied in the project were appropriate, and the quality of the work was high. However, 10 bridges in the Southern Province had unexpected cracks on the pavement above the expansion joints[18] and repairs were carried out (see 3.4.7 of this report for details of the repairs). The type of expansion joints was reviewed by the parties involved in the project during the detailed design, and the type which was considered appropriate was selected after considering the climate of Sri Lanka, economics, necessary maintenance work, and availability of materials. Therefore, it appears that there were no problems in the process of selection of the type. Considering the above-mentioned problem, a different type of expansion joint was installed on the bridges in the Northern Province, and this did not have any problems.

During detailed design, it was found that there was soft ground at five bridge locations, and ground settlement was anticipated. Therefore, several construction methods were compared and the best countermeasure was selected based on cost-effectiveness, with a plan to increase the thickness of the pavement if settlement occurred in the future. Since settlement occurred after the construction of these bridges, they were re-paved and the thickness of the pavement was increased.

(5) Safety measures

In accordance with the construction contract, the contractor submitted a plan for safety measures during construction, safety personnel were appointed, and safety measures were implemented at the construction sites. Programs such as safety and quality seminars, fire drills, first aid, AIDS prevention measures, school programs, and safety meetings were also

to conduct an additional study regarding the environment of the bridge sites, cost-effectiveness, etc., and finalize the bridges to be constructed, locations for the construction and types of the bridges, in addition to the data collection survey, to accurately determine the applicability of the Japanese technologies.

[18] Expansion joints are installed to absorb external forces such as expansion and contraction due to temperature change and have the role of minimizing structural damage.

implemented. Safety measures were implemented without fail, and there were no accidents during construction. The school program promoted residents' understanding of construction safety and their cooperation with the construction (for details, see 5.2 in this report).

(6) Consulting services

Consulting services were implemented as planned.

3.2.2 Project Inputs

(For details, see "Comparison of the Original and Actual Scope of the Project" on the last page of the report.)

3.2.2.1 Project Cost

As noted in "2. Outline of the Evaluation Study" of this report, this evaluation compared and analyzed the planned and actual project costs for the 18 bridges, which are the outputs of the project. The planned project cost for the 37 bridges was JPY16,132 million (JPY12,381 million from Japan and JPY3,751 million from Sri Lanka). The planned project cost for the 18 bridges was JPY9,291 million (JPY7,130 million from Japan and JPY2,161 million from Sri Lanka) according to the calculation made by the external evaluator by using the project appraisal document. The actual project cost for the 18 bridges was JPY8,325 million (JPY7,795 million from Japan and JPY530 million from Sri Lanka) (90% vs. plan). From this, it is judged that the project cost was within the plan.

Table 5: Planned and Actual Project Cost

(Unit: million JPY)

Items		Plan at the project appraisal		Actual
		Total cost for 37 bridges	Cost for 18 bridges*2	
Cost for civil construction works	Southern	23 bridges: 5,726	10 bridges: 3,069	10 bridges: 4,588
	Northern	8 bridges: 2,143	8 bridges: 2,143	8 bridges: 2,277
	Central	6 bridges: 1,180	0	0
Other costs*1		37 bridges: 7,083	18 bridges: 4,079	18 bridges: 1,460
Total		16,132	9,291	8,325

Notes:

*1: Other costs include the price escalation, contingency, consultant fees, land acquisition costs, administrative expenses, value-added tax, import duties, interest during construction, and commitment charges.

*2: The planned project cost for 18 bridges was calculated according to the documents provided by JICA, with an assumption that the cost of civil works and other expenses would increase or decrease in proportion to the total bridge surface area.

Sources: The source of planned cost at the project appraisal is the documents provided by JICA. The actual project cost from Japan is based on documents provided by JICA. For the actual cost from Sri Lanka, the project cost described in the documents provided by JICA was recalculated by using the IMF exchange rates.

Although the cost for civil construction works exceeded the plan, costs for the price escalation, contingencies, land acquisition, administrative expenses, value added tax, and import duties were lower than planned. This has contributed to the project costs being lower than planned. Factors that may have contributed to the contingencies not being spent were that a highly feasible plan was developed in the detailed design, there were no unexpected changes in the construction environment, such as climate and soil, and efficient construction management was implemented. The decrease in value added tax and import duties may be because of the reduction in imported materials due to the change from steel bridges to PC bridges, as shown in Table 3.

3.2.2.2 Project Period

In the same way as the analysis for the project cost, the planned and actual project period for the 18 bridges, which were the Output of the project, were comparatively analyzed. The planned period for the 18 bridges was calculated as 68 months (March 2013 (L/A signing) to October 2018) based on the project appraisal documents. The actual project period was 66 months (March 2013 (L/A signing) - August 2018). Therefore, the actual was within the plan (97% vs. plan).

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

For this project, the economic internal rate of return (EIRR) was calculated to be 26.13% at the time of the appraisal. At the time of the ex-post evaluation, the EIRR for the 18 bridges constructed by the project was recalculated using the actual traffic volume and project cost, with the project cost and O&M cost as expenses, and savings in travel time and expenses as benefits (Table 6), and found to be 31.98%. In order to compare the EIRR at the time of the ex-post evaluation, an attempt was made to calculate the EIRR for the 18 bridges at the time of the appraisal. However, this was not possible due to insufficient information. Therefore, an analysis of the difference between the EIRRs at the time of the appraisal and post-evaluation was not conducted.

The financial internal rate of return (FIRR) was not calculated at the time of the appraisal; therefore, it was not recalculated in the ex-post evaluation.

Table 6: Costs and Benefits of the EIRR

Cost	Project cost (excluding taxes and contingencies), cost for O&M
Benefit	Savings in travel time and expenses
Project life	30 years

Source: Documents provided by JICA

As described above, both the project cost and project period for the 18 bridges, which are the outputs of the project, are within the plan; and the efficiency of the project is very high.

3.3 Effectiveness and Impacts[19] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

Operation and effect indicators of the project were set as (1) annual average daily traffic, and (2) Savings in travel time compared to detour routes in the event of bridge damage. Table 7 shows the results of the study for these indicators.

Table 3: Performance and Target Achievement of the Operation and Effects Indicators

Indicators	Baseline	Target	Actuals (Values in italic are estimates)			
	2012	2020	2019	2020	2021	2022
		2 years after project completion	1 year after project completion	2 years after project completion	3 years after project completion	4 years after project completion
(1) Annual average daily traffic (vehicles/day) - Average of 18 bridges (% of target achieved)	5,108	12,051	9,104 (76%)	*9,255* (77%)	*9,407* (78%)	11,267 (93%)
(2) Travel time savings compared to detour routes in case of bridge damage - average per bridge	-	2.4 hours	-	-	-	36 min.

Sources: Baseline and target values are from the ex-ante project evaluation report and documents provided by JICA; actual values are from documents provided by the RDA.

Note: With respect to actuals, the value for 2019 is the actual value of the annual average daily traffic[20]; those for 2020 and 2021 are annual average daily traffic estimated by RDA[21]; and that for 2022 is actual daily traffic measured by RDA.[22]

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

[20] The 2019 value is the annual average daily traffic calculated by the RDA by carrying out periodic traffic surveys around the country, which were calibrated by STRADA, a software package developed for traffic demand forecast, and analyzing the results together with information on traffic flows and trends. This can be considered a reasonably accurate value.

[21] The 2020 and 2021 values were also calculated by the RDA using the STRADA. However, in these years, the RDA was unable to carry out traffic surveys due to Covid-19, and actual traffic volume for these years was not entered into the STRADA. Therefore, the values of these years were forecast based on the previous year's values. These values were considered as estimates in this ex-post evaluation.

[22] The 2022 value was measured by RDA by setting up sensors to measure traffic volume on each bridge of the project in late February 2022 and early March 2022. These were measured on specific days, and are daily traffic, not annual average daily traffic.

(1) Annual average daily traffic

The project was expected to increase the annual average daily traffic per project bridge from 5,108 vehicles/day - at the time of the appraisal - to 12,051 vehicles/day two years after project completion. The annual average daily traffic for the 18 bridges constructed by the project was studied and compared to the target values of the 18 bridges at the time of the appraisal (Table 7 and Figure 2).[23]

Figure 2: Annual Average Daily Traffic for Average of the 18 Bridges (vehicles/day)

Note: Notes and sources are same as in Table 7

Although actual values were not available for the target year (2020), estimated values obtained were 9,255 vehicles/day, with a target achievement of 77%. With regard to the values before and after the target year, the actual value for 2019, the estimated value for 2021 and the actual value at the time of the post-evaluation were 9,104 vehicles/day, 9,407 vehicles/day and 11,267 vehicles/day respectively. This indicator is judged to have been largely achieved since the values for each of these years reached more than 70% of the target.[24]

The annual average daily traffic for the ten bridges in the Southern Province and the eight bridges in the Northern Province were also analyzed. It was found that the traffic volumes for the ten bridges in the Southern Province after completion of the project were lower than their target - 19,808 unit/day in average (Figure 3). Traffic volumes for the six bridges located along the A2 National Highway did not increase as much as expected, presumably due to the increased choice of the Southern Expressway instead of the National Highway for travel from the Colombo area to the south and between southern cities. The traffic volumes of the eight bridges of the Northern Province after the completion of the project were well above their target - 2,353 vehicles/day in average (Figure4). The traffic volume had increased beyond expectations, probably because serious traffic problems that existed at the time of the appraisal were solved, such as road closures due to flooding during the rainy season - 5 bridges, and slippery bridge surfaces that reduced vehicle speed - 2 bridges. It may also have increased because people became more active and economic activities increased following rehabilitation and reconstruction of the area after the end of the civil conflict in 2009.

[23] The target values of the annual average daily traffic for the 18 bridges were mentioned in the project completion report of the Project. They were supposed to be set in accordance with the method for setting the target used at the time of the project appraisal. Therefore, these figures are considered as "targets at the time of the appraisal" in this evaluation.

[24] The values for each year should have been compared to the target of each year. However, target values for each year were not able to be calculated, because the method used to set the target value used at the time of appraisal was not available. Therefore, the figures of these years were compared to the target in 2020.

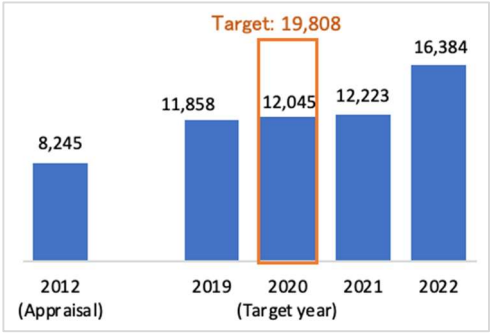


Figure 3: Annual Average Daily Traffic - Average of the 10 Bridges in the Southern Province (vehicles/day)

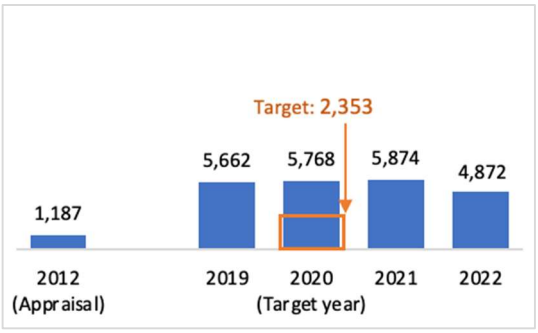


Figure 4: Annual Average Daily Traffic - Average of the 8 Bridges in the Northern Province (vehicles/day)

Note: Notes and sources of these figures are same as in Table 7

(2) Travel time savings comparing the normal route and detours to be used when bridges are damaged

This indicator compares the travel time required for the normal route through the bridges and the detour route that must be used when the bridges are closed to traffic. The savings in travel time by using the normal route is considered to be an effect of the project. At the time of the appraisal, the target for average travel time savings for the 37 bridges proposed for the project was 2.4 hours.

In the ex-post evaluation, the external evaluator attempted to calculate the travel time savings using the same method used for the appraisal. However, information on starting and ending points of the normal and detour routes for each bridge that were used for the appraisal were not available. Therefore, time required for the normal and detour routes were calculated by setting the starting and ending points of the two routes for the 18 bridges in the most reasonable manner. In this way, the time saving for the 18 bridges on average was found to be 36 minutes.[25] These results were considered as reference; comparative analysis and verification of target achievement were not conducted, since it is not sure whether the calculation was made in the same manner as that used for the appraisal.

[25] For each bridge, the starting and ending points were identified, taking through traffic and local traffic into account, and the distance traveled through the bridges (existing route) and the distance traveled when detouring without passing through the bridges (detour route) were obtained using Google Map. Then, the time required to travel these routes at a reasonable driving speed were calculated by "distance divided by speed". The travel time savings was calculated by subtracting the travel time for the existing route from that of the detour route obtained in this way. The travel time displayed on Google Maps was also used as a reference. The identification of the existing and detour routes and the calculation of the travel times were conducted with advice from faculty members of the Department of Civil Engineering: Transportation Engineering Division, Faculty of Engineering, University of Moratuwa, Sri Lanka.

3.3.1.2 Qualitative Effects

It was expected that the construction of the bridges by the project would ensure smooth road transportation and facilitate logistics. The external evaluator held interviews with residents around the bridges and RDA staff about changes before and after project implementation. It was found that the project solved problems related to traffic and transportation that existed before the project, such as road closures due to flooding and damage to the bridges, and traffic jams. Examples of the problems at the time of the appraisal and the effects of the project are shown in Table 8 (Note: refer Figure 1 for the bridge numbers in the table). The project has produced the qualitative effects expected at the time of the appraisal.

Table 4: Effects on Promotion of Logistics by Ensuring Smooth Road Transportation

Qualitative effects		Problems at the time of the appraisal	Effects of the project
No more traffic closures due to flooding		 The bridge was flooded every year during the rainy season, and no vehicle could travel over it.	 The bridge is no longer flooded. Obstacles for traffic and transportation were solved.
Relevant bridges	No. 14, 15, 16, 17 and 18		
Photo	Marichchukkaddi bridge		
No more traffic jam		 Traffic jam before and after the bridge because the bridge was narrower than the road.	 The bridge was widened and there is no longer traffic congestion before and after the bridge.
Relevant bridges	No. 1, 2, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17 and 18		
Photo	Denipitiya bridge		
Resolving problem of over loading		 The bridge was so old that heavy vehicles were not allowed to cross it.	 All types of vehicles are now allowed to travel across the bridge.
Relevant bridges	No. 10		
Photo	Denagama bridge		
Resolving risk of damage and collapse		 The bridge was severely damaged and in danger of collapsing.	 The bridge is no longer in danger of breaking or collapsing.
Relevant bridges	No. 3, 4, 5, 10, 14, 15, 16, 17 and 18		
Photo	Kathaluwa bridge		

Qualitative effects		Problems at the time of the appraisal	Effects of the project
Resolving risk of traffic accidents			
Relevant bridges	No. 14		
Photo	Mandai Kallar bridge	There was a risk of vehicles colliding due to poor visibility.	The bridge has better visibility and is wider.
Resolving problem of slippery bridge surface			
Relevant bridges	No. 11 and 12		
Photo	Navatkuli bridge	Bridge surface was slippery, and vehicles needed to slow down.	No longer need to worry about skidding or having to slow down.

Note: Photos at the time of the appraisal are taken from the Data Collection Survey report; photos at the time of the post evaluation were taken by the external evaluator.

3.3.2 Impacts

3.3.2.1 Intended Impacts

(1) Contribution for improving people's lives and economic activities, transportation, and supply of goods

It was expected that the project would contribute to improving people's lives and economic activities, transportation, and supply of goods. The external evaluator conducted interviews with residents and RDA staff during the ex-post evaluation and found the following examples of improvements that were expected as a result of the project.

(a) Inconvenience caused by traffic jams on the way to work, schools, or hospitals were resolved (interview with a bus driver of the route of Denipitiya bridge)

Previously, the bridge was so narrow that vehicles could not pass each other and had to wait for oncoming traffic to cross the bridge. This created traffic jams in front of and behind the bridge. On market days, the traffic was especially congested, and buses sometimes had to stop for 10 to 20 minutes before and after the bridge. The bus route includes hospitals and high schools, which are essential to the daily life and education of the citizens. When buses stop due to traffic jams, passengers were feeling hot, sweaty, and tired. If the service is delayed, they cannot get to work, hospitals, or schools on time. The bridge construction has solved these problems.

(b) Blockages to traffic and transportation, obstacles to agriculture and fisheries, and the need to use detour routes were solved (interviews with residents near the Aru Kuli bridge)

In the past, the bridge was flooded every year during the rainy season. Then, vehicles were not able to travel on the bridge, and we couldn't go to Vankalai, where schools and a hospital are located. If the residents had to go to the other side of the bridge, they would take a bus or motorcycle to just before the bridge, walk across the river to the other side, and wait for a bus to come from the other side. It took a lot of time and effort. It was extremely inconvenient for children, the elderly, and the sick, because it was more difficult for them to walk across the river. At night, they could not cross the river because there are snakes and vermin in the river. The supply of goods to the village also stopped, which was very troublesome. After the bridge was built, all these problems and hardships were solved.

(c) Contribution to the recovery and reconstruction of the Northern Province (interviews with RDA officials in the Northern Province)

The roads and bridges in the Northern Province were in poor condition because they were not developed during the civil conflict. After the end of the conflict in 2009, national roads were improved, but the bridges were not replaced. Therefore, bridge sections were an obstacle to traffic in some places. This project improved these bridges, facilitated the traveling of construction vehicles and transportation of materials for rehabilitation and reconstruction, and helped to improve economic activities in the region and lives of citizens.

(d) Contribution to tourism promotion and increased income opportunities for local residents in the South (interview with a resident near Polwatta bridge)

Previously, four-wheeled vehicles could not cross the bridge because it was badly damaged. After the new bridge was built, four-wheeled vehicles can now cross, and access to this village from the surfing area of Weligama has greatly improved. This has led many residents of this village to set up guest houses for foreign tourists. Some tourists stay for long periods of time during the tourist season. Running a guest house has become an important source of income for residents.

(2) Promotion of local economy

In order to verify whether the local economy has been promoted in the project sites, satellite night-time light intensity data was analyzed for three selected locations in the target areas, where several bridges constructed by the project are located and which are key transportation hubs.[26] Figure 5 shows that the annual average night-time light intensity is generally increasing

[26] The external evaluator decided to utilize satellite data in the verification of economic promotion of the project sites in this evaluation, since there are no macroeconomic indicators based on municipalities in Sri Lanka. This is because the intensity of night-time light observed by satellites has been shown to have a statistically significant correlation with macroeconomic indicators such as GDP growth rate. The following areas were selected for the analysis: (a) near the Polwathumodara, Kore Danda, Denipitiya, and Polwatta bridges in Weligama city, Matara District, Southern Province; (b) near the Navatkuli and Kaitadi bridges in Chavakachcheri Division, Jaffna District, Northern Province; (c) in the

in all three locations. It can be said that the local economy in these three locations is more active after the project than before the project, since the average annual average night-time light intensity in the three years after the completion of the bridges is greater than that before completion of the bridges. However, when the rate of increase in night-time light intensity was examined, the rate for the three years after the completion of the project was lower than that for three years before the completion of the project in all three locations. This result suggests that the bridge construction may not be the primary factor promoting the local economy.

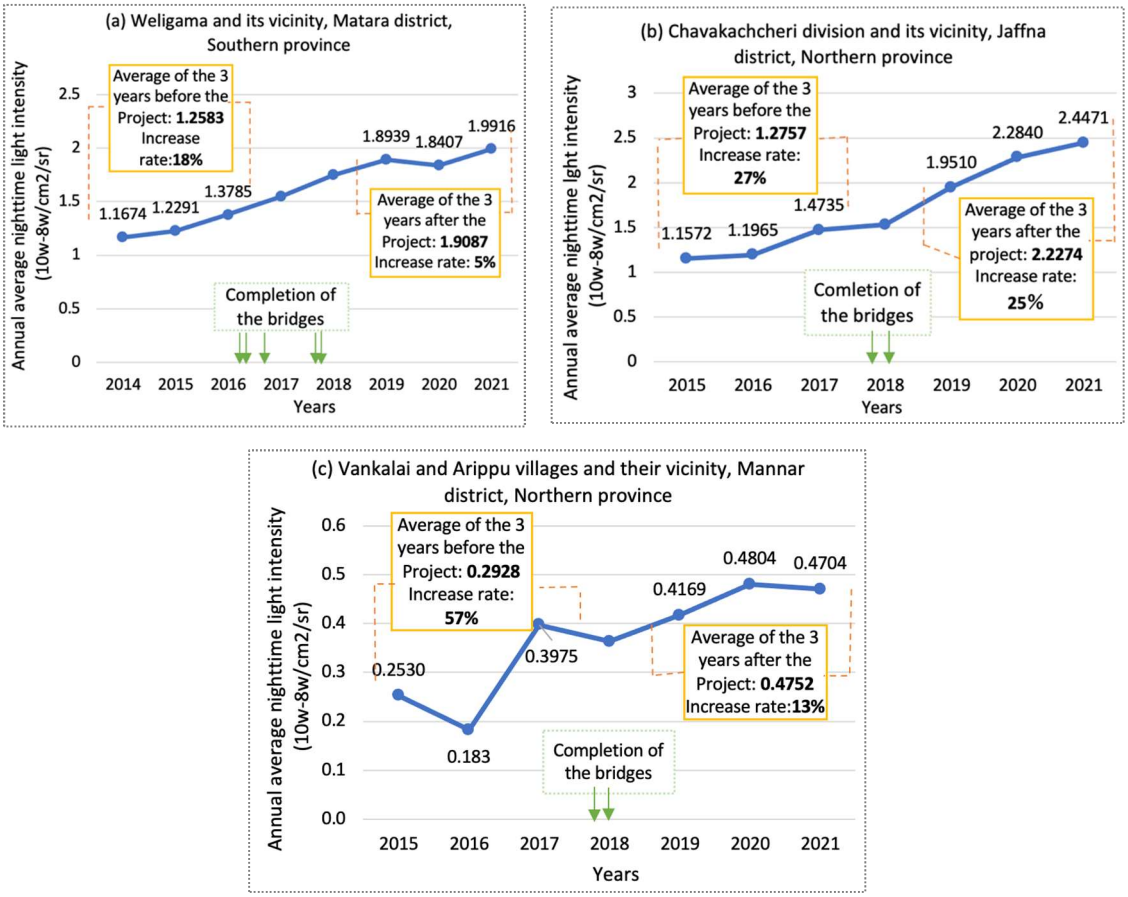


Figure 5: Annual Average Night-time Light Intensity in the Study Area

Source: Analysis conducted by the Arthur C Clarke Institution for Modern Technologies, Sri Lanka. Satellite imagery NPP-VIIRS (resolution of 15 arcseconds (about 500 m)) produced by the Earth Observation Group of the National Center for Environmental Information, USA, from 2015 to 2021 was used for the analysis.

3.3.2.2 Positive and Negative Impacts

(1) Impacts on the Natural Environment

There were no problems related to the natural environment. Control and monitoring of noise, vibration, and dust were conducted as scheduled during construction. During the

vicinity of Aru Kuli and Arippu bridges, Vankalai and Arippu villages in Mannar District, Northern Province. A buffer zone of 5 km before and after each bridge and 1 km on each side was demarcated for the analysis for each area.

construction in the Southern Province, cracks in the walls of houses and other structures due to vibration were expected during construction, because the ground at the bridge construction sites included sandy soil and there were many temporary houses in the neighborhood. Therefore, the contractor asked residents to submit any complaints, and conducted crack surveys before and after the construction, measured the vibrations, and repaired all cracks caused by the construction.[27]

(2) Resettlement and Land Acquisition

The construction works in the Southern Province involved small-scale resettlement and land acquisition. The project was categorized "B," and a resettlement action plan was not prepared, but JICA and the executing agency had confirmed and agreed on the outline of the resettlement plan and necessary considerations in the minutes of discussions during the appraisal. The JICA Sri Lanka Office explained about the JICA Guidelines for Environmental and Social Considerations to the RDA officials from time to time, to ensure that the resettlement was implemented according to the guidelines. They conducted monitoring of the implementation process by using reports and progress review meetings.

Both compensation payments and relocation have been completed for the 19 resettlement cases. Compensation was paid before relocation to 12 of the cases according to the reacquisition price, as they wished to receive compensation and relocated voluntarily.[28] In seven cases alternative sites were provided, electricity and water were installed, and compensation for the cost of construction of houses was paid. A new store was rebuilt at the relocated site for one resident who would lose his store and whose livelihood may be affected.

The replacement cost has been paid for 85 of the 109 private land acquisitions, while 24 have not yet been paid because ownership had not been determined at the time of the post-evaluation. Payments for these cases will be made in accordance with court decisions regarding ownership and instructions from the Divisional Secretary.

In this project, it was planned to finalize the bridges to be constructed and the types of the bridges in the detailed design, to confirm the detail of land acquisition and resettlement according to the design, and then to start the process of land acquisition and resettlement. As planned, the process started after the completion of the detailed design, but civil works started in parallel, since it was expected to take several years to complete the process. However, the land acquisition procedures for the approach sections were not completed even

[27] Except for one case in which residents did not agree on the implementation of repairs. All were minor cracks and were not covered by construction insurance, so repairs were made at the contractor's expense.

[28] Regarding resettlement, in addition to compensation at market value, the costs of the resettlement were also paid or facilitated. Regarding land acquisition, in addition to the market value of the land, compensation was paid for the cost of replacement, or the value of any items belonging to the land and lost as a result of the acquisition. Therefore, the payment can be deemed to have been made at the reacquisition price.

at the midpoint of construction for some of the bridge construction sites, although the RDA and JICA Sri Lanka office encouraged relevant agencies, such as the Divisional Secretariat and the valuation department, so that the land acquisition, resettlement, and compensation payments were implemented promptly. This delay affected the progress of the civil work.

There were no disputes related to resettlement or compensation payments, both during project implementation and at the time of the ex-post evaluation. There was no resettlement or land acquisition for the construction of bridges in the Northern Province.

(3) Gender

There were no specific impacts of the project regarding gender.

(4) Socially Vulnerable Groups

As discussed in 3.1.1.2 and 3.3.1.1 of this report, in the Northern Province the project solved the problems of flooding of the bridges and road closures during the rainy season. This reduced significant inconvenience suffered by residents, especially the elderly and children, and mobility restrictions in meeting basic needs, such as access to schools, hospitals, and markets. The project has produced a positive impact on the protection of vulnerable groups in this manner.

(5) Social System and Norms, People's Well-being and Human Rights

There were no specific examples of impact by the project regarding social systems and norms, people's well-being or human rights.

(6) Other positive and negative impacts

There were no specific positive and negative impacts.

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

3.4 Sustainability (Rating: ③)

3.4.1 Policy and Systems

At the time of the ex-post evaluation, there is no change in the policy emphasis on the development and improvement of the road network both in the RDA National Road Master Plan (2018 - 2027) and the updated version being prepared. The country's road sector policies and institutions are supportive of the sustainability of the effect of the project, and there are no policy or institutional issues.

3.4.2 Institutional/Organizational Aspect

The Maintenance and Management Division at RDA Headquarters oversees the maintenance of bridges and roads. Provincial, district and divisional offices of the RDA are responsible for maintenance works. The responsibility for O&M is clearly defined among the RDA Headquarters, its Southern and Northern Provincial Offices, and the district and divisional offices. At each office, under the guidance of technical staff, work supervisors and workers undertake regular and periodic maintenance work on bridges, and the necessary number of personnel are assigned for the work.

The BM&AU, which was introduced by the Technical Cooperation Project, is located within the Engineering Division at the head office, and engineers are assigned to each province. At the time of the ex-post evaluation, the Southern Province had a chief engineer in BM&AU who was responsible for periodic inspections and soundness diagnosis of bridges in the province. He is providing advice on bridge maintenance and management. The Northern Province had a BM&AU engineer, but the post was vacant at the time of the ex-post evaluation, since the engineer was attending a highway design training program at the head office. Instead of the engineer, the BM&AU staff at Headquarters are conducting periodic inspections and soundness diagnosis of the bridges in the province. The engineer is scheduled to return to this position upon completion of his training in mid-2022.

The RDA Northern Provincial office does not own a box crane, which is necessary for maintenance of bridge lighting. It is difficult to rent it, because other government agencies in the province do not own one. Timely maintenance of the lighting is necessary for safety reasons, although the function of the bridge itself is not affected. The office has applied to the head office for placement of a box crane.

There are some institutional and organizational issues; however, they are expected to be resolved or are not likely to have a significant impact on the effect of the project.

3.4.3 Technical Aspect

The staff in charge of the O&M of the project's bridges have acquired the skills generally required in O&M of bridges and no other special skills are required for the O&M of the said bridges, and, therefore, no technical problems have arisen. The bridge management system and the bridge inspection vehicle introduced in the Technical Cooperation Project are being used to maintain the bridges of the project. Engineers from BM&AU in the headquarters and Southern Province are playing an important role in inspections and diagnostics, drawing on their extensive knowledge of bridge maintenance and management.

After the Technical Cooperation Project was completed in 2017, technical training in bridge diagnosis and management techniques was conducted by BM&AU in non-project provinces.

Technical training was not conducted in 2020 and 2021 due to Covid-19. Training will resume in 2022, depending on the status of the Covid-19.
There are no particular problems in terms of technical aspects in O&M of the project bridges.

3.4.4 Financial Aspect

Until 2021, the Southern and Northern Provincial Offices of RDA have been allocated the necessary budget for routine and periodic maintenance of roads and bridges without delay, and no problems have occurred. However, due to the severe deterioration of the country's financial situation, the maintenance budget of the RDA for 2022 was significantly reduced compared to previous years (Table 9), and the amount of budget to be allocated to the Southern and Northern Provinces was also reduced. On the other hand, the O&M of the bridges of the project do not require a large budget, and the personnel assigned to work on the bridges will remain in place. Therefore, it is expected that the O&M of the bridges will be able to be conducted within the allocated budget amount.

Table 9: Budget for Maintenance of Roads and Bridges of the RDA

(Unit: millions of rupees)

Expenditure			Estimate	Projections	
2019	2020	2021	2022	2023	2024
4,961	4,749	8,502	3,000	5,000	6,000

Sources: Page 227, Budget Estimate 2022 Volume II, Sri Lanka for the data from 2020 to 2024; and page 199, Budget Estimate 2021, Sri Lanka for the data of 2019.

As mentioned above, the budget reductions due to financial difficulties of the country are a concern. However, their impact on the effect of the project would be limited, since no significant influence on the O&M of the bridges of the project is expected.

3.4.5 Social and Environmental Aspect

No negative environmental impacts were identified as a result of the bridge construction of the project. No environmental or social issues were raised by residents. In the case of the Polwathumodara and Denagama bridges, reforestation was conducted in response to changes in the natural environment near the riverbank and approach roads due to the bridge construction. At the time of the ex-post evaluation, it was confirmed that the natural environment at these locations had been restored. As described above, there are no issues regarding the sustainability of the project in terms of environmental and social considerations.

3.4.6 Preventative Measures to Risk

No soil erosion or increased flood risk due to construction has been observed, and no traffic congestion, noise, or vibration has occurred due to increased traffic volume after the bridge construction. Navatkuli bridge was repaired after a traffic accident damaged a part of the handrail. There are no sustainability issues with respect to the project in terms of preventive measures to risk.

3.4.7 Status of Operation and Maintenance

(a) Regular maintenance and periodic maintenance work

Regular and periodic maintenance are being performed on the bridges of the project. Regular maintenance is performed with the workers and tools, once every month or two months. This includes cleaning bridge surfaces, removing grass and sand from drainage catchpits, and mowing approach roads and slopes. Routine maintenance, which involves the purchase of materials and use of equipment, is performed every six months to a year, or as needed. This includes brushing and repainting handrails, repainting markings on bridge surface, repairing settlements and cracks on the bridge surface, and replacing lighting bulbs. Denagama Bridge, a steel bridge, has nuts and bolts tightened approximately once every six months.

During the first field survey of the ex-post evaluation, minor cracks on the paint of the handrails, minor corrosion on the underside of the beams, partial damage to the lid of the sidewalk section, and lack of lighting due to problems in bulbs or power distribution, were found on some of the bridges. At the time of the second field survey, it was found that these defects had already been addressed or were being worked on, and those that were less urgent were scheduled to be addressed in the next periodic maintenance.

Re-painting of handrails
(Denagama bridge)

Cleaning of bridge surface
(Aru Kuli bridge)

(b) Cracks on the pavement above the expansion joints

As noted in 3.2.1 (6) of this report, 10 bridges in the Southern Province had cracks on the pavement above the expansion joints. Repairs were made during the defect liability period, but the cracks have continued to appear even after the repairs. Expansion joints for the bridges in the Southern Province have metal plates installed inside to improve durability, but repeated vehicle loads may have caused the welds that hold these metal plates in place to fatigue and move, causing the cracks.[29]

Before the repair work

After the repair work

Cracks on the pavement above the expansion joints (Kathaluwa bridge)

RDA Matara and Galle District Offices have been performing repair work by applying asphalt sealing and pavement to cracks as needed. However, the pressure of passing vehicles causes the repaired areas to come off again, and they need more frequent repair work. In the field survey, it was observed that in the Goviyapana bridge there was a relatively larger collapse of pavement due to large cracks, creating hollows inside the expansion joints. It is difficult to repair this collapse of the pavement. It was observed that rainwater was leaking from the expansion joints of Denagama bridge (a steel bridge). These could cause deterioration of the deck slabs and steel plates.

The RDA Southern Provincial Office is aware of the above problems and is considering removing the metal sheets from the expansion joints and replacing them with other types of joints as a drastic measure. They plan to replace the expansion joints with the RDA standard-type expansion joints with aluminum sheets. This can be carried out by their own workforce and requires relatively inexpensive materials on a trial basis at one location. They will replace the expansion joints of other bridges later once they confirm the effect of the replacement.

(c) Settlement of approach area

Likewise, as stated in 3.2.1 (6) of this report, the approach roads of the five bridges in the Southern province have settled and they were repaired by increasing the thickness by re-pavement during the defect liability period. Since then, RDA has continued to monitor settlement and has added additional thickness in the pavement as needed.

[29] The metal plate installed inside the expansion joints was designed so that one side was fixed, and the other side moved due to expansion and contraction. The design allowed for minor cracks on the pavement above the moving side, but unexpected cracks occurred on the pavement of the fixed side, too, causing the pavement to collapse. This type of expansion joint was designed in consideration of the natural conditions of Sri Lanka and economy, and has been used in an ODA loan project in the Eastern Province of Sri Lanka. The expansion joints in the Eastern Province are in a good condition and have no problems.

As mentioned above, there are some minor problems in the institutional/organizational, financial, and current status of the O&M. However, they will probably be improved or resolved. Therefore, sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion (same as the summary)

This project was implemented to ensure smooth road transportation by replacing old bridges on major national roads across the country, thereby contributing to promote the nation's economic growth and social development.

The project is consistent with Japan's aid policy, Sri Lanka's development policy and development needs, and has produced the expected outcomes in collaboration with the projects of JICA and others. However, the project required significant changes to its content, such as the bridge types and the kind and number of Japanese technologies to be applied to the construction during its implementation, because the plan of the project at the time of the appraisal was based on limited information. Tied (Special Terms for Economic Partnership (STEP)) were applied to the main contractors of the project with an expectation of application of the Japanese technologies. However, the first round of bidding on civil construction for Package-3 of the project was unsuccessful because Japanese companies did not show much interest. The bid was postponed due to deteriorating security conditions in Sri Lanka. It was finally cancelled as no Japanese companies were interested, and there was little time remaining in the project period. Due to this, although it was planned that the project would construct 37 bridges, it was ended when a total of 18 bridges had been constructed in Packages 1 and 2. The relevance and coherence of the project are moderately low, because, as mentioned above, there were issues with the project plan and approach adopted at the time of the appraisal.

As explained, the output of the project changed from 37 bridges to 18 bridges, but the efficiency, effectiveness, impact and sustainability of the project were analyzed and evaluated for the 18 bridges that were constructed. This change was agreed between JICA and the executing agency and decided through proper procedures.

Both the project cost and project period for the 18 bridges were within the plan and the efficiency is very high.

The project was expected to increase the amount of traffic on the bridges constructed by the project. The estimated annual average daily traffic for the target year of the 18 bridges was 9,255 vehicles/day, which was 77% of the target. In the years before and after the target year, and also at the time of the ex-post evaluation, the annual average daily traffic was over 70% of the target. Therefore, it can be said that this indicator was largely achieved. The project has helped solve traffic and transport problems in the project area, and has also contributed to an improvement in the lives of citizens and economic activities. In this manner, the expected effects have been

achieved through the implementation of the project, and the effectiveness and impacts of the project are high.

There are some minor problems in the institutional/organizational and financial aspects, and current status of the O&M. It is likely that they will be improved or solved. Therefore, sustainability of the project effects is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

(1) Repair work and replacement of the expansion joints of the 10 bridges in the Southern province

The RDA Southern Province Office has been repairing cracks on the pavement above the expansion joints of the 10 project bridges in the province. It is necessary to continue to identify cracks through regular inspections and repair them as early as possible. The office is considering removing the metal plates of the expansion joints and replacing them with other types of expansion joints as a drastic measure, since frequent repair work has become necessary, and the cracks are getting wider in some places. They are going to replace them with the RDA's standard type of expansion joints, but they would like to consider replacing it with an expansion seal joint or expansion strip joint if it is found that the durability of the standard type joint is not sufficient. This may require procurement of imported materials and a civil contractor. It is advisable for the Maintenance and Management Division and the Engineering Services Division of the RDA head office to provide budgetary measures and technical advice to the Southern Province Office to assist the implementation of the said replacement, when necessary.

4.2.2 Recommendations to JICA

As mentioned above, RDA continues to repair the cracks on the pavement above the expansion joints of the bridges in the Southern Province, and is considering replacing them with other types of expansion joints. Since the improvement of the expansion joints is important for sustainability of the project effect, JICA is advisable to monitor the progress of the RDA's maintenance and replacement work by receiving regular reports and visiting the sites and providing necessary advice as appropriate.

4.3 Lessons Learned

(1) Careful determination of STEP through highly accurate planning on application of Japanese technologies

The project started with a plan to apply five kinds of Japanese technology to 24 of the 37 proposed bridges based on the Data Collection Survey. However, it was later decided to apply 2

kinds of Japanese technology to 3 of the 37 bridges. This was the consequence of the review of the proposed bridges, examination of environment of the bridge location and cost-effectiveness of the 37 bridges, which were selected after the said review, and re-consideration of the needs to apply the Japanese technologies in the detailed design. In this way, significant changes were required during project implementation for the bridge types and the number and kinds of Japanese technology to be applied for the construction. It was possibly because the information available at the time of the appraisal was not enough to formulate a plan on application of the Japanese technologies.

The plan on applying Japanese technologies at the time of appraisal is important for examining and determining applicability of the STEP. For bridge construction projects in which Japanese technology is to be applied, it is important to collect information at a level that enables JICA and the executing agency to make a proper judgment on whether Japanese technologies are required for the project, and if the technologies have comparative advantages in terms of economy and efficiency, by conducting a study on environment of the bridges construction sites, cost-effectiveness, etc., and finalize the bridges to be constructed, locations of the construction and types of the bridges before the appraisal, so that they can develop a highly accurate plan on application of Japanese technologies and examine and determine the procurement condition.

The project was formed with the plan of constructing 37 bridges scattered across the country. Conducting the above-mentioned study on such projects would be difficult to implement, as it requires a lot of resources and time. For projects where STEP is expected to be applied, it is a reasonable option to formulate the project scope so that a study on matters to be finalized to determine the necessity of applying Japanese technology can be conducted before the appraisal.

(2) Early start of resettlement and land acquisition process

At the time of the appraisal, the project was expected to involve small-scale resettlement and land acquisition. The plan at the time of the appraisal was to finalize the details of resettlement and land acquisition at the time of detailed design after commencement of the project, and to start the process of resettlement and land acquisition after completion of detailed design. As planned, the process was started after the completion of the detailed design, but civil works were started in parallel since the process was expected to take several years to complete. At some of the construction sites of the bridges, the land acquisition process was not completed until midway through the construction work, which affected the progress of the work.

Resettlement and land acquisition is a process that takes a certain amount of time. For projects where land acquisition and resettlement are expected, even at a small-scale, it is advisable to determine the outline of the project and likely cases and impacts of resettlement and land acquisition before the appraisal, to establish a plan to start the resettlement and acquisition procedures before the start of the project, and complete these procedures when construction starts,

in order to give due consideration to the residents and to ensure efficient implementation of the project.

5. Non-Score Criteria

5.1 Performance

5.1.1 Objective Perspective

None in particular.

5.2 Additionality

Wakachiku Construction, which was in charge of the construction of the bridge in the Southern Province, actively worked to increase Japan's presence and exchange with local residents by hiring local personnel, providing assistance during a natural disaster, and implementing school programs, etc. When major flooding occurred in May 2017 in Matara District, where the bridges of this project are located, the company inspected the damage, rebuilt a science classroom and computer classroom, and donated computers and furniture at Dudley Senanayake Central High School in the district. It was deeply appreciated by the students, parents and teachers of the school, as well as the local community. A program titled "Road Traffic Safety" was held at the Denagama School near the Denagama Bridge. At the same event, students learned the purpose of the construction work and points to keep in mind to travel safety near a bridge under construction. These were also conveyed to their parents and relatives (source: materials provided by JICA Sri Lanka office, interviews with Wakachiku Construction Sri Lanka office and principal of the Denagama school).

Dudley Senanayake Central High School damaged by flooding in May 2017

Computer rooms rebuilt at the school (August 2017)

Photos: Provided by Wakachiku Construction Co., Ltd.

(end)

Comparison of the Original and Actual Scope of the Project

Items	Plan	Actual
1. Project Outputs	Construction of 37 bridges	Construction of 18 bridges
2. Project Period	March 2013 – December 2018 (70 months) For this evaluation, for the purpose of comparison and analysis, the planned project period was set from the signing of the L/A to the completion of Package-2 (October 2018), according to the plan for the project period made at the time of the appraisal.	March 2013 – August 2018 (66 months) The project period was defined to be from the signing of the L/A to the completion of Package-2.
3. Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total ODA Loan Portion Exchange Rate	4,461 million yen 11,670 million yen (19,714 million rupees) 16,131 million yen 12,381 million yen 1 rupee = 0.592 yen (as of November 2012) In this evaluation, for the purpose of comparison and analysis, the project cost for the 18 bridges was calculated to be as follows, based on the planned project cost for the 37 bridges made at the time of appraisal. 7,130 million yen on the Japanese side and 2,161 million yen on the Sri Lankan side, 9,291 million yen in total.	3,085 million yen 5,240 million yen (6,955 million rupees) 8,325 million yen 7,795 million yen 1 rupee = 0.575 yen to 0.891 yen Foreign and domestic currency amounts on the Japanese side were converted into yen using data provided by JICA, and rupee amounts on the Sri Lankan side were converted into yen using the IFS annual average rates for each year from 2013 to 2020, as indicated in the project completion reports.
4. Final Disbursement	October 2020 (early completion)	

(end)